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URBAN POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVT OF SINDH

ENVIRONMENTAL & SOCIAL MANAGEMENT FRAMEWORK (ESMF) STUDY

SINDH ENHANCING RESPONSE TO REDUCE STUNTING PROJECT

ADDENDUM TO ESMF

FINAL REPORT
JANUARY 2018

EMC Pakistan
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Pakistan

SINDH ENHANCING RESPONSE TO REDUCE STUNTING PROJECT

Cover Note

Environmental and Social Management Framework (ESMF)

Directorate of Urban Policy & Strategic Planning, Planning & Development Department, Government of Sindh

Addendum of ESMF
January 2018

Cover Note

Rationale

Childhood stunting is one of the most significant impediments to human development. Stunting, or low height for age, generally occurs before age two, and effects are largely irreversible. It is caused by long-term insufficient nutrient intake and frequent infections. Underlying causes of stunting are multiple, including sanitary conditions and hygiene practices, lack of nutrition and health related services. From international literature it is as well-known that low intrauterine growth and low birth weight accounts for 20% of all childhood stunting. Stunting rates are persistently high throughout Pakistan and Sindh has one of the worst nutrition indicators whereby almost half the children are stunted.

Recognizing the need of addressing malnutrition as a top priority, the Government of Sindh has adopted an Accelerated **Action Plan (AAP) namely "Sehatmand Sindh"** for the reduction of stunting and malnourishment by 2021 *with an overarching goal for ten years i.e.: to reduce stunting from 48% to 30% in first five years (by 2021) and 15% by 2026 in Sindh by increasing and expanding coverage of multi-sectoral interventions, that are known to reduce stunting in first five years of children's lives*.

The Project Development Objective (PDO) of the World Bank funded Sindh Enhancing Response to Reduce Stunting Project (SERRS) is to contribute the reduction of the stunting rate in Sindh from 48% to 43% by the end of the project. Achievement of the PDO relies on a theory of change which links improved child nutrition, growth, and cognition to improved dietary intake and reduced burden of disease, which in turn rely on improved maternal and child care, improved hygiene and sanitation, and improved household food security. The project would support implementation of the AAP with a more modest objective of reducing stunting in Sindh by at least 1% per year from 48% to 43% over the life of the project. Given the inadequate results of previous input-based projects, this project would use a results-based approach to link disbursements to the achievement of agreed-upon, pre-defined indicators. Disbursement-linked indicators (DLI) have been used in other projects in Sindh and contributed significantly to: (i) sector dialogue (by focusing on political ownership of the Government's program); (ii) technical results (by linking disbursements to planned progress and performance targets); and (iii) donor coordination (by facilitating planning, budgeting, and supervision within a common framework).

The project will finance: (i) results contributing to the achievement of the objectives set forth in the Government's AAP in Sindh; and (ii) technical assistance and other inputs needed by the government to facilitate the implementation of the AAP. Under Component 1 (US$ 50 million), the project will support a multi-sectoral package of services shown to contribute to the PDO by financing results achieved through DLIs under a defined Eligible Expenditure Program (EEP). Under Component 2 (US$ 13 million), the project would finance technical assistance and selected inputs to support: (i) measures for implementing the pilot CCT program for women and children in the poorest quintile to access health and nutrition services; (ii) development and implementation of an overarching multi-sectoral communications strategy for social and behaviour change; and (iii) institutional arrangements for cross-cutting interventions including coordination, strengthening accountability, citizen engagement, integrated multi-sectoral data information systems, monitoring, evaluation, gender and supervision. The project Component 1 would support the GoS by (i) expanding the number of interventions that will have a direct and immediate impact on reducing stunting in the medium to long-term; and (ii) creating an enabling environment and incentives to encourage the required behaviours that need to accompany the expansion of the multi-sectoral interventions in the following sectors:

- Sanitation and Hygiene: Building on the proposed Multi-Sectoral Actions for Nutrition Project (MSAN) in 15 districts to make villages open defecation free (ODF), the AAP plans to expand coverage across Sindh. In addition to supporting the ODF initiative, project will incentivize an enhanced program on hand washing.
- Agriculture (including Livestock and Fisheries): Building on a flexible and demand driven approach to be piloted in 20 union councils of 4 districts under the proposed MSAN Project, the department plans to scale up to 10 districts with a high incidence of stunting with nutrition sensitive interventions that would contribute to enhancing household food diversity and access to high nutritive value foods, especially of the poorest and most food insecure households; and to consumption of high nutrition content food, especially by pregnant-nursing women, children under five and adolescents.

Scope of Addendum to MSAN ESMF

The Environment and Social Management Framework (ESMF) was prepared by the Directorate of Urban Unit of Planning and Development department GoS for the 15 districts of Sindh province targeted under the MSAN project. The existing ESMF has been reviewed and this addendum is prepared to reflect the scale up of activities under the AAP. AAP has targeted all the districts of Sindh including 14 additional districts which are not covered under the existing ESMF i.e. *1) Ghotki, 2) Hyderabad, 3) Khairpur, 4) Matiari, 5) Naushahro Feroze, 6) Shaheed Benazirabad, 7) Sukkur 8) Tando Allahyar 9) Karachi Central 10) Karachi East 11) Karachi West 12) Karachi South 13) Korangi (Karachi) and 14) Malir (Karachi)* for implementation. Therefore, this addendum to ESMF of MSAN provides an update for Environmental and social baseline, assessments and consultations with stakeholders for the remaining fourteen (14) districts.

Justification of using existing ESMF for AAP Districts

The SERRS Project is supporting the Govt of Sindh's AAP that would support the GoS by (i) expanding the number of interventions that will have a direct and immediate impact on reducing stunting in the medium to long-term; and (ii) creating an enabling environment and incentives to encourage the required behaviors that need to accompany the expansion of the Multi-Sectoral interventions in the following sectors; 1) Sanitation and Hygiene and 2) Agriculture (including Livestock and Fisheries). The existing MSAN project has two components under Inter Sectoral Nutrition Strategy of Sindh (INSS), i) the sanitation component of the project which aims to increase the number of ODF villages through certification while ii) the agriculture for nutrition (A4N) component by adopting nutrition sensitive agriculture (NSA) and these two components are directly linked to the reduction of the stunting rate in Sindh. MSAN project activities are being scaled up in the remaining districts of Sindh as part of SERRS and would be implemented by Sindh Local Government and Sindh Agriculture Department. Therefore, the existing ESMF has been reviewed and this addendum has been prepared for the additional 14 districts under AAP for which the activities are same but the locations are different.

As the SERRS project interventions are same as proposed in MSAN project and AAP plans only the scale up of activities in overall Sindh, therefore there impacts, mitigation measures, consultation with institutions (as all the institutions consulted are at provincial level and the scale up activities are applied all over Sindh province), implementation arrangements for environmental and social safeguards, recommendations under environmental and social mitigation plan as proposed in ESMF of MSAN remains same. Therefore, most of the text provided in this addendum is taken from MSAN ESMF. Only environmental and social baseline section and consultation with communities are updated as the scale up of activities will be undertaken in rest of the districts of Sindh not covered under MSAN ESMF.

Pakistan

SINDH ENHANCING RESPONSE TO REDUCE STUNTING PROJECT

Environmental and Social Management Framework (ESMF)

Directorate of Urban Policy & Strategic Planning, Planning & Development Department, Government of Sindh

Addendum of ESMF

Final Report
January 2018

Executive Summary

The Government of Sindh (GoS) recently adopted an Accelerated Action Plan for Reduction of Stunting and Malnutrition (AAP). The AAP has the ambitious goals of reducing stunting from 48% to 30% by 2021 and to 15% by 2026 by increasing and expanding coverage of multi-sectoral interventions proven to reduce stunting in the first five years of life. The Sindh Enhancing Response to Reduce Stunting Project (hereinafter referred to as SERRS) project would support implementation of the AAP with a more modest objective of reducing stunting in Sindh by at least 1 percentage point per year from 48% to 43% over the life of the project. ESMF study undertaken by Directorate of Urban Policy & Strategic Planning to fulfil World Bank Operational Policies and to prepare the addendum of "Environmental and Social Management Framework (ESMF)" for additional 14 districts at its inception stage via assessing the SERRS project's environmental and social viability through various environmental components like air, water, noise, land, ecology along with the parameters of human interest and mitigating adverse impacts along with chalking out of guidelines, SOPs, procedure for detailed EA during project execution.

The project will finance: (i) results contributing to the achievement of the objectives set forth in the Government's AAP in Sindh; and (ii) technical assistance and other inputs needed by the government to facilitate the implementation of the AAP. Under Component 1 (US$ 50 million), the project will support a multi-sectoral package of services shown to contribute to the PDO by financing results achieved through DLIs under a defined Eligible Expenditure Program (EEP). Under Component 2 (US$ 13 million), the project would finance technical assistance and selected inputs to support: (i) measures for implementing the pilot CCT program for women and children in the poorest quintile to access health and nutrition services; (ii) development and implementation of an overarching multi-sectoral communications strategy for social and behavior change; and (iii) institutional arrangements for cross-cutting interventions including coordination, strengthening accountability, citizen engagement, integrated multi-sectoral data information systems, monitoring, evaluation, gender and supervision.

The physical interventions which are triggering the environmental and social adverse impacts are as under;

- Sanitation and Hygiene: Building on the proposed Multi-Sectoral Actions for Nutrition Project (MSAN) in 15 districts to make villages open defecation free (ODF), the AAP plans to expand coverage across Sindh (remaining 14 districts). In addition to supporting the ODF initiative, project will incentivize an enhanced program on hand washing.
- Agriculture (including Livestock and Fisheries): Building on a flexible and demand driven approach to be piloted in 20 union councils of 4 districts under the proposed MSAN Project, the AAP plans to scale up to more districts with a high incidence of stunting with nutrition sensitive interventions that would contribute to enhancing household food diversity and access to high nutritive value foods, especially of the poorest and most food insecure households; and to consumption of high nutrition content food, especially by pregnant-nursing women, children under five and adolescents.

As the SERRS project interventions are same as proposed in MSAN project and AAP plans only the scale up of activities in overall Sindh, therefore there impacts, mitigation measures, consultation with institutions (as all the institutions consulted are at provincial level and the scale up activities are applied all over Sindh province), implementation arrangements for environmental and social safeguards, recommendations under environmental and social mitigation plan as proposed in ESMF of MSAN remains same. Therefore, most of the text provided in this addendum is taken from MSAN ESMF. Only environmental and social baseline section and consultation with communities are updated as the scale up of activities will be undertaken in rest of the districts of Sindh not covered under MSAN ESMF.

Environmental and Social Management

The existing ESMF of Multi-Sectoral Action for Nutrition (MSAN) Program is reviewed and this addendum has been prepared to reflect the scale up of activities under the AAP for the remaining 14 districts of Sindh. Therefore, this addendum to the existing ESMF of MSAN provides an update for Environmental and social baseline, assessments and consultations with stakeholders for the remaining fourteen (14) districts i.e. Ghotki, Hyderabad, Khairpur, Matiari, Naushahro Feroze, Shaheed Benazirabad, Sukkur, Tando Allahyar, Karachi Central, Karachi East, Karachi West, Karachi South, Korangi (Karachi) and Malir (Karachi).

The ESMF report presents the regulatory review, broad baseline data collected for air, water, land, biological and socio-economic components of environment, identification, prediction and evaluation of generic impacts and preparation of ESMF with Resettlement Policy Framework (RPF) for mitigation of adverse impacts that may arise due to the proposed project interventions.

Baseline Data Collection

After initial information was collected and reviewed, Reconnaissance Survey (RS) in each district was conducted to collect primary information for the sub-projects. Profiles of each district were made during the RS depicting varied baseline conditions.

Eastern part of Ghotki, Sukkur and Khairpur lies in desert region where extreme drought conditions prevail throughout the year which make it difficult for agriculture. However, Due to IBIS (Indus Basin Irrigation system), remaining districts except Karachi have extensive agriculture through irrigation. Karachi on the other hand, is a rock land with extensive urban footprint in the south and dry rangelands in the north due to scarcity of rainfall.

Open defecation exist in 12 out of 14 surveyed / target districts due to the unavailability of enough latrines in the area. The villagers are well known with the problems associated with open defecation but cannot build latrines because of lack of funds. The depth of fresh groundwater decreases with distance from the river. There is a very wide range of groundwater quality distribution in Sindh i.e. 0.5 dS/m to 7.1 dS/m. The native groundwater of the Lower Indus Plain is very saline being of marine origin. The depth and quality is variable in all districts of Sindh especially in target districts also varied in pre- and post-monsoon seasons. Water logging prevails in some of the districts especially in Shaheed Benazirabad, Matiari and Hyderabad. The water scarce areas are, Eastern part of Ghotki, Sukkur and Khairpur with water table below 50 ft.

The agriculture for nutrition components will be implemented in some areas where water is scarce and bad groundwater quality prevails. Agriculture activities use pesticides and chemical fertilizers. In Matiari, the use of pesticides is the highest due to the prevalence of agriculture activities through irrigation and higher cropping intensities. The lowest use of pesticide and chemical fertilizers is in Karachi District due to lack of irrigation water as well as less rainfall and rocky terrain.

Reconnaissance Survey also revealed that the use of pesticide has continued in cash crops e.g. Dates, rice, wheat, bananas, mangoes and cotton in western parts of Khairpur, Ghotki, Shaheed Benazirabad and Matiari. Recently Pesticide manufacturing companies' especially multinational manufacturers has reached out local farmers and provide awareness to apply fertilizers and pesticides at proper time to increase the yield and save the crops. However, due to inflation and increase in the prices of imported fertilizer and pesticides in recent years, farmers switching over to conventional methods like manure and locally made pesticides. Supply of substandard and adulterated pesticides and fertilizers is also affecting the crop yields and the cost of production. Due to extreme weather conditions, the cropping pattern has also been changed. Increase Floods, droughts and waterlogging and salinity after 2010 impacted the agriculture practices and changed the cropping pattern in Matiari and western parts of Hyderabad, Ghotki, and Khairpur Districts.

Stakeholder Consultations

Stakeholder consultations have been carried out with (i) local communities who are the direct beneficiaries of the project interventions and (ii) institutions who have an important role in enabling the realization of the project interventions. These consultations have revealed that the proposed SERRS project is considered to have a positive social impact by improving sanitation while eradicating open defecation as well as provision of nutrition food by the introduction of nutrition sensitive agriculture. Communities were of the view that i) SSS programme can change villagers' health and environment and can save children from diseases ii) people were aware that diseases are cause due to unhygienic conditions but find it very difficult for them to build latrines and enclosed washrooms, iii) several community members were expected to be provided financial assistance from any organization for the construction of latrines, iv) due to waterlogging situation in some districts, fish farming becomes a good source of livelihood and many farmers have switched their lands into fish farms, v) farmers are keen to learn good agriculture practices (GAP) because they are unaware of them, and vi) Improved employment opportunities and skill set trainings for women were identified as the priority areas for future interventions.

Consultation with institutions revealed that i) different environmental and socio-economic conditions of the target districts calls for localized management plans to implement the environmental and socio-economic targets, ii) training and capacity-building components must be imparted for implementation and monitoring of community-based environmental protection, iii) existing project should be designed to ensure rigorous periodic awareness and sensitization sessions, iv) clean water should be ensured in schools as part of the health and hygiene awareness component, v) lesson learning from previous projects and ground realities must be incorporated for both the SSS and A4N projects, vi) available technologies of latrine construction should be carefully revised for social and environmental implications, and vii) coordination amongst various stakeholders at all levels to enable knowledge-sharing, incorporation of lessons learnt and harmonization of project execution at the field level.

Impact Assessment

Most of the Project's environmental and social impacts will be beneficial, including for example the positive effect on health caused by the reduction in diarrhea and sanitation related diseases and the associated socio-economic benefits, considerable behavior change activities at community and district levels, and improved productivity (particularly benefiting females) generated by taking nutritious diet and good sanitation and hygiene conditions. The potential negative environmental and social impacts of the project are i) construction related localized and short-term impacts under SSS such as air and water pollution, noise generation, drainage and safety hazards etc. ii) under A4N includes increased use of pesticides and other agro-chemicals, water contamination especially surface water etc. these impacts require appropriate mitigation and management measures to contain them.

Environmental and Social Management Framework

Under ESMF approach, each subproject will be screened for the severity and extent of environmental and social impacts. Subprojects having negligible environmental and or social impacts will be screened through a screening checklist. Subprojects having some negative but localized environmental and or social impacts will require a generic Environmental and Social Management Plan (ESMP) to be prepared. The Resettlement Policy Framework which is a part of this addendum will only apply to interventions where land may be acquired for small-scale interventions that cannot be acquired through Voluntary Land Donation (VLD) procedures.

Recommendations under Environmental and Social Mitigation Plan

Subproject Siting to any sensitive area

- It will be ensured through screening checklist that the subproject avoids any ecologically sensitive areas, any chance find under PCRs, and involuntary resettlement.
- Involuntary Resettlement Screening Checklist to be used to check that the land belongs to the school or is government land and is free from any disputes.
- Village Organizations and LGD officials will be taken onboard for the identification construction site in schools.
- The subprojects will be established on the land owned by Agriculture department. However, private land, if acquired, will be through Voluntary Land Donation (VLD) procedure. Complete documentation of the VLD process will be maintained. In instances where VLD is not possible, the RPF, which is part of this addendum, will be applicable.
- Valuation and compensation of affected assets of community should be in accordance with RPF/Sub-projects RAPs and considered before the field activities.
- Community consultations will be carried out before establishing the sites.

Unsuitable toilet construction may lead to water contamination

- During behavior change activities in the communities, environment friendly designs of toilets (suitable for that specific area) will be disseminated within the communities as a guide and unfriendly design impacts shall be communicated.
- Monitoring shall be made during project life cycle to check the sustainability of implemented interventions.
- Flush toilets should not be encouraged in areas under the project where water is scarce and in dry season. It will be ensured to provide these site-specific provisions in toilets construction guidelines by the project implementation unit.

Pit/septic tank Sludge Management

- Sludge Management should be made part of generic ESMPs of each sub-project. Sludge after emptying the tanks/pits should be landfilled at proper location and left for degradation.
- During behavior change activities in the communities, this aspect will be communicated and awareness raising workshops will be conducted in communities.

Use of Adulterated/ banned Pesticide / Excessive use of chemical Fertilizer

- Judicious use of the irrigation water, chemical inputs and use of alternate techniques (such as integrated pest management, using disease-resistant seeds, and mulching) will be promoted through awareness raising and capacity building initiatives.

- The capacity building program will also include safe handling of hazardous substances such as pesticides.
- High efficiency irrigation technologies (e.g. tunnel farming) which is included one of the interventions of A4N component will be promoted to conserve already scarce irrigation water. ES of IP and ES from directorates will ensure to promote it in above areas after filling environmental checklists and incorporated in the FFS scope.

Health and Safety Hazards for the farmers

- Awareness and capacity building regarding Material Safety Data Sheet (MSDS) for each hazardous substance will be promoted.
- WB Group's EHS Guidelines will be implemented as appropriate.
- Use of appropriate personal protective equipment (PPE) will be mandatory while using rodenticides/ herbicides/ pesticides.

Impacts on Women, Children, and Vulnerable Groups

- Women's participation is already included in project interventions including development of Female Farmer Field Schools (F3S), construction of toilets for girls, and focus on women as main agriculture producers;
- Lady Extension Workers (LEW) will be engaged as contingent staff for short periods, so as to work with women beneficiaries;
- Environmental screening checklist will provide first stage information about impacts on the poor, women, and other vulnerable groups including needs and priority for social and economic betterment;
- IPs and TSPs will ensure the active participation and adequate consultation of women in project interventions;
- Ensure participation of vulnerable groups in project activities through consultations, to ensure planned investments take the well-being of such groups into consideration

Grievance Redress Mechanism (GRM)

The Directorates for both the SSS and A4N projects will serve as the secretariat for the Grievance Redressal Committee (GRC-Directorate) that will be responsible for providing oversight on the entire GRM process at a strategic level and monitoring of complaints management. Grievance Focal Points (GFPs), which will be the ambassador of change and educated people from each community on each sub-project site. Two GFPs (1 male and 1 female) will be selected for each sub-project locations and will be community members who are easily approached by the community. A Public Complaints Center (PCC), which will be responsible to receive, log, and resolve complaints. A Grievance Redress Committee (GRC-District) will be established for each district that will manage GRM aspects for all sub-project locations in each district including decisions to be taken, actions and monitoring of complaints resolution at sub-project level. The ESFPs will play an instrumental role in steering the GRC functions at the district levels.

ESMF implementation cost

The total cost of this addendum to the ESMF has been estimated to be about **Pak Rupees 84.160 million**. This includes additional costs for capacity building and mitigation measures required to be taken for 14 additional districts.

پاکستان

ملٹی سیکٹورل ایکشن فار نیوٹریشن پراجیکٹ

ماحولیاتی اور معاشرتی انتظامی ڈھانچہ

ڈائریکٹوریٹ اربن پالیسی اینڈ اسٹراٹیجک پلاننگ، پلاننگ اینڈ ڈویلپمینٹ ڈیپارٹمینٹ

حکومتِ سندھ

مختصر خلاصہ

جنوری ۲۰۱۸

مختصر خلاصہ

حکومت سندھ نے حال ہی میں Accelerated Action Plan for Reduction of Stunting and Malnutrition (AAP) منتخب کیا ہے۔زندگی کے پہلے پانچ سال میں Stunting کو 2021 تک 48% سے 30% تک اور 2026 تک 15% تک کم کرنے کے لیئے multi-sectoral مداخلتوں میں اضافے کو اہمیت دینے کے لیئے AAP کے حوصلہ مند مقاصد ہیں۔ پراجیکٹ کی تکمیل تک حقیقی معنوں میں stunting کو 1% point سالانہ 48% سے 43% تک کم کرنے کے لیئے SERRS AAP کے نفاذ کی حمایت کرے گا۔ ESMF اسٹڈی ڈائریکٹوریٹ آف اربن پالیسی کی طرف سے شروع کی گئی ہے تاکہ ورلڈ بینک کی عملیاتی پالیسیوں کی تکمیل ہوسکے اور ابتدائی مرحلے پر پرجیکٹ کے ماحولیاتی اور سماجی اجزا کی جانچ کرکے اس کے ابتدائی مرحلے میں ۱۴ اضافی اضلاع کا ESMF کا ضمیمہ تیار کیا جائے بذریعہ مختلف ماحولیاتی اجزا جیسے ہوا، پانی، شور، زمین، حیاتیات کے ساتھ انسانی دلچسپی کے پیمانے اور منفی اثرات کے تدارک کے ساتھ تفصیلی ماحولیاتی جانچ کے لیئے رہنما اصول کو مرتب کرنا، SOPs، طریقہ ءکار کا وضع کرنا جن کو پراجیکٹ کی عملدرآمد تک اپنایا جاسکے۔

پراجیکٹ مالی مدد کرے گا:(۱) سندھ میں حکومت کے AAP متعین مقاصد کے حصول میں تعاون کے نتائج (۲) AAP کے نفاذ کے لیئے تکنیکی مدد اور حکومت کی طرف سے دیگر معلومات کی سہولت۔ جزو ۱ کے تحت (US$50million) پراجیکٹ multi-sectoral کے خدمات کی پیکج جوکہ PDO کو دکھایا گیا ہے فنانسنگ کے نتائج DLIs کے ذریعے جوکہ ایک واضح Eligible Expenditure Program کے تحت ہے۔ جزو۲ کے تحت (US$ 13 million) پراجیکٹ کی تکنیکی مدد کے لیئے مالی مدد کریں گے اور منتخب اعانت کریں گے:(۱) عورتوں اور بچوں کے لیئے پائلٹ CCT پروگرام کو لاگو کرنے کے لیئے اقدامات کیے جائیں گے سب سے غریب ترین پانچ حصوں میں صحت اور غذائیت کی خدمات تک رسائی حاصل کریں گے؛(۲) سماجی اور طرز عمل میں تبدیلی کے لیئے ایک انتہائی اہم multi-sectoral مواصلاتی حکمت عملی کی ترقی اور نفاذ لاگو کریں گے؛(۳) کراس کٹنگ کی مداخلت کے لیئے ادارہ جاتی انتظامات ان میں ہم آہنگی، مضبوطی، احتساب، شہری مصروفیت، ضم multi-sectoral اعداد وشمار کی معلومات، مانیٹرنگ، تشخیص، جنس اور نگرانی کی جائے گی۔

ماحولیاتی اور سماجی منفی اثرات کو فروغ دینے والی ظاہری کام درج ذیل ہیں:

- **صفائی اور حفظان صحت:** مجوزہ MSAN پروجیکٹ کے تحت 15 اضلاع کے گاؤں کو کھلے بیت الخلاء (ODF) سے پاک کرنے کے لیئے AAP سندھ بھر (بقیہ 14 اضلاع) میں اپنے کام کے دائرے کو وسیع کرنے کی منصوبہ بندی کر رہا ہے۔(ODF) کی حمایت کے پہل کے علاوہ یہ پروجیکٹ ہاتھ دھونے کے پروگرام کی حوصلہ افزائی کرے گا۔
- **زراعت (بشمول مویشی اور ماہی گیری):** 14 ضلاع کے 20 یونین کونسل کے لیئے بنائے گئے لچکدار اور طلب کرنے کی بنیاد پر بنائے گئے MSAN پروجیکٹ کے تحت AAP غذائیت میں رکاوٹوں کے ساتھ stunting کے زیادہ ہونے والے واقعات کو روکنے کے لیئے پیش رفت کرنے کا منصوبہ بنارہی ہے جس سے خوراک کی تنوع میں اضافے میں مدد ملے گی اور غذائیت سے بھرپور خوراک تک

رسائی ہوگی، خاص طور پر غریب ترین افراد اور جہاں خوراک کے عدم تحفظ کا شکار ہیں اور خاص طور پر حاملہ۔ دودھ پلانے والی عورتوں اور پانچ سال سے کم عمر بچوں کو غذائیت سے بھرپور خوراک دی جائے گی۔

SERRS پراجیکٹ کے جزو تجویز کردہ MSAN پراجیکٹ سے مماثلت رکھتے ہیں اور AAP کا نفاذ پورے سندھ میں لاگو کیا جائے گا، لہذا ماحولیاتی اور سماجی اثرات، تخفیفی اقدامات، اداروں سے مشاورت، ماحولیاتی اور سماجی تحفظ کے لیئے عملدرآمد کے انتظامات، ماحولیاتی اور سماجی تخفیف کی منصوبہ بندی کے تحت سفارشات جو MSAN ESMF میں پیش کی گئی ہیں اس ماحولیاتی اور سماجی انتظام کا حصہ رہیں گی۔ لہذا اس اضافی ماحولیاتی اور سماجی انتظام کا متن MSAN ESMF سے لیا گیا ہے۔ صرف ماحولیاتی اور سماجی بنیادی صورت اور برادری سے مشاورت کو اپ ڈیٹ کیا گیا ہے۔

ماحولیاتی اور سماجی انتظام:

موجودہ MSAN ESMF کا جائزہ لیا گیا ہے اور یہ addendum سندھ کے بقیہ 14 اضلاع کے لیئے جو کہ AAP کے تحت سرگرمیوں کے پیانے پر عکاسی کرنے کے لیئے تیار کیا گیا ہے۔ لہذا موجودہ ESMF(MSAN) استعمال کیا گیا ہے بقیہ 14 اضلاع کے ماحولیاتی اور سماجی بنیاد، تشخیص اور اسٹیک ہولڈر کے ساتھ مشاورت کے بارے میں تازہ ترین معلومات فراہم کرتا ہے۔ 14 اضلاع ہیں: گھوٹکی، حیدرآباد، خیر پور، ٹھیاری، نوشہرو فیروز، شہید بینظیر آباد، سکھر، ٹنڈو اللہ یار، مرکزی کراچی، مشرقی کراچی، مغربی کراچی، جنوبی کراچی، کورنگی (کراچی) اور ملیر (کراچی)۔

یہ ESMF رپورٹ ہوا، پانی، زمین، حیاتیاتی، سماجی اور معاشرتی، ماحول کے اجزاء شناخت، پیشن گوئی اور عام اثرات کا اندازہ اور ESMF کی تیاری Resttlement Policy Framework (RPF) کے ساتھ پران منفی اثرات کو کم کرنے کے لیئے جو کہ مجوزہ پروجیکٹ کی وجہ سے ہونگے کا وسیع انضباطی جائزہ پیش کرتی ہے۔

بنیادی اعداد و شمار کو یکجا کرنا:

ابتدائی معلومات جمع کرنے اور جائزہ لینے کے بعد ہر ضلع کے سب پروجیکٹ کی بنیادی معلومات جمع کرنے کے لیئے Reconnaissance Survey (RS) منعقد کیے گئے تھے۔ Reconnaissance Survey کے دوران مختلف بنیادی حالات کے اسباب جاننے کے لیئے ہر ضلع کے profile بنائے گئے تھے۔

گھوٹکی، سکھر اور خیر پور کا مشرقی حصہ صحرائی علاقے میں واقع ہے جہاں سارا سال خشک سالی غالب رہتی ہے جو زراعت کے لیئے مشکلات پیدا کرتے ہیں۔ تاہم Indus Basin Irrigation System (IBIS) کی وجہ سے کراچی کے علاوہ بقیہ اضلاع میں آبپاشی کے ذریعے وسیع پیانے پر زراعت ہوتی ہے۔ دوسری طرف کراچی پتھریلی زمین پر مشتمل ہونے کے ساتھ جنوب میں وسیع علاقہ شہری آبادی کے زیر اثر ہے اور بارش کی کمی کی وجہ سے شمال کی زمین خشک ہے۔

علاقے میں لیٹرین کی عدم دستیابی کی وجہ سے 14 سروے شدہ اضلاع میں سے 12 میں ODF موجود ہیں۔ گاؤں کے لوگ ODF سے منسلک مسائل سے اچھی طرح واقف ہیں لیکن فنڈز کی کمی کی وجہ سے لیٹرین نہیں بنوا سکتے۔ دریا سے فاصلے کے ساتھ زمینی پانی کی

گہرائی کم ہوتی جاتی ہے۔سندھ میں زمینی پانی کے معیار کی تقسیم کی ایک بہت وسیع حد اطلاق ہے جو کہ 0.5dS/m to 7.1dS/m Lower Indus Plain کا مقامی زمینی پانی سمندری ہونے کی وجہ سے بہت نمکین ہے۔سندھ کے تمام اضلاع میں گہرائی اور معیار متغیر ہے خاص طور پر ہدف شدہ اضلاع میں مون سون سے پہلے اور مون سون کے بعد مختلف ہیں۔سیم کچھ اضلاع میں غالب ہے خاص طور پر شہید بینظیرہ آباد، ٹھیاری اور حیدرآباد۔پانی کے قلت والے علاقوں میں گھوٹکی، سکھر اور خیر پور کے مشرقی حصے شامل ہیں جہاں پانی 50ft سے نیچے ہے۔

غذائی اجزاء کے لیئے زراعت کچھ علاقوں میں لاگو کیا جاتا ہے جہاں پانی کی قلت ہے اور خراب معیار کا زمینی پانی ہے۔زراعت کی سرگرمیوں میں کیڑے مار دوا اور کیمیائی کھاد کا استعمال شامل ہے۔ٹھیاری میں زراعت آبپاشی کے ذریعے کی جاتی ہے اس لیئے کیڑے مار دوا کا استعمال بہت زیادہ ہے۔کراچی میں آبپاشی کے پانی کے نہ ہونے اور اس ے ساتھ کم بارش اور پتھریلی زمین ہونے کی وجہ سے کیڑے مار دوا کا استعمال بہت کم ہے۔

Reconnaissance Survey نے یہ بھی بتایا ہے کہ کیڑے مار ادویات کا استعمال cash فصلوں میں بھی کیا جاتا ہے مثلا کھجور، چاول، گیہوں، کیلے، آم اور کپاس جو کہ خیر پور، گھوٹکی، شہید بینظیرہ آباد اور ٹھیاری کے مغربی حصے میں ہیں۔حال ہی میں کیڑے مار ادویات بنانے والی کمپنیاں خاص طور پر multinational کمپنیوں والے مقامی کسانوں تک پہنچ گئے ہیں اور ان کو پیداوار میں اضافے اور فصلوں کو بچانے کے لیئے مناسب وقت پر کھاد اور کیڑے مار ادویات کے استعمال سے متعلق معلومات فراہم کرتے ہیں۔تاہم حالیہ برسوں میں افراط زر اور درآمد شدہ کھاد کی قیمتوں میں اضافے کی وجہ سے کسان روایتی طریقوں کو اپنا رہے ہیں جیسے مقامی کھاد اور مقامی کیڑے مار ادویات۔غیر معیاری اور خراب کیڑے مار ادویات اور کھاد کی فراہمی فصلوں اور پیداوار کی لاگت کو متاثر کرتی ہیں۔

انتہائی شدید موسمی اثرات کی وجہ سے بھی crop pattern بدل گیا ہے۔2010 کے بعد سیلاب، خشک سالی اور سیم اور تھور زراعت کے طریقوں پر اثر انداز ہوتے ہیں اور ٹھیاری اور حیدرآباد، گھوٹکی اور خیر پور اضلاع کے مغربی حصوں میں crop pattern بدل دیا ہے۔

شراکت دار سے مشاورت:

شراکت داروں سے مشاورت جن سے کی گئی (i) ان میں بنیادی طور پر مقامی برادری جو کہ منصوبہ سے براہ راست مستفید ہو رہی ہے۔ (ii) وہ ادارے جو منصوبہ کو عملی جامہ پہنانے میں کلیہ کردار کر دیے ہیں ان سے مشاورتوں سے معلوم ہوا کہ مجوزہ SERRS منصوبہ کا مثبت سماجی اثر سامنے آیا ہے۔جس میں صفائی میں بہتری اور کھلے میدان میں رفع حاجت میں کمی کی صورت اور غذائیت سوز خوراک کی فراہمی بذریعہ غذائیت فروغ زراعت شامل ہے برادریوں کا کا خیال تھا کہ SSS(i) منصوبہ کے تحت دیہاتیوں کی صحت اور ماحول میں تبدیلی آسکتی ہے اور ان کے ان کی بچوں کو بیماریوں سے بچایا جا سکتا ہے (ii) لوگ یہ جانتے ہیں کہ بیماریاں گندگی سے پھیلتی ہیں لیکن ان کے لیئے بیت الخلاء کی تعمیر اور مکان میں نہانے کی سہولتیں بنانا بہت مشکل ہے۔(iii) اکثر افراد یہ توقع کرتے ہیں کہ انہیں کسی تنظیم سے بیت الخلاء بنانے کے لیئے مالی امداد مل جائے گی۔

اثرات کاتخمینہ:

منصوبہ کے اکثر ماحولیاتی اور سماجی اثرات مفیہ ثابت ہونگے جیسا کہ صحت پر مثبت اثر جو کہ اسحال میں کمی کا باعث ہوگی اسی طرح دیگر صفائی سے متعلق بیماریوں میں کمی اور اس سے متعلق سماجی و معاشی فائدے، غیر معمولی برتاؤ میں تبدیلی جو کہ برادری اور ضلع سطح پر سرگرمیاں جن سے پیداواری صلاحیت میں بہتری (بالخصوص عورتوں کے لیئے مفید) انداز میں موثر غذائیت والی خوراک، صفائی وستھرائی کی حالت سے حاصل ہوگی منفی ماحولیاتی اور سماجی اثرات اسی منصوبہ کہ (i) تعمیر سے منسلک اور محلِ وقوع سے متعلق اور چھوٹے دورانیہ کے بتائے جاتے ہیں جو کہ (sss) کے تحت ہوا، پانی، شدد کی آلودگی، نکاس اور تحفظ وغیرہ سے متعلق ہیں(ii)، A4N کے تحت حد سے زیادہ کیڑا کش ادویات اور دیگر زرعی کیمیائی کھاد، پانی کی آلودگی بالخصوص سطح آب کی آلودگی وغیرہ ان تمام اثرات کو مناسب تخفیف اور انتظام کی ضرورت ہے۔

ماحولیاتی اور سماجی انتظام:

ESMF کے تحت پر ذیلی منصوبہ آب ماحولیاتی اور سماجی اثرات کی شدت کی بنیاد پر جانچ پڑتال کے عمل سے گزرے گا۔ وہ ذیلی منصوبہ جن کے معمولی ماحولیاتی اور سماجی اثرات ہونگے، RAPID ASSESSMENT سے جانچا جائیگا۔ وہ ذیلی منصوبہ جس کے کچھ منفی میں مگر مقامی اثرات مرتب ہوں گے میں ماحولیاتی اور سماجی انتظامی (ESMP) منصوبہ کی تشکیل دی جائیگی۔

گزارشات ان ماحولیات اور سماجی اصلاحی تدابیر (ESMP)

<u>ذیلی منصوبہ کی جائے وقوع کسی حساس علاقہ میں:</u>

☆ یہ اچھی طرح سے اطمینان کرلیا جائے گا کہ ذیلی منصوبہ کسی حساس مقام پر نہیں ہے اور نہ ہی وہاں کوئی آبادکاری کا عمل ہونا ہے۔

☆ جبری آبادکاری ونقل مکانی کی Checklist کا استعمال اسکول، حکومتی اراضی، کی جانچ کے لیئے کیا جائے گا اور اس بات کو یقینی بنایا جائے گا کہ اس میں کوئی تنازعات نہ ہوں۔

☆ دیہی تنظیموں اور مقامی ضلعی حکومتوں کی مدد سے اسکول کی تعمیر کے لیئے زمینوں کی نشاندہی کی جائے گی۔

☆ ذیلی منصوبہ زرعی محکمہ کی زمیں پر تعمیر کئے جائیں گے اگر چہ ذاتی زمیں بھی حاصل کرنا پڑی تو VLD طریقے کار اپنایا جائے گا بصورت دیگر RPF سے کام لیا جائے گا۔ مکمل VLD کا دستاویز برقرار رکھا جائے گا۔

☆ برادری کے متاثرہ اثاثے کا تخمینہ اور معاوضے RAP/RPF کے مطابق طے پائے جائینگے اس سے قبل کے سرگرمیاں شروع ہوں۔

☆ برادری سے مشاورت منصوبہ کی وقوع پذیر ہونے سے پہلے ہی شروع کردی جائیں گی۔

☆ غیر مناسب بیت الخلاء کی تعمیر پانی کی آلودگی کا باعث بن چکی ہے۔

☆ رویوں کی تبدیلی اور سرگرمیوں کے دوران برادریوں میں حاصل دوست بیت الخلاء کی ساخت کو فروغ دینا (اس مخصوص کے لئے موثر ہے) اور ایک غلط ساخت کے بیت الخلاء کے منفی اثرات سے آگاہی دینا ہے۔

☆ نگرانی کا اصل منصوبہ کے دوران جاری رکھا جائے گا تا کہ پائیداری کا عنصر و عمل جاری و ساری رہے۔

☆ پانی سے صفائی حاصل کرنے والے بیت الخلاء ان علاقوں میں جن میں پانی کی قلت خشک سالی میں ہوتی ہے غیر مناسب ہیں۔ یقینی بنایا جائے گا منصوبے پر عمل درآمد کرنے والا یونٹ بیت الخلاء کی تعمیر کی ہدایات پر عمل کرے۔

کھڈا / گڑھا برائے انتظام فضلہ

☆ فضلہ کا انتظام ESMP کا حصہ ہے جو کہ ہر ذیلی منصوبہ کا جزو ہے۔ فضلہ جو کہ ٹینک یا گڈھے کے خالی ہونے پر زمین کی بھرائی جو کہ ایک مخصوص جگہ ہوتی ہے وہاں کی جائے اور اسے نامیاتی مواد پر گلنے دیا جائے گا۔

☆ برادری میں رویئوں کی تبدیلی کی سرگرمیوں کے دوران اس عنصر کو پرچار کیا جائے گا اور بیداری بڑھانے کی ورکشاپ کی جائیں گی۔

کالعدم کیڑہ مار ادویات ،اور کیمیائی کھاد کا بے دریغ استعمال

☆ آب پاشی کے پانی کا منصفانہ استعمال، کیمیائی کھاد کا استعمال اور متبادل ترکیب (جیسا کہ ضم شدہ کیڑوں سے دفاع کا انتظام، بیماریوں سے مدافت بیجوں کا استعمال (Mulching) کو فروغ دینا اور آگاہی ک ساتھ صلاحیت کی تعمیر بھی کرنا شامل ہے۔

☆ صلاحیت کے حصول میں منفرد مادہ کی محفوظ انداز (HANDLING) شامل ہے جیسا کی کیڑے مار ادویات۔

☆ بہتر آب پاشی کی ترکیبیں جیسا کہ (Tunnel Farming) جو کہ A4N میں شامل ہے اس کو فروغ دیا جائے گا تا کہ پانی کی قلت پر قابو جا سکے۔

کسانوں کی صحت اور حفاظت کے لئے خطرات:

☆ آگاہی اور تعمیر صلاحیت برائے MSDS ہر اس خطرناک مادہ کے لئے بہم پہنچائی جائے گی۔

☆ WB گروپ اور EHS کے رہنما اصولوں کو لاگو کیا جائے گا۔

☆ PPE ذاتی حفاظتی آلات کے استعمال کو یقنی بنایا جائیگا خصوصاً کیڑا کش ادیات کے استعمال کے لیے

عورتوں بچوں اور غیر محفوظ گروہوں پر اثرات:

☆ عورتوں کی شمولیت پہلے سے ہی منصوبہ میں شامل ہی جیسا کہ (FSS) لڑکیوں کے لیے بیت الخلاء کی تعمیر اور عورتوں کو بنیادی طور پر زرعی پیداوار کا مرکز بنانا۔

☆ (LEW) لیڈی ایکسٹینشن ورکرز کو مختصر مدت کے لیے ملحقہ عملے کے طور پر لیا جائے گا تا کہ عورتوں کے مفادات پورے ہو سکیں۔ (PC-1, A4N)

ماحولیاتی جانچ کی فہرست غریب عورتوں اور غیر محفوظ گروہوں کے بارے میں ابتدائی مرحلہ کی معلومات فراہم کرے گا کہ ان کی ضروریات اور ترجیحات برائے سماجی و معاشی بہتری کا پتہ چل سکے۔

☆ IPS اور TSP اس کو یقینی بنائیں گے کہ عورتیں منصوبہ میں بھرپور حصہ لیں اور ان سے پر اثر مشاورت ہو۔

☆ غیر محفوظ گروہ کی منصوبہ میں شمولیت اور حصہ داری کو مشاورت سے یقینی بنایا جائے تا کہ جو سرمایہ کاری کی جائے وہ ان تمام گروہ کے مفاد

میں ہو۔

نظام برائے تدارک شکایت GRM:

A4N اور SSS کے دونوں ڈائریکٹوریٹ کمیٹی برائے تدارک ازالہ شکایت کے سیکریٹریٹ کا کام انجام دیں گی جو کہ تمام GRM کی کاروائی کی ذمہ دار ہونگی اور اس کے ساتھ ساتھ اس کے نگرانی بھی کریں گی۔ شکایات کے مرکزی اشخاص (GFPs) دراصل تبدیلی کے سفیر ہونگے اور ہر ذیلی منصوبہ کے علاقے کی برادری کو تعلیم دیں گے۔ دو شکایات کے مرکزی اشخاص (GFPs) ہر ذیلی منصوبہ کے علاقے کی برادری سے چنے جائیں گے جو کہ آسانی سے برادری میں جا سکیں۔ عوامی شکایت مرکز PCC شکایات درج کرنے اور شکایت لینے کے لیئے قائم کیا جائے گا شکایت کے ازالے کی کمیٹی کا قیام کیا جائے گا ہر ضلع سطح پر جو کہ GRM چلائے گی جس کی تحت احکامات نگرانی اور ازالائے شکایت ذیلی منصوبہ کی سطح پر دیکھا جائے گا۔ ESFPs ضلعی سطح پر GRC کو فعال بنانے مین ایک کلیدی کردار ادا کریں گے۔

ESMF کے نفاذ کی لاگت:

ESMF Addemdum کے نفاذ کی کل لاگت کا تخمینہ پاکستانی روپیوں میں تقریبا 84.160 ملین لگایا گیا ہے اس میں ماحولیاتی ماہر اور سماجی ماہر، تربیت اور تخفیف کے اقدامات کی لاگت شامل ہے یہ لاگت اجتماعی لاگت میں شامل ہے جو ۱۴ اضلاع میں ہوں گے۔

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Acronyms

A4N	Agriculture for Nutrition	MAF	Million acre feet
AAP	Accelerated Action Plan	MDGs	Millennium Development Goals
ADP	Annual Development Program	MHa	Million hectares
ALRI	Acute Lower Respiratory Infection	MICS	Multiple Indicator Cluster Survey
APs	Affected Persons	MRL	Maximum Residue Limit
BHU	Basic Health Unit	MSAN	Multi-Sectoral Action for Nutrition
DC	Deputy Commissioner	NCCP	National Climate Change Policy
DCO	District Coordination Officer	NGO	Non-governmental organization
DMS	Detailed Measurement Survey	NNS	National Nutrition Survey
DMU	District monitoring unit	NPSC	Nutrition Project Steering Committee
DNCC	District Nutrition Coordination Committee	NSA	Nutrition sensitive agriculture
DOA	Department of Agriculture, GOS	O&M	Operation & Maintenance
DOH	Department of Health, GOS	ODF	Open Defecation Free
DOLF	Department of Livestock and Fisheries, GOS	P&DD	Planning & Development Department, GOS
EA	Environmental Assessment	Pak-EPA	Pakistan Environmental Protection Agency
EIA	Environmental Impact Assessment	PAHs	Project Affected Households
ENMCP	Enhanced Nutrition for Mothers and Children Project	PARC	Pakistan Agricultural Research Council
ESFP	Environmental and Social Focal Point	PBS	Pakistan Bureau of Statistics
EHS	Environment, Health, and Environment	PCRs	Physical Cultural Resources
EIA	Environmental Impact Assessment	PD	Project Director
EPA	Environmental Protection Agency	PDMA	Provincial Disaster Management Authority
ES	Environmental Specialist	PKR	Pakistani Rupees
ESMF	Environmental and Social Management Framework	PMU	Project Management Unit
ESMP	Environmental and Social Management Plan	POPs	Persistent Organic Pollutants
FAO	Food and Agriculture Organization	PPE	Personal protective equipment
F3S	Female Farmer Field School	PSC	Poverty Scorecard
FBS	Farmer Business Schools	RAP	Resettlement Action Plan
FFS	Farmer Field School	RFP	Resettlement Policy Framework
FGD	Focus Group Discussion	RS	Reconnaissance Survey
FO	Farmers' Organization	SIA	Social Impact Assessment
GAP	Good Agriculture Practice	SEPA	Sindh Environmental Protection Agency
GDP	Gross Domestic Product	SERRS	Sindh Enhancing Response to Reduce Stunting Project

GOP	Government of Pakistan	SESA	Strategic environmental and social assessment
GOS	Government of Sindh	SEQS	Sindh Environmental Quality Standards
GRC	Grievance Redress Committee	SIDA	Sindh Irrigation Development Authority
GRM	Grievance redress mechanism	SS	Social Specialist
GPI	Gender Parity Index	SSS	Saaf Suthro Sindh
IESMC	Independent Environmental and Social Monitoring Consultant	SUN	Scaling Up Nutrition
INSS	Inter-Sectoral Nutrition Strategy of Sindh	SWD	Sindh Wildlife Department
IP	Indigenous people	SWMO	Sindh Water Management Ordinance
IPs	Implementation Partners	TA	Technical Assistance
IPM	Integrated pest management	TSP	Technical Support Partner
IPMP	Integrated pest management plan	UC	Union Council
IUCN	International Union for Conservation of Nature	UNDP	United Nations Development Programme
LAR	Land Acquisition and Resettlement	VOs	Village Organizations
LBOD	Left Bank Outfall Drain	WASH	Water, Sanitation and Hygiene
LGD	Local Government Department, GOS	WB	World Bank
M&E	Monitoring and evaluation	WHO	World Health Organization

Chapter 1 INTRODUCTION

The Government of Sindh (GoS) recently adopted an Accelerated Action Plan for Reduction of Stunting and Malnutrition (AAP). The AAP has the ambitious goals of reducing stunting from 48% to 30% by 2021 and to 15% by 2026 by increasing and expanding coverage of multi-sectoral interventions proven to reduce stunting in the first five years of life. The Sindh Enhancing Response to Stunting and Malnutrition (hereinafter referred to as SERRS) project would support implementation of the AAP with a more modest objective of reducing stunting in Sindh by at least 1 percentage point per year from 48% to 43% over the life of the project. ESMF Consultant[1] has been commissioned by Directorate of Urban Policy & Strategic Planning to fulfil World Bank Operational Policies and to prepare the addendum of “Environmental and Social Management Framework (ESMF)” for additional 14 districts at its inception stage via assessing the SERRS project’s environmental and social viability through various environmental components like air, water, noise, land, ecology along with the parameters of human interest and mitigating adverse impacts along with chalking out of guidelines, SOPs, procedure for detailed EA during project execution.

1.1. Background

UNICEF (2013) notes that Pakistan comprises the third highest percentage of stunted children in the world and that more than 9.6 million Pakistani children face chronic malnutrition. Data shows that in the South Asia region, Pakistan has the lowest rates of early initiation of breastfeeding and exclusive breastfeeding (and the highest rate of bottle feeding), as well as low rates of timely initiation of complementary feeding, all of which contribute to the chronic malnutrition. It is estimated that the malnutrition crisis in Pakistan costs the economy 2-3% of GDP per year (in comparison, the present energy crisis is estimated to cost 2% of GDP) by impairing health, growth and cognitive development, school readiness and learning outcomes as well as potential productivity and earnings and adults. Furthermore, without an urgent response to significantly address malnutrition, the country will continue to experience this ‘demographic nightmare’ of a large population whose human capital potential is not fully realized, thereby resulting in unskilled, economically unproductive population which is left behind in a global economy that is increasingly requiring specialized skills.

While Pakistan’s social indicators for health, nutrition, and education are low and lag seriously behind other countries in the region, the country ranks among the lowest spenders on education and health in the region (each at less than 3% of GDP). In addition, provincial and district disparities in access to and quality of services have become an important concern since the delivery of most key services became a provincial responsibility with the adoption of the 18th amendment of the constitution in 2010.

Nationally, only about 10% of the national health budget is spent on nutrition, and 90% of this amount is financed by development partners in Pakistan. Nutrition-related activities are mainly delivered by NGOs, often contracted directly by the development partners. Nutrition-supported activities in Sindh Province that contribute to reduced stunting and malnutrition include: (i) the World Bank-financed “Enhanced Nutrition for Mothers and Children”; (ii) the EU-funded “Women and Children Improved Nutrition Sindh” which will end in 2017, and the USAID-funded “Maternal and Child Nutrition Stunting Reduction” (implemented by UNICEF and WFP). With a contribution from DFID, the Pakistan Partnership for Improved Nutrition (PPIN), a Multi Donor Trust Fund administered by the World Bank, plans to finance nutrition sensitive interventions to complement the health sector’s nutrition interventions, focusing on sanitation and hygiene interventions in 13 districts and nutrition sensitive agriculture interventions in four districts.

[1] M/s EMC Pakistan Private Limited

1.2. Project Overview

The project would support implementation of the AAP with a more modest objective of reducing stunting in Sindh by at least 1 percentage point per year from 48% to 43% over the life of the project. Given the inadequate results of previous input-based projects, this project would use a results-based approach to link disbursements to the achievement of agreed-upon, pre-defined indicators. Disbursement-linked indicators (DLIs) have been used in other projects in Sindh and have contributed significantly to: (i) sector dialogue (by focusing on political ownership of the Government's program); (ii) technical results (by linking disbursements to planned progress and performance targets); and (iii) donor coordination (by facilitating planning, budgeting, and supervision within a common framework).

The project will finance: (i) results contributing to the achievement of the objectives set forth in the Government's AAP in Sindh; and (ii) technical assistance and other inputs needed by the government to facilitate the implementation of the AAP. Under Component 1 (US$ 50 million), the project will support a multi-sectoral package of services shown to contribute to the PDO by financing results, measured by the achievement of DLIs, under a defined Eligible Expenditure Program (EEP). Under Component 2 (US$ 13 million), the project would finance technical assistance and selected inputs to support: (i) measures for implementing the pilot Conditional Cash Transfer (CCT) program for women and children in the poorest quintile to access health and nutrition services; (ii) development and implementation of an overarching multi-sectoral communications strategy for social and behavior change; and (iii) institutional arrangements for cross-cutting interventions including coordination, strengthening accountability, citizen engagement, integrated multi-sectoral data information systems, monitoring, evaluation, gender and supervision.

1.2.1. Results Indicators

The target population and beneficiaries of nutrition-sensitive interventions will vary: (i) certain sectoral initiatives (hygiene and sanitation, agriculture, and social protection) will initially be piloted in selected districts before further roll out; (ii) several sectoral programs (MNCH and population) are already province-wide in scope; and (iii) other sectoral interventions (social and behavioral change) are cross-cutting in nature and will target the entire province. Specifically, prior to the mid-term review, the project will aim to increase the synergy of the various interventions on reducing the stunting rates by concentrating them in selected districts. When progress and achievements are confirmed at the mid-term review, a decision will be made on further expansion to other districts or additional concentration on specific districts.

1.3. Environmental and Social Management Framework (ESMF)

Location and design of the sub-projects to be undertaken under SERRS project are not known yet, therefore a framework approach has been being taken to carry out environmental and social assessment for SERRS project in line with the World Bank's Operational Safeguard Policy (OP 4.01) and local environmental legislations. Under this approach, the present ESMF has been prepared to identify the potential generic negative environmental and social impacts, propose generic mitigation measures, provide basic screening criteria, list the type of safeguard instruments to be developed and provide institutional, monitoring, reporting and documentation measures for environmental and social safeguards compliance.

1.3.1. Purpose of the ESMF Study

The objective of the ESMF study is to carrying out broad safeguards analysis, screening the proposed subproject interventions against adverse environmental and social impacts and recommending, where necessary, appropriate mitigation and enhancement measures, and course of action for further and detailed assessment so as to enable the preparation of an Environmental and Social Management Framework (ESMF) as well as the generic Environmental and Social Management Plans (ESMP) and Integrated Pest

Management Plan (IPMP) or the identified activities/investments of the sanitation and A4N components of the subprojects. Also to broadly assess generic environmental and social consequences. The relevant portions of the ESMP and IPMP will be suitably integrated with the contract documents to facilitate smooth implementation during project operation phases.

Sindh Environmental Protection Act 2014 which is the principal legislation on environmental protection and compliance in Sindh since 2014, states the provisions of environmental protection and compliance and this ESMF has been prepared in line with those provisions laid down in the Act. Also the ESMF will need to comply with the WB safeguards requirements given in different operational policies (OPs).

1.3.2. Scope of the Addendum

The addendum of ESMF for the subprojects of Sanitation and A4N will provide baseline information and also identify generic environmental as well as social impacts of the subprojects for the additional 14 districts. The specific tasks will include:

(i) Study the overall project details and also details of the subprojects under Sanitation and A4N their design, location, nature, key interventions supported by project/subprojects; carry out reconnaissance survey of the subprojects under sanitation and A4N components; and collect baseline data on physical, biological and socio-economic conditions prevailing in the area of each sub-project. Determine environmental and social sensitivity of the area and also environmental and social hot spots;

(ii) Undertake stakeholder consultations with a select sample of communities and institutions;

(iii) Prepare cover note for the existing ESMF stating the rationale and scope of the addendum and its applicability to the Sindh Enhanced Response to Reduce Stunting initiative.

The Addendum will cover the following sections of the MSAN's ESMF.

a. Executive Summary
b. Introduction.
c. Project description.
d. Baseline description of the area of subprojects (i.e. the two additional districts where MSAN will be scaled up)
e. Impact assessment and mitigation measures (mostly generic).
f. Stakeholder consultations.
g. Outline the existing GRM and extend it to include the existing districts
h. Discuss how the Public consultation framework will apply in the 14 additional districts
i. Budget:
j. Annexes

The addendum to the ESMF will need to be reviewed and cleared by the World Bank. The addendum will be subject to consultations in Sindh Province before it is disclosed locally, in the local language and in English in the World Bank Infoshop, before implementation of activities in 14 districts of approved SERRS project.

1.3.3. Layout of addendum to ESMF

Chapter 1 (this chapter) provides a rationale and introduction of the project and addendum TORs. **Chapter 2** provides a simplified description of the Project and its components. The environmental and social baseline conditions are presented in **Chapter 3**. The stakeholder consultations have been covered in **Chapter 4**. The assessment of environmental as well as socioeconomic impacts, their mitigation measures are presented in **Chapters 5**. The implementation budget of ESMF under SERRS project is included in **Chapter 6**.

Chapter 2 PROJECT DESCRIPTION

2.1. Project Context

Sindh Province, with an estimated population of 51 million[2], comprises about a quarter of the country's population; it is the second most populous province of Pakistan and is nearly 50% urban. The province contributes 30-33% of the country's GDP, and its GDP per capita is roughly three times that of the country as a whole. However, based on the latest poverty data, 25% of the population of Sindh lives under the revised poverty line, and the 2011 National Nutrition Survey (NNS) found that Sindh was the most food-deprived province, with 72% of households' being food insecure. The most recent data (MICS, 2014) shows that 48% of children under five suffered from stunting and 15% from wasting. The situation differs across the province, with highest rates of stunting for the Districts of Tharparkar and Umerkot (63% and 66% respectively) and as low as 33% to 36% for Karachi's urban districts.

Under Pakistan's Vision 2025, nutrition has received increased attention, and the federal as well as provincial Governments have established a secretariat to coordinate and support its scale-up. Pakistan joined the global movement of Scaling-Up-Nutrition (SUN) in 2013. Having acknowledged that despite better economic conditions and a large agrarian population, Sindh's nutrition indicators have fallen behind those in the South Asia region. As a response, the Government of Sindh (GoS) recently adopted an Accelerated Action Plan for Reduction of Stunting and Malnutrition (AAP). The AAP has the ambitious goals of reducing stunting from 48% to 30% by 2021 and to 15% by 2026 by increasing and expanding coverage of multi-sectoral interventions proven to reduce stunting in the first five years of life. It comprises objectives and expected outcomes related to addressing the underlying causes (by sector) of stunting: health, population, sanitation and hygiene, agriculture (including livestock and fisheries), social protection, education, and behavioral change communication. Addressing stunting is important because of its impact on the economic development of the country. There are at least three channels via which stunting produces economic losses over the life cycle: (i) reduction in physical growth potential; (ii) neurological consequences that lead to poor learning and grade attainment; and (iii) increased susceptibility to chronic diseases in adulthood. These in turn have adverse effects on productivity, lost employment, premature death, healthcare costs, and opportunity costs of caregivers. In addition, in the short run, child under nutrition is a risk factor for child morbidity and mortality and leads to increased healthcare costs and forgone income for care givers. GoS has committed itself to match every USD of Overseas Development Aid (ODA) funding to address malnutrition by 0.5 USD domestic financing and has allocated 1 billion PKR per year for the next three years through their recurrent budget as an indication of this commitment and ownership. The World Bank funded SERRS project would support implementation of the AAP with a more modest objective of reducing stunting in Sindh by at least 1 percentage point per year from 48% to 43% over the life of the project.

The following section provides the detailed description of the proposed components and anticipated subprojects.

2.2. Project Components

To increase coverage and improve the quality of key services over the period 2017-21, the project will finance a mix of sectoral and cross-cutting interventions to improve behaviors and practices. These interventions will be supported by measures to strengthen social and behavioral change communication. The Project includes two components which will finance: (i) results contributing to the achievement of the AAP's

[2] Current Sindh Province population data may be found at: http://sindhbos.gov.pk/. Population growth rates are based on UN estimates

goals; and (ii) technical assistance and other inputs needed by the government to facilitate the implementation of identified activities under Component 1.

Component 1 (total estimated cost: US$50 million) would support expansion of a multi-sectoral package of services known to reduce stunting in the medium to long-term. Sectoral plans (for Health and Nutrition; Population and Welfare; Sanitation and Hygiene; Agriculture, Livestock & Fisheries; Education; and Social Protection) have been prepared and included in the AAP.

Component 1 would support the GoS by (i) expanding the number and quality of interventions listed above that will have a direct and immediate impact on reducing stunting in the medium to long-term; and (ii) creating an enabling environment and incentives to encourage the required behaviors that need to accompany the expansion of the multi-sectoral interventions in the following sectors:

- Health and Nutrition: The Department of Health (DOH) is currently implementing the Enhanced Nutrition for Mothers and Children Project in the nine most vulnerable districts of Sindh with a basic package of nutrition-specific services indicated in Table 4 above largely provided by the Lady Health Care Workers (LHW) Program and contracted NGOs in non LHW covered areas. The project also builds institutional capacity to plan, implement and monitor nutrition services. A similar set of field level interventions is under implementation in four additional districts, implemented by international NGOs and funded by the European Union (EU) which is ending mid-2017. New donor support (including EU and United States Agency for International Development (USAID) commitments) will be phased in to achieve the targets of the AAP in those districts. The AAP supported by this proposed project will scale up the basic package of nutrition services to the remaining districts over the next 10 years to ensure that the targets for the reduction of stunting are achieved. In addition, the project will support the development and conduct of a pilot to reach mothers and caregivers of young children (under 3 years) with guidance on early learning and stimulation through the LHW platform, since parents of children under 3 years are not reached by the education system's Early Childhood Development (ECD) program.
- Population: The GoS has developed a costed implementation plan to meet the Family Planning (FP) 2020 targets, which would also be critical to reducing levels of stunting. The plan for 10 districts is currently under implementation with a limited set of activities which are planned to be scaled up under the AAP. This project will incentivize the training of LHWs to provide FP counselling and supply of short term methods as well as special outreach FP services delivery camps to communities currently not reached with FP services.
- Sanitation and Hygiene: Building on the proposed Multi-Sectoral Actions for Nutrition Project (MSAN) in 13 districts to make villages open defecation free (ODF), the AAP plans to expand coverage across Sindh. In addition to supporting the ODF initiative, the project will promote an enhanced program on hand washing through capacity development of the Local Government Department (LGD), Village Organizations (VO) and school teachers who, in turn, will advocate and motivate communities to become 100% ODF. NGOs and private sector will be utilized to work as intermediaries to transform the behavior of villagers through special triggering and motivating interventions, such as cash reward to VO for developing communal infrastructure, rewards in the form of 3-5 latrines with hand washing stations in public schools and on a need and priority basis, support for rural water provision to deprived community could be provided. In addition, a female resident of the same village - called an 'Ambassador of Change (AOC)' -will be selected for advocacy with women and household dwellers.

- Agriculture (including Livestock and Fisheries): Building on a flexible and demand driven approach to be piloted in 20 union councils of four districts under the proposed MSAN Project, the department plans to gradually scale up to more districts with a high incidence of stunting. The focus will be on nutrition sensitive interventions that would contribute to enhancing household food diversity and access to high nutritive value foods, especially for the poorest and most food insecure households, and to consumption of high nutrition content food, especially by pregnant-nursing women, children under five and adolescents.
- Education: The two key interventions in the AAP are: (i) to improve access to Early Childhood Education (ECE) in the public schools and (ii) to improve knowledge of nutrition and healthy living among girls enrolled in high schools in the public sector. There is a need to develop curriculum and supplementary material for training of teachers and adolescent girls in schools. ELD is also operating an IT citizen engagement platform ("Ilmi") that could be used to further engage the larger community on the stunting agenda (including the importance of early stimulation of babies) by engaging School Management Committees (which include teachers, parents and administrators). This IT platform which provides useful education-related data could also be expanded to include data needs of other multisectoral interventions.

Component 2 (total estimated cost: US$13 million) would finance TA and selected inputs to support: (i) measures for implementing the pilot CCT program; (ii) development of an overarching multi-sectoral communications strategy for social and behavior change; and (iii) institutional arrangements for cross-cutting interventions including coordination and project management, citizen engagement, integrated multi-sectoral data information systems, and monitoring, evaluation and supervision. Specifically, Component 2 will focus on the following interventions:

- Social Protection/CCT (approx. $5 million): To create demand for nutrition services, promote behavioral change and increase uptake of health and nutrition services focused on the first 1000 days of life by incentivizing health check-ups of pregnant and lactating mothers, growth monitoring and immunization of children under 2 years of age through a regular and predictable cash transfer within targeted poor and vulnerable households, the project would pilot a CCT program. Beneficiaries would be selected from the existing cohort of poverty targeted beneficiary families as identified from the National Socio Economic Registry (NSER).
- Strategic Communication (approx. $1 million): To consolidate the existing sectoral communication plans, the project would support development of a comprehensive multi-sectoral communications package for dissemination and use by all key sectors for consistent and more effective messaging. The key messages will include those promoting exclusive breastfeeding up to 6 months; adequate complementary feeding 6 to 24 months; prevention of common childhood illnesses and accessing care early for those who need it; food diversification and consumption using locally available foods.
- Cross-cutting interventions (approx. $7 million):
    - Coordination Support: Coordination across diverse sectors and stakeholders to ensure synergistic action that is required including government, donor, and inter-sectoral coordination.
    - Project Supervision and Management: A secretariat led by the Nutrition Coordinator to the Chief Minister will be established and staffed by a core team comprising technical specialists (such as Project Management Specialists, Procurement and FM Specialists, Communication Expert, M&E Specialist, etc.). The Secretariat and the Planning and Development (P&D) department will collaborate to ensure smooth implementation of the prioritized package of multi-sectoral interventions under the AAP.

- Nutrition Expenditure Tracking: An Integrated Financial Management Information System that operates at all three levels of government (e.g. Federal, Provincial & District) will be supported and will generate useful reports for policy makers and relevant stakeholders. Support will be provided to strengthen the system to track nutrition specific and sensitive allocations, disbursement and expenditure which will help to identify bottlenecks in managing financial resources for nutrition and will be the first time that the actual costs incurred at the various levels of implementation would be available. This will also support the Finance and Health Departments with evidence-based decision-making related to the provincial budget. Having this credible, timely and user-friendly data is a pre-requisite for assessing the level and quality of expenditure in districts and provinces and will strengthen accountability of the AAP and facilitate accelerated progress of the program to reduce stunting rates.
- Monitoring and Evaluation, Reporting and Impact Evaluation: Project support will include consolidation of different potential sources of information; strengthening the line department's Information Management System, including the use of the District Health Information System (DHIS) and scale up of the nutrition reporting system developed under the "Enhanced Nutrition for Mothers and Children Project", to ensure that all needed data is captured and collated through the system; establishing and maintaining third party monitoring for verification of DLIs; and conducting of specialized surveys to assess the stunting rate and other project relevant indicators.
- Citizen Engagement Platform: This will support advocacy and awareness efforts as well as for registering complaints and redressing grievances; and an added means of results verification (for the DLIs, provision of services, ODF status, CCT, etc.).

2.3. Institutional and Implementation Arrangements[3]

For Component 1, the project will use the framework of institutional arrangements established by GoS for implementing the AAP.

Provincial-level arrangements: The Government of Sindh will ensure the establishment/appointment and maintenance of (i) a Provincial Task Force for AAP of all relevant ministers participating in the implementation of the AAP, and (ii) a Coordinator to the Chief Minister Sindh for Nutrition (Nutrition Coordinator) to coordinate the task force's responsibilities to direct and oversee all programmatic and operational activities related to the achievement of the AAP's objectives. The Nutrition Coordinator will also support the Provincial Steering Committee (PSC), comprising the secretaries of all relevant and participating departments. The PSC will meet twice a year and will provide overall strategic policy guidance, planning, and oversight of the AAP; coordination among related sectors and stakeholders; and support and review of the project's implementation progress and performance.

A Provincial Task Force Secretariat for AAP (Secretariat) will assist the Nutrition Coordinator in the day-to-day management of the overall AAP and this project. The Secretariat will be staffed by a core team of technical specialists in such areas as project management, procurement, financial management, communication, M&E, and safeguards. With support from the P&D Nutrition Unit, the Secretariat will ensure coordination among the different sectors and smooth implementation and monitoring of the multisectoral interventions. The Secretariat will have specific responsibilities for (i) monitoring project performance; (ii) monitoring the implementation of the prioritized packages of multisectoral interventions

[3] World Bank PAD Document of SERRS

as well as the activities under each DLI; (iii) overseeing the data collection and verification process to ensure the validity of the evidence for the DLIs; and (iv) conducting project midterm and completion reviews.

District level arrangements: All sectoral representatives (e.g., nutrition, health, local government, education, population welfare, agriculture, livestock, fisheries and social welfare department (SWD)) hold operational district level offices. Health, nutrition, and population interventions will be delivered through LHWs and Community Midwives (CMWs); where there are no LHWs, non-governmental organizations will be contracted to deliver the package of services financed by the project. The Local Government (LG) representative (Additional Director LG) will be the district focal person for water and sanitation, while Secretaries of respective Union Councils serve as the field force of LG Department. For agriculture, the government's agriculture extension workers are available at district level as Agriculture Officers.

Overall sectoral coordination at the District Level will be the responsibility of the Deputy Commissioner, assisted by the District Coordinator. Monthly district coordination meetings will be arranged by the coordinator and chaired by the Deputy Commissioner, with representation from all the relevant sectors. The District Coordinator, assisted by a communication officer and M&E officer, will coordinate with all the sectoral focal persons to ensure that: (i) quarterly work plans are prepared and implemented; (ii) activities are supervised and monitored; (iii) all sectors provide monthly reports to the District Commissioner; and (iv) consolidated reports are transmitted to the provincial level. In addition to the inter-sectoral reporting mechanisms, every sector will carry responsibility for their sectoral and technical reporting. Front line workers, like LHW and CMWs for the health sector, will compile information and present to the district line departments, district reports will then be shared with the provincial line departments for technical review and feedback for quality improvements.

A Project Operations Manual (to be prepared by GoS within 2 months of project effectiveness) will set out procedures, processes, and systems to be followed by the management and staff of the project at all levels, including issues related to safeguards, procurement and financial management, and coordination among the sectors involved in project implementation.

For Component 2, the institutional arrangements for SBCC and CCT are as follows:

- **Social and behavioral change communication (SBCC):** To develop the widest possible awareness and ownership at various societal levels, the project will finance a multipronged outreach initiative aimed at both internal and external stakeholders and audiences. Each sector of the program will implement sectoral communication strategies designed to help achieve the stunting-reduction targets. To ensure a cohesive strategy, a Communication Coordination Cell will initially be established within P&D and then within the Secretariat. Staffed by communication specialists from the various sectors, the cell will build on the strategy and material developed under the ENMCP to develop an overall communication strategy and action plan in a consultative and participatory manner while ensuring synergies with sectoral communication strategies. It will also ensure quality control of outreach materials; coordinate event management, public information campaigns, and advertisements for print/electronic media; and help build relationships with media and civil society.
- **Conditional Cash Transfers (CCT):** A Technical Working Group, chaired by the Chief Economist and including representatives of P&D, Health, Finance, Social Welfare Department (SWD), and the Benazir Income Support Program, proposed the delivery of the CCT pilot through SWD until the time that the Government of Sindh develops a comprehensive Social Welfare Policy to guide a comprehensive province wide CCT program. For certain elements, such as pro-poor targeting, the CCT pilot will use the available National Socio-Economic Registry maintained by the Benazir

Income Support Program. A detailed manual (as part of the project operational manual) will provide program rules and regulations, processes, and implementation procedures for targeting, beneficiary outreach, social mobilization, enrollment, payments, conditionality/co-responsibilities, compliance verification process, exit policy, grievance redress mechanism, management information system, communication strategy, and M&E.

2.4. Project Cost

Estimated project cost is US$ 61.62 Million. Under Component 1 (US$45 million), the project will support provision of a multisectoral package of services by financing results. Under Component 2 (US$16.62 million), the project will finance technical assistance and inputs[4].

2.5. Monitoring and Evaluation

M&E responsibilities have been established at the provincial and district levels and will contribute to tracking project indicators, including DLIs. Following current practice, each sector at the district level will collect, consolidate, and analyze data on the services provided and their use. Sector-specific monthly reports will be consolidated at the provincial level by the Secretariat with assistance from P&D. The provincial programs in different sectors will have the responsibility for preparing and disseminating semiannual results reports, which will be presented to the PSC for review of the results and resolution of any bottlenecks to implementation. For the DLIs, an independent third party will be contracted to conduct a semiannual verification of the DLIs reported through the routine system. The information obtained from the third-party monitoring will serve to confirm the routine system data and will be used to issue performance-based payments through EEPs.

Data for all proposed project indicators, including the beneficiary feedback indicator, will be collected through existing systems, but there is a need to consolidate the existing systems (often developed independently for specific purposes) into a well-coordinated and integrated provincial information management system for multisectoral interventions. To this end, a “bottom-up” approach will be used for collecting and analyzing the data, and capacity for this approach will be strengthened gradually through TA under Component 2. The project will also draw on the experience gained in the education sector to pilot and gradually expand the use of new information technology to improve the effectiveness of coordinated and overarching monitoring for the AAP and to enhance social accountability.

[4] World Bank PAD Document of SERRS

Chapter 3 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

This section of the Report presents a broad picture of the existing environmental and social conditions of project areas covered in this addendum comprising districts of **Ghotki, Hyderabad, Khairpur, Matiari, Naushahro Feroze, Shaheed Benazirabad, Sukkur, Tando Allah Yar, Karachi Central, Karachi East, Karachi West, Karachi South, Korangi (Karachi) and Malir (Karachi)**. Available secondary data from published literature and previous studies conducted by Consultants in the area, case studies, district census reports, and other documents was used to develop the baseline profile.

The project Districts are shown in the following map:

Figure 3.1: Project Area Districts (Districts in Yellow covered in this addendum)

3.1. Physical Environment

The physical environment of Project Districts has been described in this study with respect to the air shed, watershed, geology, soil characteristics, hydrology and seismicity. Baseline data on the air shed describe the climatic conditions and quality of air. Similarly baseline data on watershed describe the hydrology and quality of surface and groundwater as well as water availability. Data on Geology, geomorphology, soil characteristics and seismicity are needed to evaluate the terrestrial resources with respect to quality of minerals and soil characteristics particularly stability.

3.1.1. Geography

District Ghotki

Ghotki district is divided into three clear physical parts i) desert area ii) cultivable area and 3 flooded area (katcha). The cultivable area is locating between desert and flooding areas in the center of district. It is declared fertile land of Sindh and irrigated through Ghotki Feeder of Guddu barrage irrigation system. The river Indus flows adjacent to the district in the north and its direction of flow from North-East to South-West. The length of riverine tract is 87 KMs. The Flooding plain is called Katcha, bounded by safety bunds and river forests abound in the area. The total area of district under forest and katcha is 402,578 acres, which is total area's 25.88% percent.

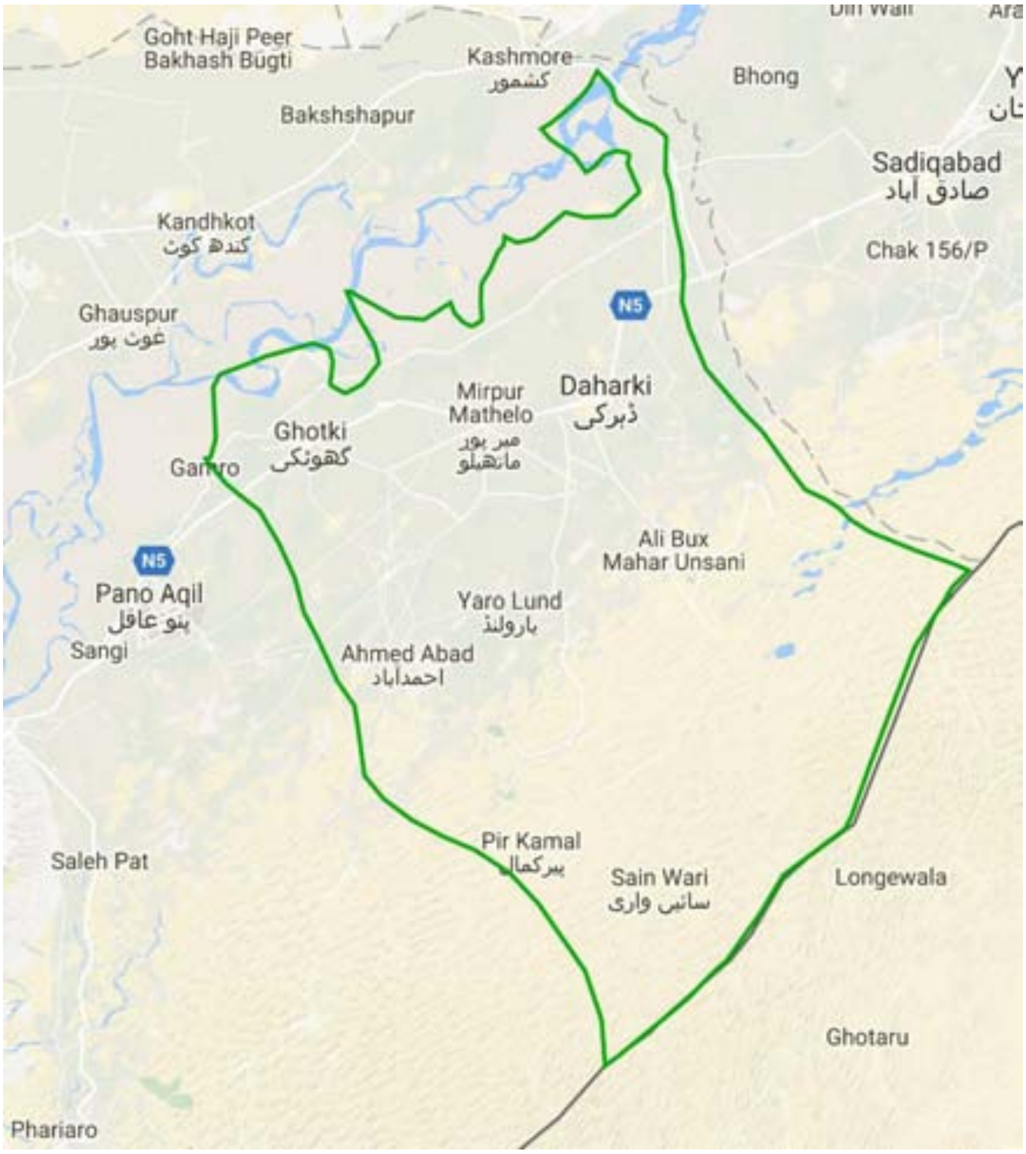

Figure 3.2: District Ghotki Geographical Map

District Sukkur

District Sukkur lies in 68° 35' 30" to 690 48' 0" east longitudes and 27° 04' 0" to 28° 02' 15" north latitudes. This district is bounded by district Ghotki and India on the east, district Kashmore on the north, district Shikarpur on the north-west, and district Khairpur on the west and south. Indus River flows on the north-western side of this district. Sukkur is the narrowest art of the Indus River course.

The land cover structure of this district comprises of the irrigated croplands on the western and northern side and barren areas in the east. On the western and northern side of the district, due to Indus River, the plane lands are fertile and are ideal for cultivation. But on the eastern side, large tracks of barren lands are prevalent, particularly in the union councils of Tarai and Lal Juryo Khan Shambani. On the southern part of this district, both vegetation and barren lands can be seen.

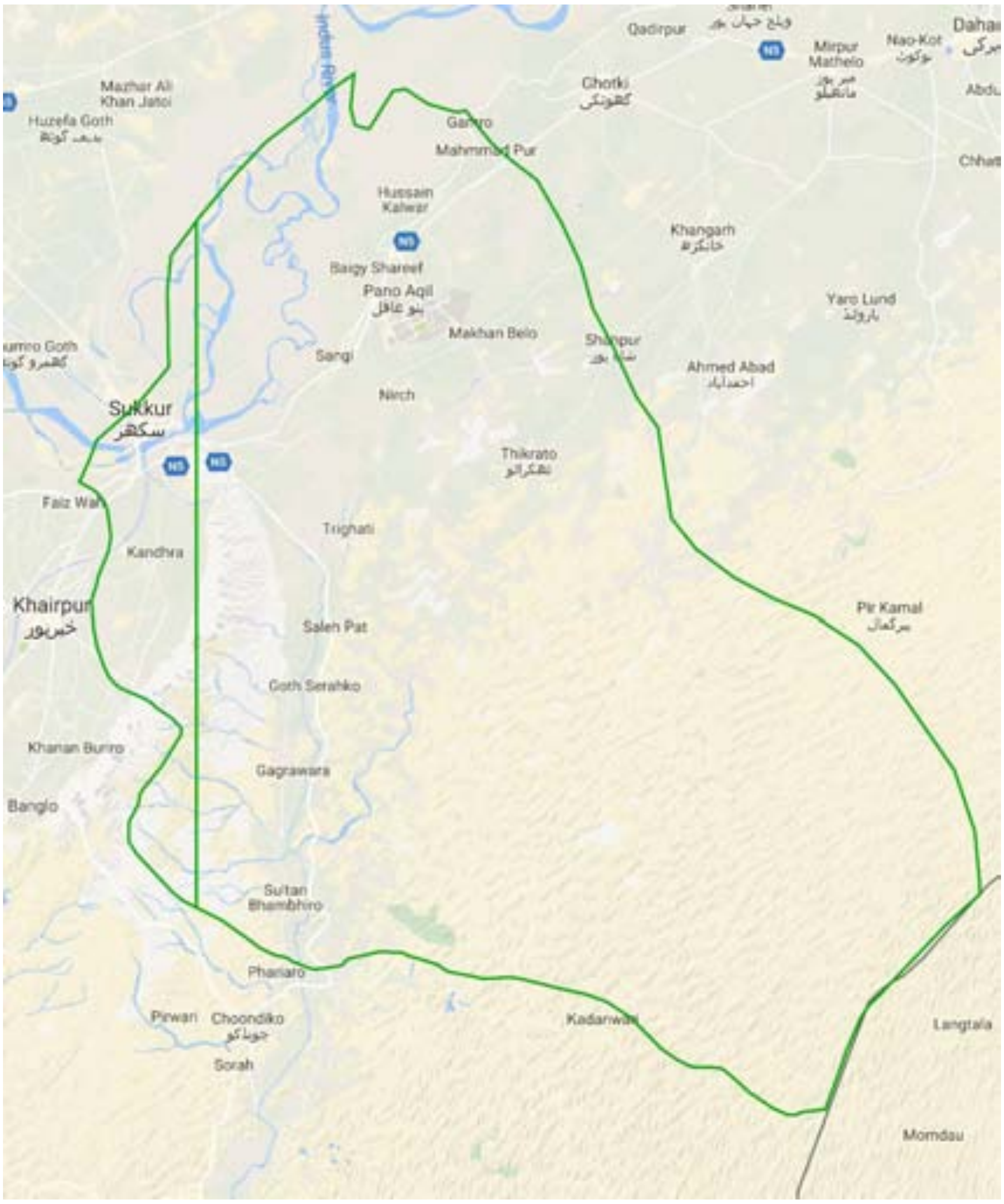

Figure 3.3: District Sukkur Geographical Map

District Khairpur

Khairpur district is located in north-eastern Sindh and is bounded on the north by Shikarpur and Sukkur, on the east by India, on the south by Sanghar and Shaheed Benazirabad and on the west by Larkana and Naushahro Feroze. The district lies from 68° 10’ to 70° 10’ east longitude and 26° 9’ to 27° 42’ north Latitude.

Figure 3.4: District Khairpur Geographical Map

District Naushahro Feroze

District Naushahro Feroze lies in 67° 48’ 2” to 68° 26’ 51” east longitudes and 26° 32’ 45” to 27° 13’ 36” north latitudes. This district is bounded by district Khairpur on the east, district Larkana on the north, district Dadu on the west, and district Jamshoro and Shaheed Benazirabad on the south. Indus Rivers flows alongside the western boundary of the district.

The land structure of this district comprises of plain fertile lands suitable for agriculture. Due to a well-organized canal system and proximity of Indus River, the whole district has irrigation facility resulting in the grasslands and irrigated crop lands.

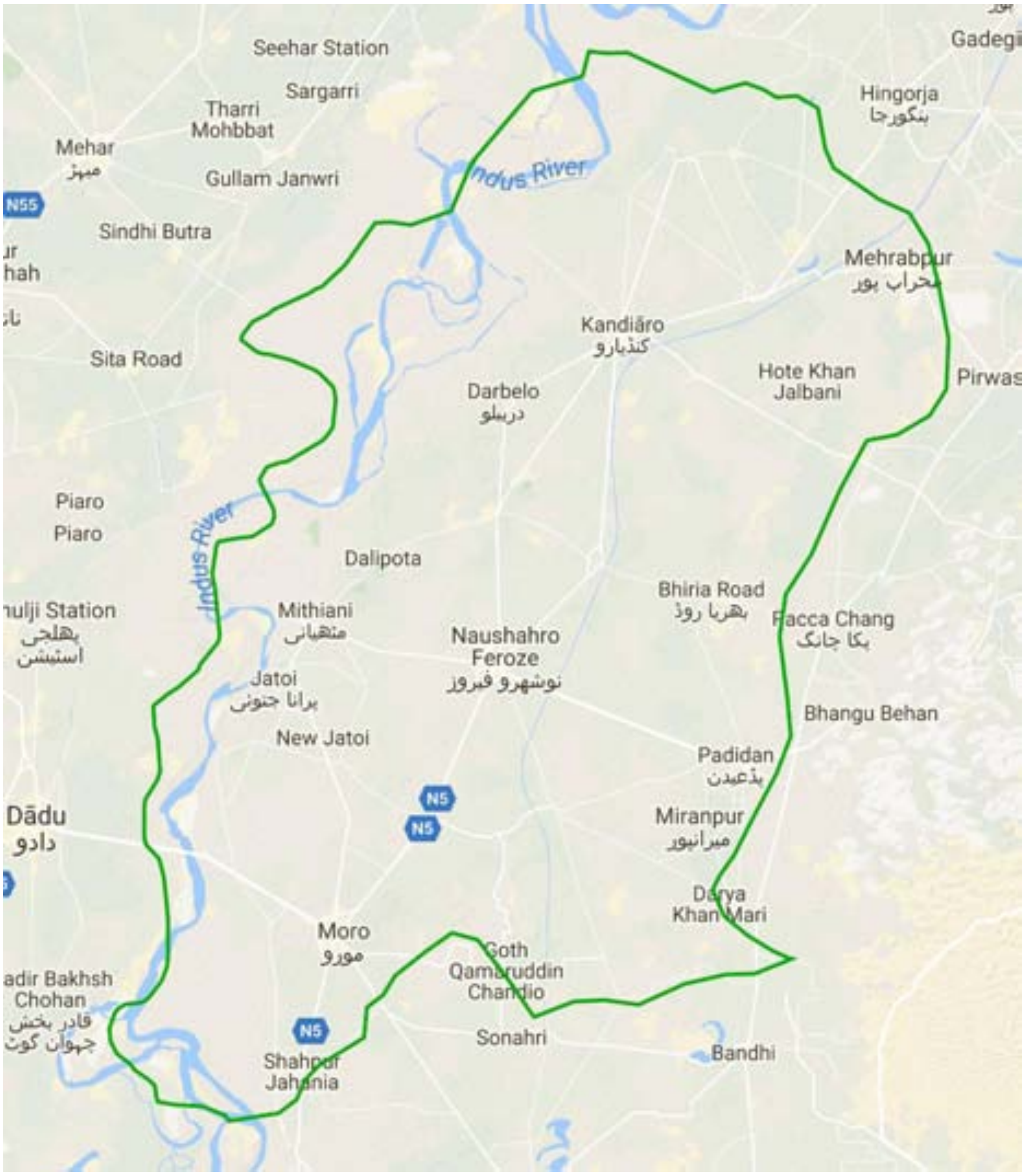

Figure 3.5: District Naushahro Feroze Geographical Map

District Shaheed Benazirabad

The district lies in 67° 52’ to 68° 27’ 2” east longitudes to 25° 59” to 26° 38’ 5” north latitudes. The district is bounded by district Khairpur and Sanghar on the east, district Jamshoro on the west, district Khairpur and Naushahro Feroze on the north and district Matiari on the south.

This district is located in the center of the Sindh province of Pakistan, and is therefore commonly known as the heart of Sindh. Indus River flows on the left bank of the district. Total geographical area of the district is 451,000 hectares[5]. The land structure of this district can be divided into three parts. First, on the northern side of the district is the kacha (the lands alongside the Indus River), these lands are very fertile but are prone to riverine floods. Second, the central and major part of the district comprises of the irrigated cultivable

[5] Sindh Development Statistics, (2008), Lahore University of Management Sciences (LUMS), pp.75

lands. This area consists of very productive agricultural land. Third, the eastern part of the district that comprises of the barren desert lands in Daur taluka.

Figure 3.6: District Shaheed Benazirabad Geographical Map

District Matiari

The district lies in 68° 14’ 8” to 68° 14’ 40” east longitudes to 25°26’20” to 26°05’43” north latitudes. The district is bounded by district Sanghar on the east, district Jamshoro on the west, district Shaheed Benazirabad on the north and district Hyderabad and Tando Allah Yar on the south.

The whole district is irrigated through canals and the river. The plane lands of Matiari are very fertile and productive. Indus River flows alongside the western border of the district. The lands along the river are formed of silt and sandy loam. Being in the Indus basin, this district has hardly any barren lands. Only a few lands (as seen in the irrigation map below) are barren while the rest are quite fertile croplands.

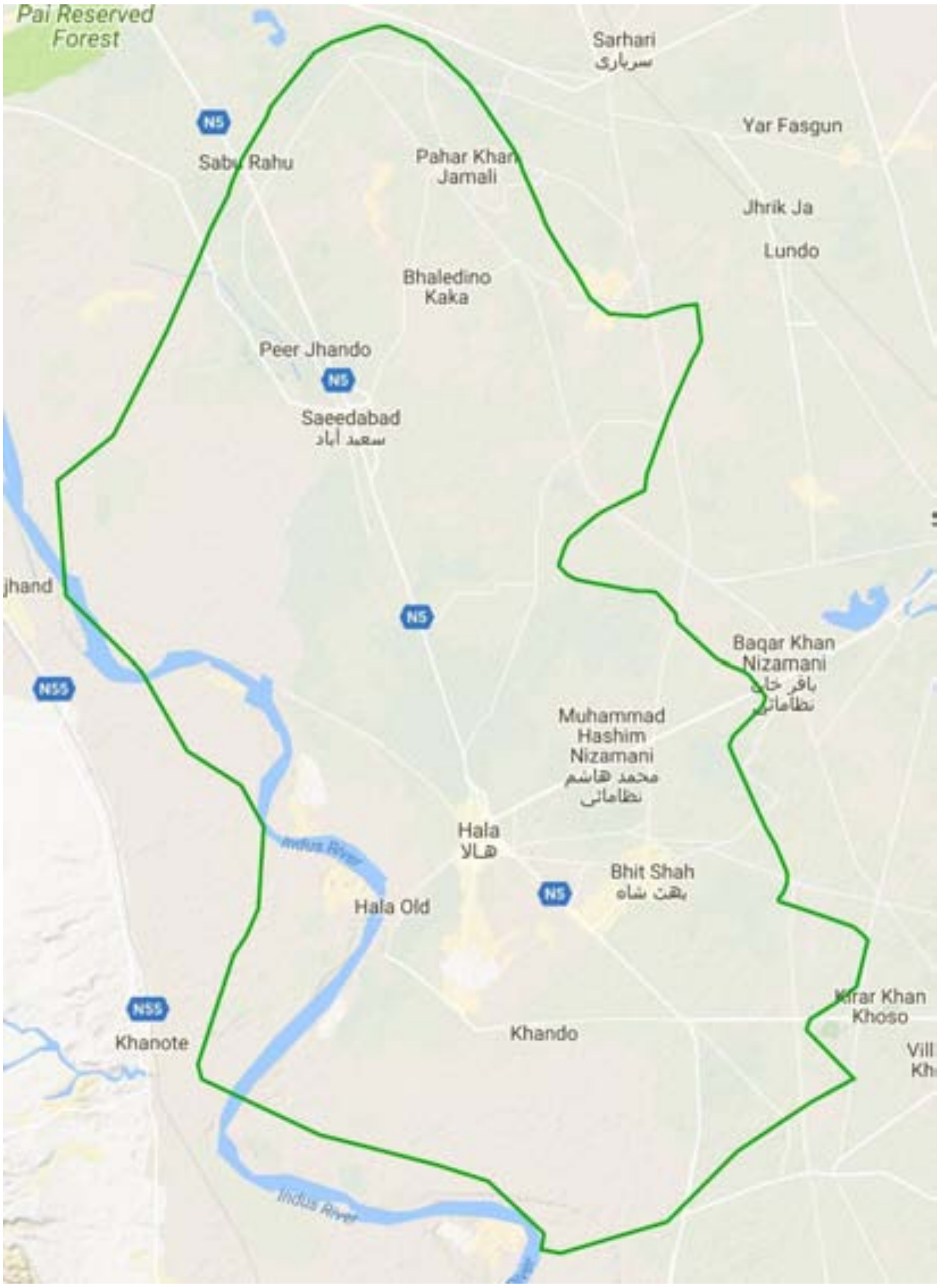

Figure 3.7: District Matiari Geographical Map

District Tando Allah Yar

District Tando Allah Yar lies in 68° 34’ 23” to 68° 57’ 35” east longitudes and 25° 12’ 24” to 25° 45’ 17” north latitudes. This district is bounded by district Mirpurkhas on the east, district Sanghar on the north, district Hyderabad and Matiari on the west and district Tando Muhammad Khan & Badin on the south.

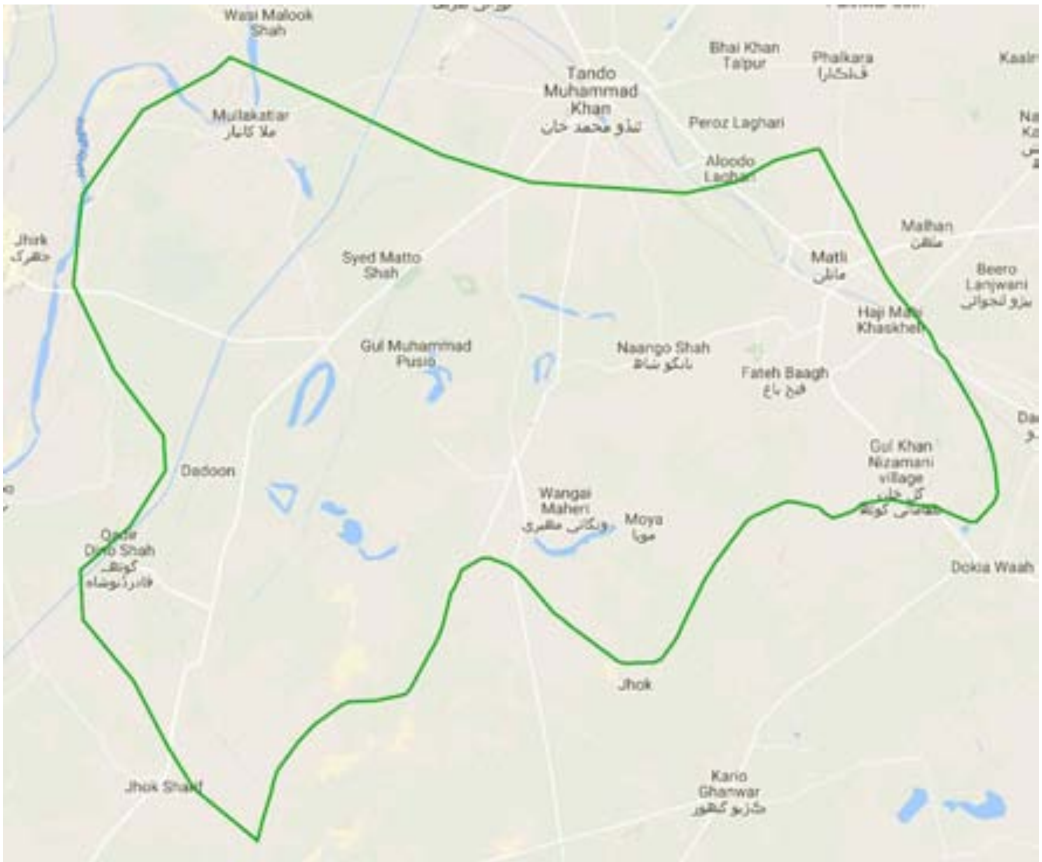

Figure 3.8: District Tando Allah Yar Geographical Map

District Hyderabad

District Hyderabad lies in 680 17" 26' to 680 38" 26' east longitudes and 240 9" 26' to 250 33" 7' north latitudes. This district is bounded by district Tando Allah Yar and Tando Muhammad Khan on the east, district Matiari on the north, district Jamshoro on the northwest, district Thatta on the south-west, and district Tando Muhammad Khan on the south. Indus River flows along the western border of this district.

District Hyderabad is a part of the lower Indus plain. There are no mountains or hills and the soil surface is uniform. The land cover structure of this district comprises of the irrigated croplands with an average altitude of 50 meters above the sea level. The efficient canal system, combined with availability of water from Indus River, enhances the agriculture productivity of this district. Except for the populated areas, particularly the area of Hyderabad city, the remaining parts of the district are fertile and irrigated.

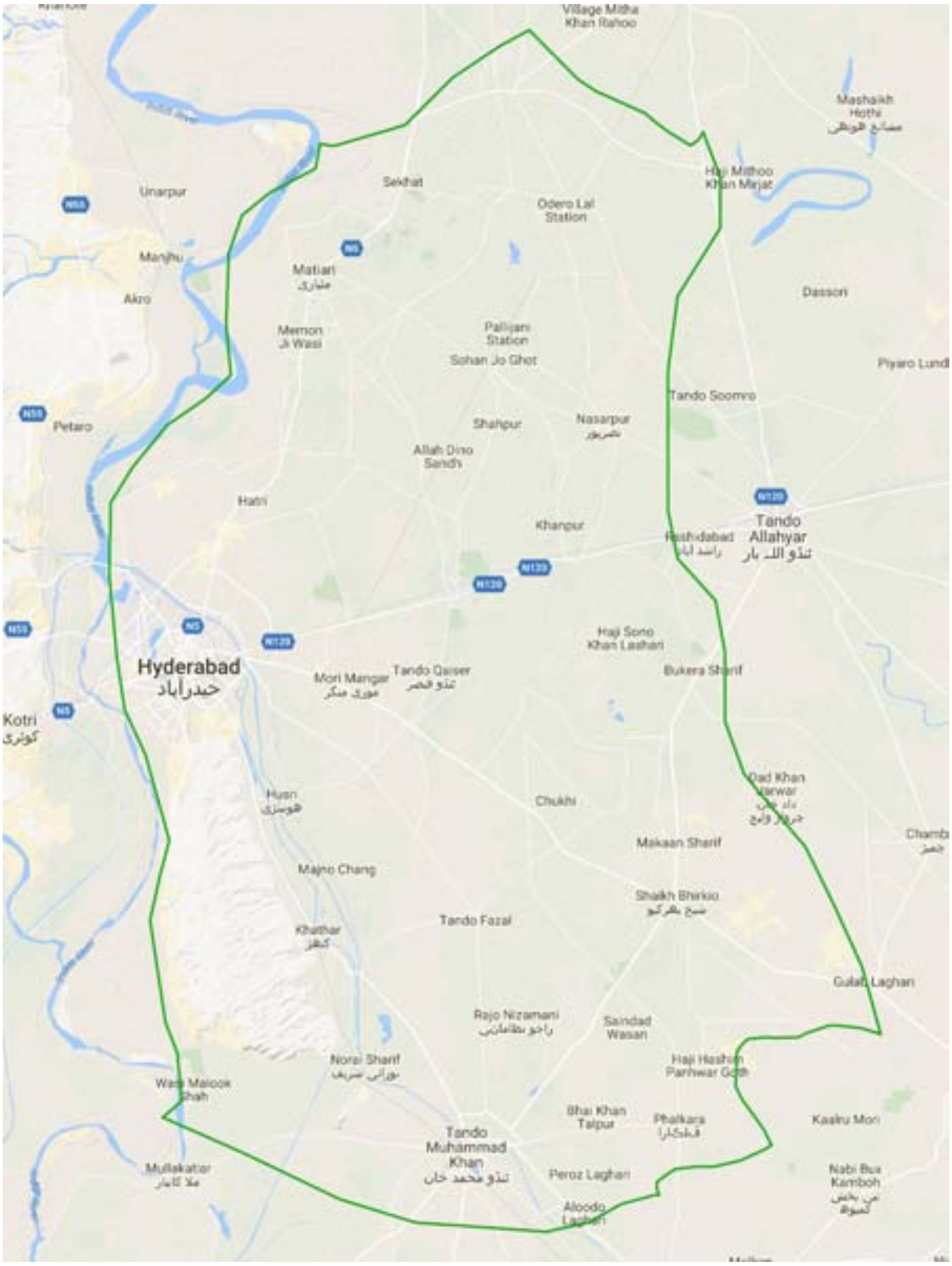

Figure 3.9: District Hyderabad Geographical Map

Karachi Division

District Karachi lies in 66° 39’ 25” to 67° 34’ 55” east longitudes and 24° 45’ 33” to 25° 38’ 32” north latitudes. This district is bounded by district Jamshoro and district Thatta on the east and north-east, district Lasbela on the west and north-west, and Arabian Sea is spread over the southern part of the district. It is the largest city of Pakistan located in the south-eastern part of the country.

Karachi is located on the coast of the Arabian Sea. The city covers an area of approximately 3,527 square kilometers. It can be broadly divided into two parts; the hilly areas in the north and west and a rolling plain and coastal area in the south-east. The hills in Karachi are the off-shoots of the Kirthar Range Mountains.

The highest point of these hills in Karachi is about 528 meters in the extreme north. All these hills are devoid of vegetation and have wide intervening plains, dry river beds and water channels. Karachi has a long coastline in the south. The famous sea beaches include Hawks Bay, Paradise Point, Sands Pit, and Clifton. China Creek and Korangi Creek provide excellent calm water channels for rowing and other water activities. Away from the shoreline are small islands including Shamsh Pir, Baba Bhit, Bunker, Salehabad and Manora9. Two rivers pass through the city: the River Malir which flows from the east towards the south and the River Lyari, which flows from north to the south-west. Dense mangroves forest and creeks of the Indus delta can be found towards the south-east side of the city. Towards the west and the north is Cape Monze, an area marked with sea cliffs and rocky sandstone promontories.

Figure 3.10: Karachi Division Geographical Map

3.1.2. Geology & Soil Morphology

The geology of Sindh is divisible in three main regions, the mountain ranges of Kirthar, Pab containing a chain of minor hills in the west and in east it is covered by the Thar Desert and part of Indian Platform where the main exposure is of Karonjhar Mountains, which is famous for Nagarparkar Granite. In the north Sindh is enquired by rocks of Laki range extending to Suleiman range and its southern most part is encircled by the Arabian Sea. The rocks exposed in this area belong to upper Cretaceous which is recent in age. The sub-surface rocks are about 20,000 feet thick and belong to Cretaceous and Pre-Cretaceous periods. Mostly the rocks are of sedimentary origin of clastic and non-clastic nature and belong to marine, partly marine and fluviatile depositional environments.

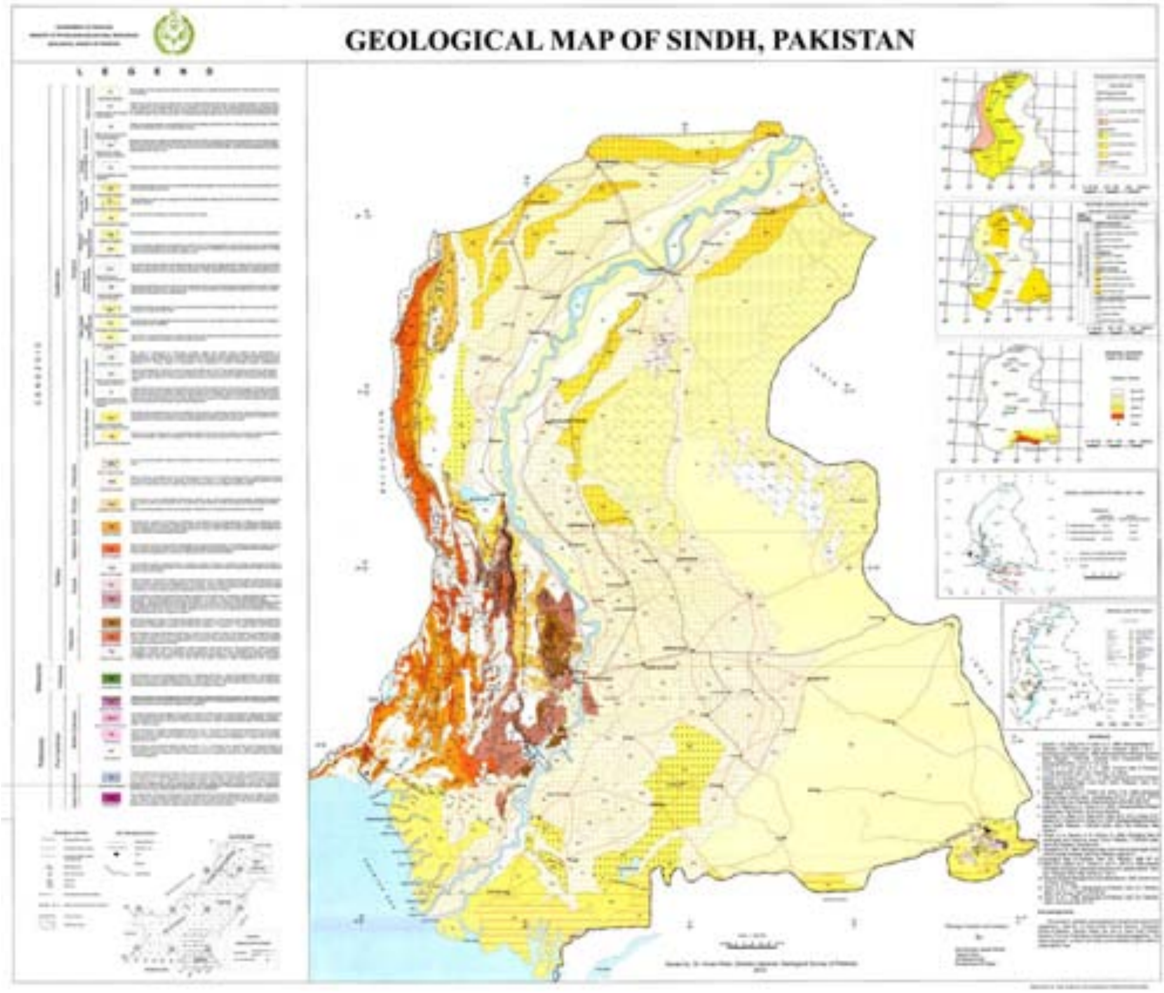

Figure 3.11: Geological Map of Sindh (Source: Geological Survey of Pakistan)

Large quantitative of sediments is brought by Indus River and is deposited along the Indus River banks and especially in the deltaic zone. Further hill torrents also bring silt and clay deposits in the lower reaches. These silts provide a highly fertile layer of soil to the region. The soils along the Indus River banks are silt and sandy loam. Outside the active flood plain, the soils are generally calcareous, loamy and silty clay. Most of the soils in the district of Thar are sandy. Moving sand dunes are also found in these districts. In Tharparkar area, the undulating flat plain is covered with variable soils mainly derived by erosion and residual weathering of the granites, granite gneisses and amphibolite's. While in the case of Dadu and Jamshoro, the soils in the plain near to subproject sites have homogenous porous structure, mainly silt and fine silt clayey, strongly calcareous with 18-20 % lime content uniformly distributed in the profile. Small patches contain shallow or very shallow, strongly calcareous, gravely and stony loams. While the soils afford very sparse shrub and grass vegetation offering limited grazing, the rocky outcrop only has a water catchment value.

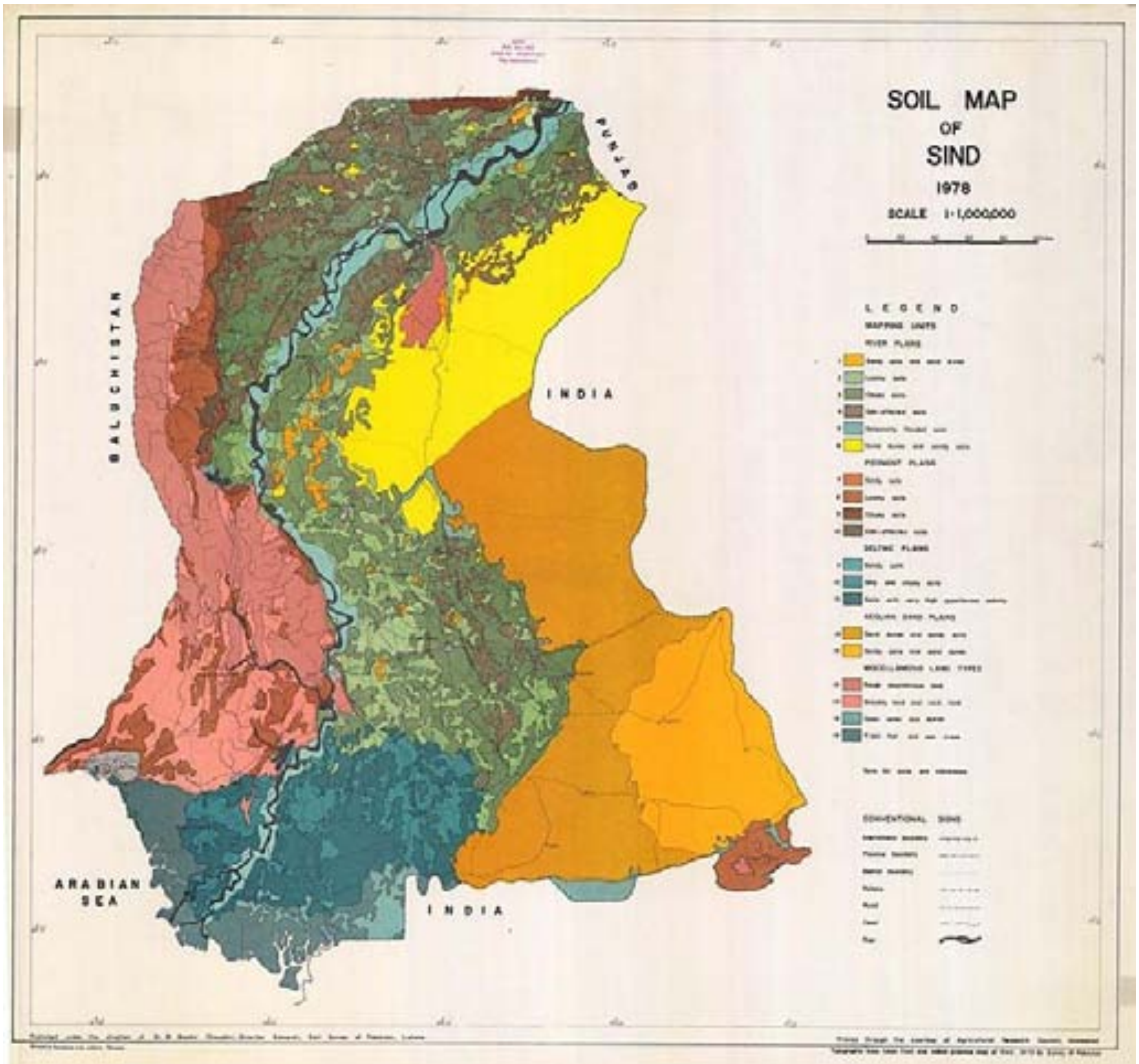

Figure 3.12: Soil Map of Sindh[6]

District Ghotki

Geologically Ghotki is formed of sedimentary & volcanic rocks of quaternary type (Atlas of Pakistan). Ghotki can be divided into three broader zones. The area lying in the vicinity of River Indus is part of Indus's active flood plain. Next to this is the area irrigated by a network of canals. A main canal Ghotki feeder flows through the district. This zone is part of Indus's old flood plain, is quite fertile and remains under year long cultivation. The eastern portion of the district is desert that forms part of Nara and eastern desert zone of Pakistan.

The soils of Ghotki are divided into three broader categories;

1. Loamy and some sandy stratified soils of young flood plains,
2. Loamy and clayey soils of older river plains,
3. Rolling to hilly sandy soils of aeolian deserts.

[6] Survey of Pakistan 1978

District Sukkur

Sukkur district forms a vast alluvial plain, broken only at Sukkur and Rohri by low limestone hills, which tend to preserve a permanent bank for the Indus at those places. Large patches of salt land (Kalar) occur frequently, especially in the upper part of the district. The desert portion of the Rohri sub-division, known as the Ragistan, possesses extensive sand hills. There are no hills in the district except the low range on the northern extremity, of which Sukkur and Rohri are built and which runs southward from the point to Khairpur district boundary. They are extended for some 45 kilometers into that district spreading out to a width of 27 kilometers. Their highest elevation is about 24 meters above mean sea level. They are nummulitic limestone and belong to the same group as the Khairpur range to which they resemble in their rugged and barren aspect. There are four prominent hills, namely "Adam Shah" hill near Sukkur, "Kalka" hill at Aror, "Laheri" hill at Rohri and "Shadi Shaheed" hill at Kandhra hill.

Soils of the Sukkur district are generally loamy, clayey and seasonally flooded soils. The Rohri hills area is designated as rough mountainous land. The soils of the area are each different characteristic. These are Latiari-a soil formed from the silt of inundation; Tanak-the hard soil left by repeated inundation; Thariari-a crooked soil, often seen near the river with great cracks in it; Gesari- dusty soil; Pat-a good soil and wariasi-sand soil; Sailabi- the heavily saturated soil with moisture which requires no water from seed time to harvest.

District Khairpur

Geologically major portion of Khairpur is formed of sedimentary & volcanic rocks of quaternary type while a tiny portion in the north is of tertiary type (Atlas of Pakistan). Khairpur can be divided into three broader zones. The area lying in the vicinity of River Indus is part of Indus's active flood plain. Next to this is the area irrigated by a network of canals. Four main canals pass through the district including Khairpur West, Rohri, Khairpur East and Nara canals. This zone is part of Indus's old flood plain, is quite fertile and remains under yearlong cultivation. Major area of the district is under the desert zone called Nara (Piedmont plains) that makes part of the eastern desert zone of Pakistan. It is placed between Cholistan in Punjab and Thar in Sindh. The north-western part of Nara is composed of a series of low lying hills/ridges (100 m high) of limestone that run for 45 km from north east to south east.

The soils of Khairpur can be divided into four broader types:

1. Loamy and some stratified soils of young flood plains.
2. Loamy and clayey soils of older river plains.
3. Rock outcrops with very patchy cover of heterogeneous soil material of the western mountainous region.
4. Rolling to hilly sandy soils of aeolian deserts.

In terms of natural vegetation tropical thorn (or rakh) is found in the active and old flood plain of Indus while desert (desertic and semi-desertic) vegetation is found in the Nara zone.

District Tando Allah Yar

The Eocene limestone underlies the entire lower Indus plain. It was deposited in a shallow sea, a remnant of the ancient Tethys Sea, which finally disappeared as a result of the gradual merging of the Indian plate into the Eurasian plate and the subsequent formation of the Himalayan mountain range.

The soils of Tando Allah Yar can be classified as Loamy and clayey soils of older river plains.

District Naushahro Feroze

The area lying in the vicinity of River Indus is part of Indus's active flood plain. Next to this is the area irrigated by a network of canals. The area is alluvial flood plains of Indus and lies in central part of lower Indus basin which form part of western passive continental margin of Indian plate.

The soils of Naushahro Feroze can be divided into four broader types:

1. Loamy and some stratified soils of young flood plains.
2. Loamy and clayey soils of older river plains.
3. Very patchy cover of sandy soils and sand dunes
4. Salt affected soil

District Shaheed Benazirabad

Shaheed Benazirabad lies in central part of lower Indus basin which form part of western passive continental margin of Indian plate. From Paleozoic to Triassic, Indian plate was an integral part of Pangaea. It was during early Jurassic that Indian plate initially began to break up from southern Africa. However, its separation from Madagascar began in early createaceous while it started to drift northwards in late createaceous. In early Paleocene (60 MY) Indian plate rotated counter clockwise and raced northwards at an accelerated pace (15-20 CM/Year). By late Eocene (40 MY) Tethys sea began to close as initial collision between India and Eurasia began. Full scale collision came about during mid-tertiary (about 20MY) which continues till today.

Originally soil of the area is made of alluvial deposits having various proportions of sand, silt and clay at different places. When irrigated with canal water, the soil had been partly modified through addition of sediments such as silt and at times clay. The soils of Shaheed Benazirabad can be divided into four broader types:

1. Loamy and some stratified soils of young flood plains.
2. Loamy and clayey soils of older river plains.
3. Very patchy cover of sandy soils and sand dunes
4. Sand dunes and sandy soils

District Matiari

Geologically, the section of the district Matiari, forms part of the Southern Indus Basin that is located south of the Sukkur Rift and west of the Indus synclinorium. It is at the head of the Indus of the region from where the deltaic activities are initiated and the meandering of the plain slows down.

The soil of the district is generally loamy and clayey and has been formed from Indus River alluvial deposits. Agricultural soils in the Project area are associated with irrigation and dry land agriculture and hence are fine in texture, rich in organic matter and nutrients as a result of their history of cropping, ploughing and fertilizer additions.

District Hyderabad

Geologically and geographically Hyderabad district is divided into two parts:

(i) The Ganjo Taker hills, which are an out-crop of the Kirthar lime-stone, and are seen around Hyderabad. The hills extend below the ground to a considerable area. An extension of similar rocks was located at Badin, at the depth of 950', by Standard Vaccum Oil Co, while drilling for oil, a few years back.

(ii) Recent and sub-recent alluvial formations, which cover rest of the district. The Laki formation of Early Eocene (Ypresian) age was divided by Nuttall 1925 into four subdivisions descending: (1) the Laki Limestone Member, the meting Shale Members (2) The meting Shale Member, (3) The Meting Limestone Member, and (4) the Sohnari Member (Basal Laki laterite) This report concentrates on the upper units, the Laki Limestone and Meting Shale Members. These units are well exposed along the Ganjo Takkar bluffs and form steep slopes, especially in the Laki Limestone Member. Rocks in the Laki Formation are predominantly marly limestone and claystone with thin beds of sandstone and lateritic clay stone. Both the clay stone and the limestone have abundant megafossils and microfossils, with the foraminifers Alveolona sp. being common.

Hyderabad is blessed with a unique landscape spectacular rock formations which are about 2,500 million years old; amongst the oldest and hardest rocks in the world. Rocky and hilly regions around the city are under obliteration for urbanization. Granite ridges and hillocks weathered into picturesque balancing forms are a part of the Deccan Shield area. Grey and Pink Granites are among the world's oldest. Crops are commonly grown in the surrounding paddy fields. The city’s soil type is mainly red sandy with areas of black cotton soil.

District Karachi

Karachi and adjoining areas have plains, hills, rivers, valleys and coasts as diversified physical features. Rocks ranging in age from Eocene to recent, deposited under shallow marine to deltaic conditions are exposed. Karachi is a part of major synclinorium stretching from Ranpathani River in the east to Cape Monze in the west. Mehar and Mol mountains lie in the north. Within the synclinorium a number of structures such as Pipri, Gulistan-e-Jauhar, PirMangho and Cape Monze are exposed. The presence of concealed structures under the Malir River Valley, Gadap and Mauripur plains can fairly be deduced (GSP, 2001).

The geology of Karachi consists of sedimentary rocks having two ranges known as Kirthar range and Pub range. The soil of Karachi city are classified into two types, the loamy sandy and gravelly soils of river valleys and alluvial cones near the coast line and shallow loamy gravelly soils and rock outcrops plateau.

The soil types in Port Qasim are highly pervious with low water bearing and moisture retention capacities. The soil is typical of a semi-arid region, in which little pedogenesis and profile development have taken place. The soil horizon is poorly developed or are very shallow, and very little leaching has taken place. The soil may be classified as alluvial soil. Most of the soil have undergone very little leaching in their formation. There is also addition of wind-blown material at some places. The soil is generally low in organic matter, nitrogen and humus, and clay colloidal matter is very low or absent. Soil is poor in major and micro nutrients with low fertility.

The soil composition is also fairly homogeneous without anomalies. Soil up to 25m is composed of medium to coarse sand with fine gravel. Standard Penetration Test (SPT) 1values indicate that the soil dense to very dense. The presence of a clay layer at about 26m has been found, which is quite hard. As there is no ground water and little moisture, this layer is consolidated. Below this layer of clay there is again a medium to coarse sand layer with some clay. This layer is also very dense with a high SPT value.

3.1.3. Soils Surface Salinity Status of Left Bank area

Command wise surface salinity status was observed during the S&R studies conducted by WAPDA Water Wing Scarp Monitoring Organization (SMO) South in 2005 which is shown in Table-3.1.

Total four categories namely Non-saline, slightly saline, moderately saline and strongly saline were recognized. These classes are briefly described as under.

Table 3.1: Left Bank Command Wise Salinity Status of the Area

S. No	Main Canal (in Project District)	Area, in acres	Salinity class-ECe dS/m @25°C (% of area)				Miscellaneous area total
			Non Saline 0-4	Slightly saline 4-8	Moderately saline 8-15	Strongly saline 15	
1.	Ghotki feeder (in Ghotki, Sukkur and Khairpur)	984795	73	6.0	3.0	9.0	9.0
2.	Nara canal (in Sukkur and Khairpur)	2431394	29	23	10	33	5.0
3.	Rohri canal (in Shaheed Benazirabad, Tando Allah Yar, Hyderabad, Naushahro Feroze & Khairpur)	998588	57	22	6.0	9.5	5.5
4.	Khairpur feeder west (in Khairpur)	300,000	72	13	4.0	4.0	7.0
5.	Khairpur feeder east (in Khairpur)	506,000	61	17	7.0	6.0	9.0
6.	Fuleli (in Hyderabad)	1045651	44	21	10	20	5.0
7.	Lined channel Akram Wah (in Hyderabad)	531965	27	23	15	22	13
	Total area of left bank command	*6798393*	*52*	*18*	*7.8*	*14.8*	*7.6*

3.1.3.1. Non Saline:

There are no visible salts on the soil surface and plant growth is not affected by salinity, this type of area covers about 48 percent of the total area in Left Bank.

3.1.3.2. Slightly Saline:

Plant growth is uneven patchy, salts are mostly present in patches and cover about 18 percent of the total area.

3.1.3.3. Moderately Saline:

Salts are fairly visible on the soil surface and growth of plants is affected and covers 7.5 percent of the total area.

3.1.3.4. Strongly Saline:

There is no cultivation except some salt loving natural vegetation. Mostly this area is lying abandoned and covers about 18 percent of the total area.

3.1.3.5. Miscellaneous Land type:

This is most important unit and includes built up area like cities, town, road, railway, canal drains and Industrial areas. It covers about 8.5 percent of the area.

3.1.4. Seismicity

The major active faults in the province are as under:

Fault Name	Trending	Features	Maximum magnitude on Richter Scale
Surjan Fault	N-S	Located in the west of Larkana, it cuts Quaternary deposits	M=6.1
Pab Fault	NN-W	The fault is located in the eastern part of Pab range	
Jhimpir Fault	N-W	A number of epicenters are located on the fault	M=5.6
Rann of Kutch	E-W	Recent studies have revealed that this fault traverses the Karachi Metropolitan Area.	M=7.6

The Seismic zoning map of Pakistan (2015) places AAP districts except Karachi Division in Zone 2A which corresponds to peak ground acceleration (PGA(g)) of 0.08 to 0.16 and Karachi in Zone 2B having PGA(g) of 0.16 to 0.24.

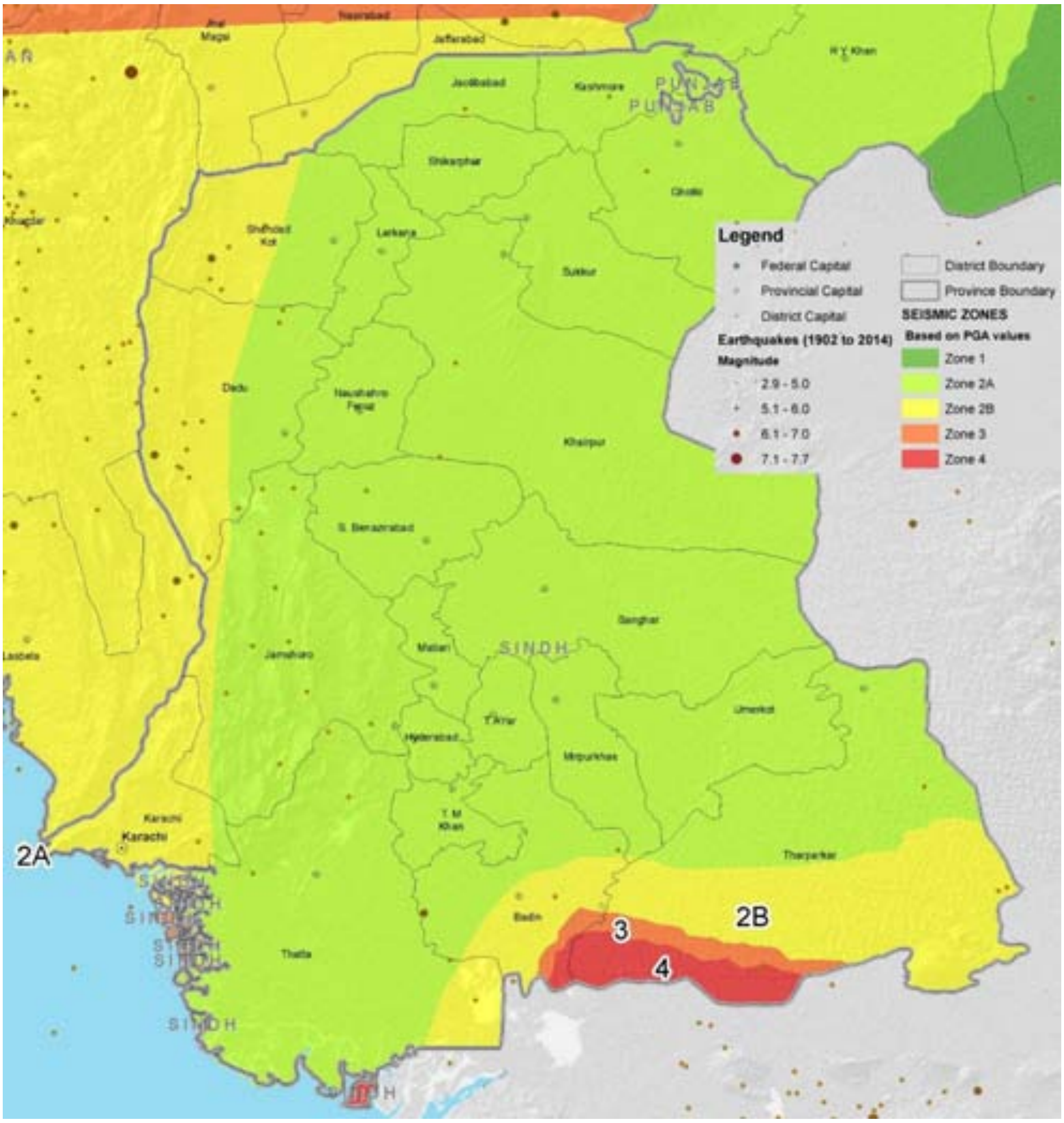

Figure 3.13: Seismic Zoning Map of Sindh including AAP districts

3.1.5. Surface Hydrology

The Indus River is the major source of surface water in the province. There are canals drawn from the rivers and a number of wetlands also exist in the province. Sindh is one of the primary beneficiaries of the Indus Basin Irrigation System (IBIS). It has three major barrages on the Indus River that divert approximately 48 million acre feet (MAF or 59.0 billion cubic meters- BCM) of water annually to the 14 main canal commands in Sindh. These canal systems have an aggregate length of 13,325 miles (21,445 km), which serve a gross command area (GCA) of 14.391 million acres (5.8million ha). There are about 42,000 watercourses (tertiary channels), which have an aggregate length of about 75,000 miles (120,000 Km). Surface and sub-surface drainage systems are inadequate, resulting in much of the drainage effluent being either retained in the basin or disposed into rivers and canals. There are 13 existing surface drainage systems in Sindh, which serve a total area of over 6.2 million acres (2.5 million hectares) and have an aggregate length of about 3,811 miles (6,133 Km). In addition, there are two sub-surface drainage systems, which serve an area of 0.10 million acres (0.04million ha). Due to inadequate drainage cover, nearly one-fifth of the canal command areas have been affected by water logging and salinity.

Tando Allahyar District

The district consists of flat and fertile lands. It has an efficient canal system, which ensures agriculture productivity. Naseer Canal runs through the district and irrigates most of the district lands through a network of branch canals and water courses. Branch canals of Khesana Canal irrigate the western part of the district. The total irrigated area of the district is 72,746 hectares in which the canal irrigated area is 48,117 hectares. 85 out of 86 mouzas are irrigated with the help of canals[7].

Figure 3.14: Tando Allah Yar district surface water resources

[7] Pakistan Emergency Situational Analysis, A profile of District Tando Allahyar

Ghotki District

River Indus flows along the western border of the district and its direction of flow is from northeast to south-west. Ghotki feeder and Rani canal are two canals in the district that are fed by Guddu barrage. Ghotki feeder has design capacity to irrigate an area of around 300,000 hectares. [8]Annual Water entitlement of Ghotki Feeder Canal is 3.484 MAF (Million acre feet). [9]While district also has a network of smaller canals (known as Wah) namely Dingro Wah, Lundi Wah, Masu Wah, Jam Wah, Dahar Wah Lower, Imam Wah, Sehar Wah, Qazi Wah, and Bago Wah etc. These smaller canals or Wahs further split into minor canals. Out of the 275 rural mouzas, 267 have canal irrigation and 158 have tube wells as well[10].

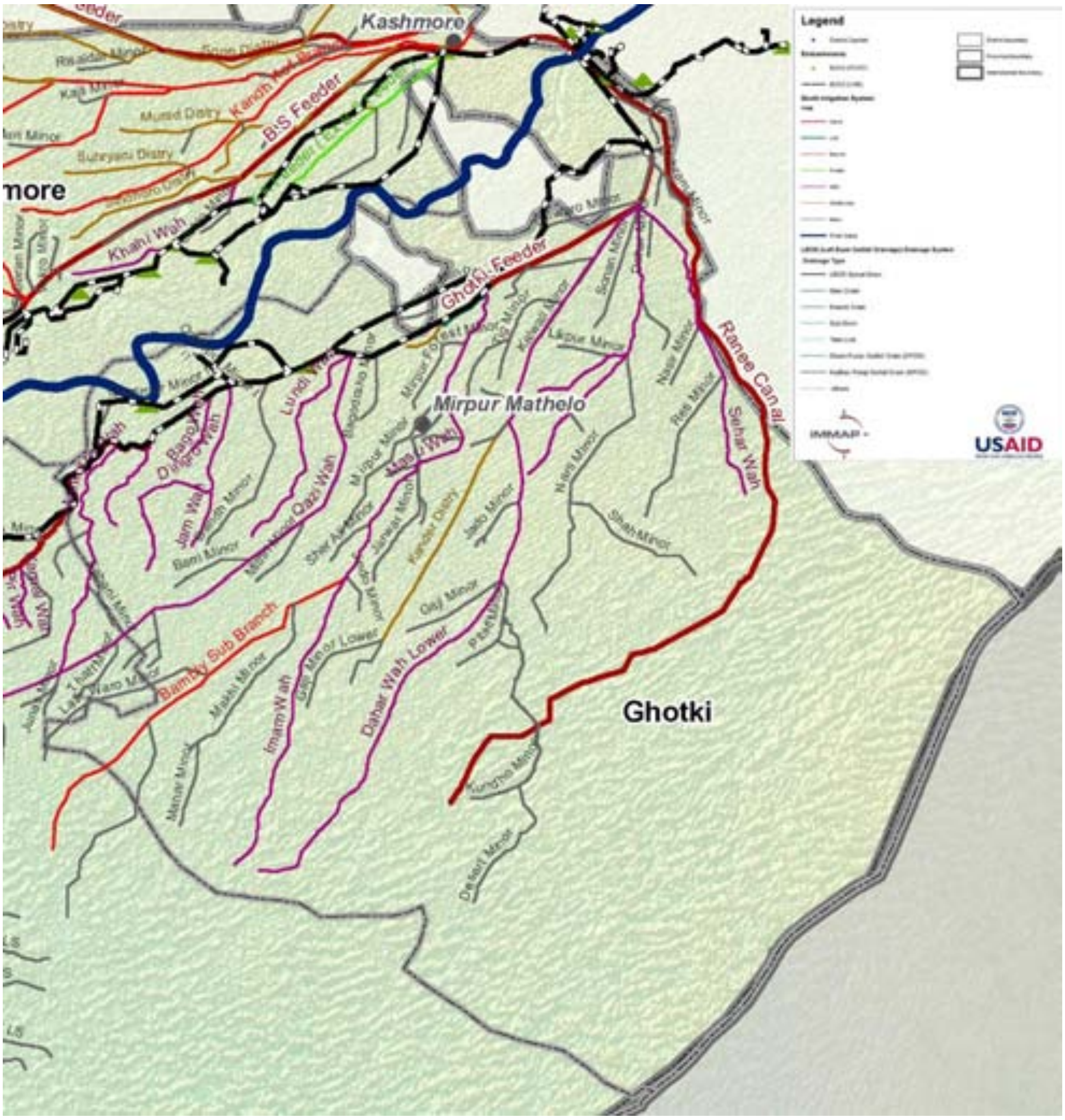

Figure 3.15: Ghotki district surface water resources

[8] http://www.lbcawb.org/introduction/
[9] Sindh Water Sector Improvement Phase-I Project
[10] Pakistan Emergency Situational Analysis, A profile of District Ghotki

Sukkur District

Indus River flows on the north-western side of this district. Sukkur is the narrowest part of the Indus River course. Khairpur East Canal; Khairpur West Canal; Rohri Canal and; Nara Canal branch out from Sukkur Barrage. Sukkur barrage commands an area of about 3 million hectares. Nara canal is the major source of water for Sukkur . Several minor canals have been branched out from Nara canal. The irrigation system of the district is partly controlled by the Sukkur Barrage but mainly by the Guddu Barrage. District Sukkur has an efficient canal irrigation system which helps in agriculture productivity. Out of a total of 271 mouzas, 180 are irrigated by canal irrigation system while 83 mousaz are irrigated by tube wells. Annual Water entitlement of Nara Canal is 7.803 MAF.

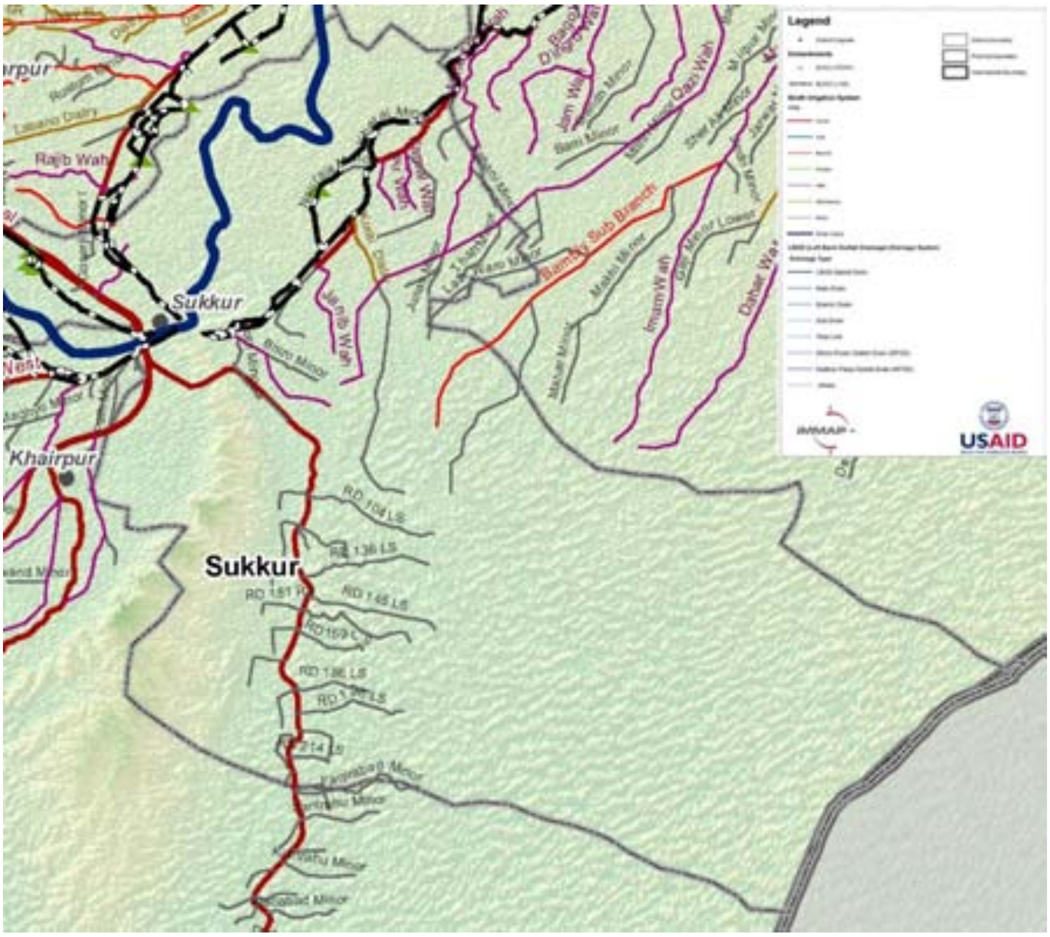

Figure 3.16: Sukkur district surface water resources

Matiari District

The whole district is irrigated through canals and the river. The plane lands of Matiari are very fertile and productive. Indus River flows alongside the western border of the district. The district has a well-established canal irrigation system. With the opening of Rohri canal, emanating from Sukkur barrage. The irrigation system of this district is dependent on two major sources i.e., Rohri Canal and Indus River. Rohri canal, originating from Sukkur barrage, irrigates the eastern lands of this district and while the Indus River irrigates the western parts of the district. Majority of the mouzas are irrigated through canals. Out of the 105 rural mouzas, 94 (90%) are irrigated through canals, and 57 (54%) are irrigated with tube wells. The total irrigated area in the district is 70,747 hectares in which 30,032 hectares are irrigated by canals while 40,715 by tube well[11].

Figure 3.17: Matiari district surface water resources

Khairpur District

District Khairpur has a well-established irrigation system, having Sukkur Barrage as the main source. The names of the main canals and branches are as follows; Khairpur East Canal, Khairpur Feeder West, Dadu Canal, Rice Canal, Eastern Nara Canal, Northwestern Canal, Nara Canal, Rohri Canal, Mir Wah, Palh Wah. River Indus flows along the North western boundary of the district. And three major canals namely Khairpur feeder west, Khairpur feeder East and Nara canal flow through the district. Khairpur feeder west and Khairpur Feeder east are situated in the north western side of the district while Nara canal flows north to south in the middle of the district. Various minor canals branch out from Khairpur feeder east and Khairpur feeder west forming a network of canals. Out of 377 rural mouzas, 355 (94%) are irrigated with the help of canals.

[11] Pakistan Emergency Situational Analysis, A profile of District Matiari

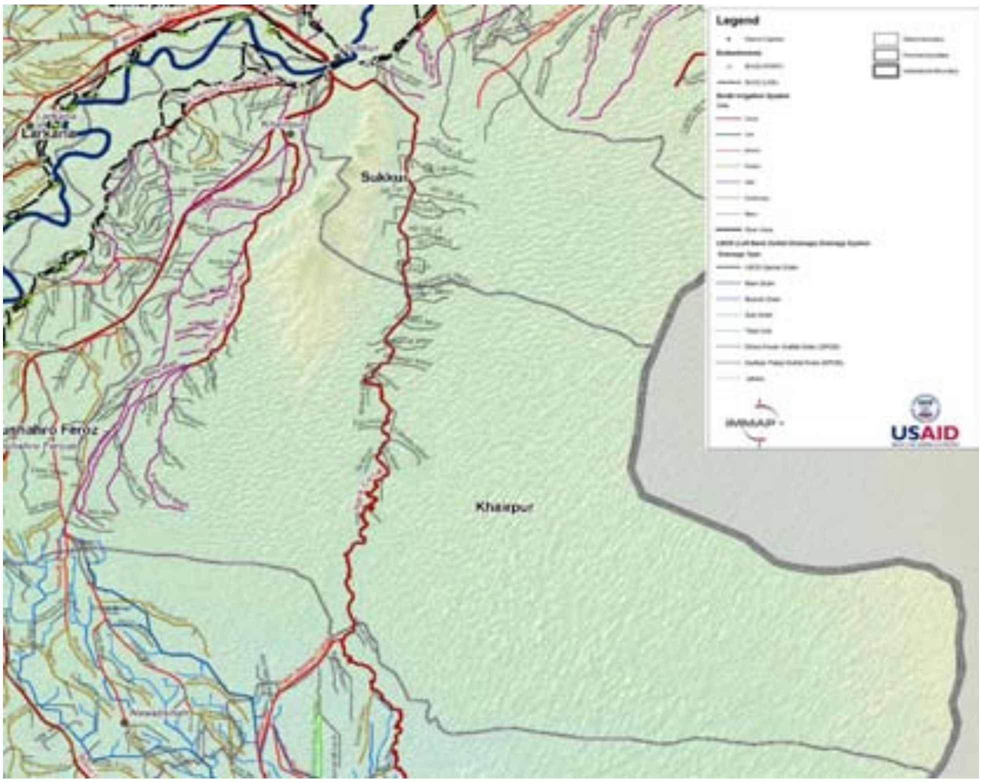

Figure 3.18: Khairpur district surface water resources

Naushahro Feroze District

The district has a well-established canal irrigation system. Rohri canal passes through the center of this district and irrigates the central and eastern parts of the district. Indus River passes alongside the western border of the district. Out of the 221 rural mouzas, 201 (91%) are irrigated with the help of canals. 166 (75%) are irrigated with tube-wells and 52 (24%) are irrigated through river.

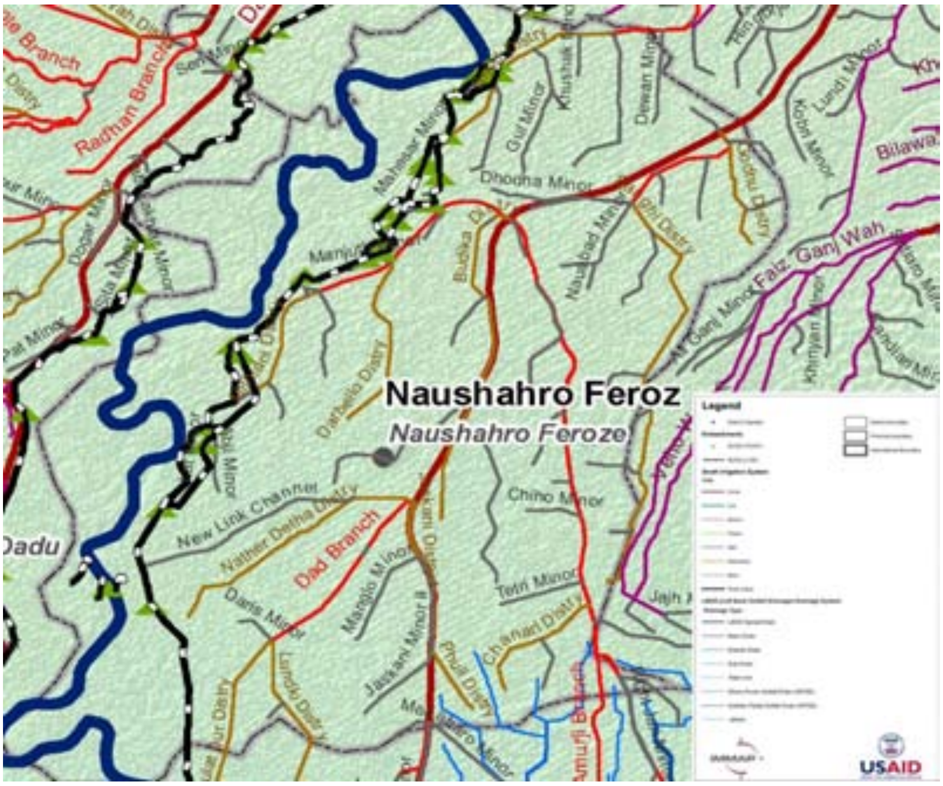

Figure 3.19: Naushahro Feroze district surface water resources

Shaheed Benazirabad District

Surface water source is the Rohri canal emerging from Sukkur Barrage. It is a perennial canal that supplies water for irrigation and domestic purposes. Most of the canals, branch canals and water courses are unlined and require periodic maintenance. Rohri canal is the major source to provide water for drinking and irrigation in district Shaheed Benazirabad. It is the largest canal serving about 2.6 million acres. The canal takes off water from the left border of Sukkur Barrage from the Indus River.

The district is entirely under irrigational settlements. Indus is the only river of the district and flows along western boundary of the district for about 90 kilometers of its length. The irrigation in the district mainly depends on canal-water, tube wells and spill of Indus river. The main canals in the district are Rohri canal and Nasrat canals and district receives perennial water supply from these canals and their channels. Out of the 305 rural mouzas, 287 (94%) are irrigated with the help of canals[12].

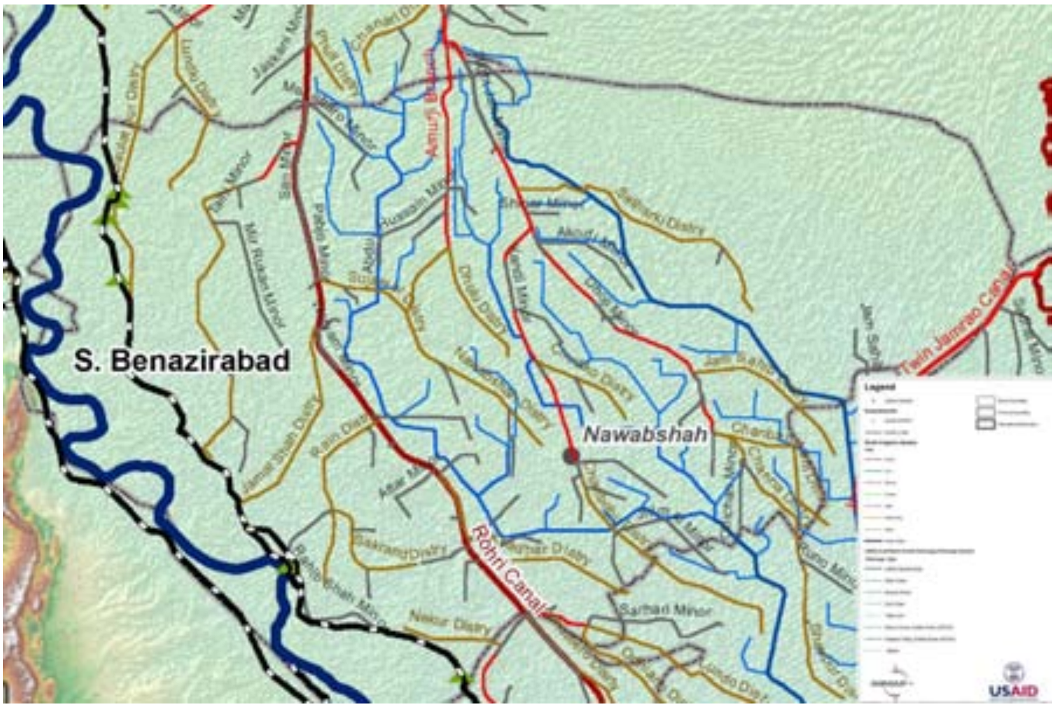

Figure 3.20: Shaheed Benazirabad district surface water resources

Hyderabad District

The district is irrigated through a well-established canal system. The Indus River flows along the western boundary of the district. Rohri canal, emanating from Sukkur barrage, irrigates eastern side of the district. Some of its distributaries irrigate the northern parts of the district. Kotri barrage is situated in district Jamshoro on the Indus River. Three major canals i.e., Phulaili Canal, Pinyari Canal and Akram Wah emanate from Kotri barrage and irrigate the southern parts of the district. Majority of the mouzas are irrigated through canals. Out of the 70 rural mouzas, 69 (99%) are irrigated from the network of canals and distributaries.

[12] Pakistan Emergency Situational Analysis, A profile of District Shaheed Benazirabad

Figure 3.21: Hyderabad district surface water resources

Karachi Division

Hydrogeologically, the city of Karachi lies in the Hub River Basin and the Malir River Basin. The Malir River Basin is drained by the Malir River and the Lyari River. The sources of fresh water in Karachi are Indus River and Hub River. The Indus River is about 120 km to the east of Karachi city and the Hub River, a perennial stream that originates in Balochistan, is about 30 km to the west of Karachi flows along the Karachi- Lasbela boundary and falls into the Arabian Sea near Cape Monze, with a total drainage course length of 336 km.

According to Karachi water and sewerage board, the total estimated water supply of Karachi is 500 MGD. Approximately 445 MGD, amounting to 89% of the total supply to Karachi, is supplied to the city from the Kotri Barrage on the Indus River through a system of canals and conduits. The second source of surface water to Karachi is the dam on the Hub River located north of Karachi, which supplies about 29 MGD of water to the city.

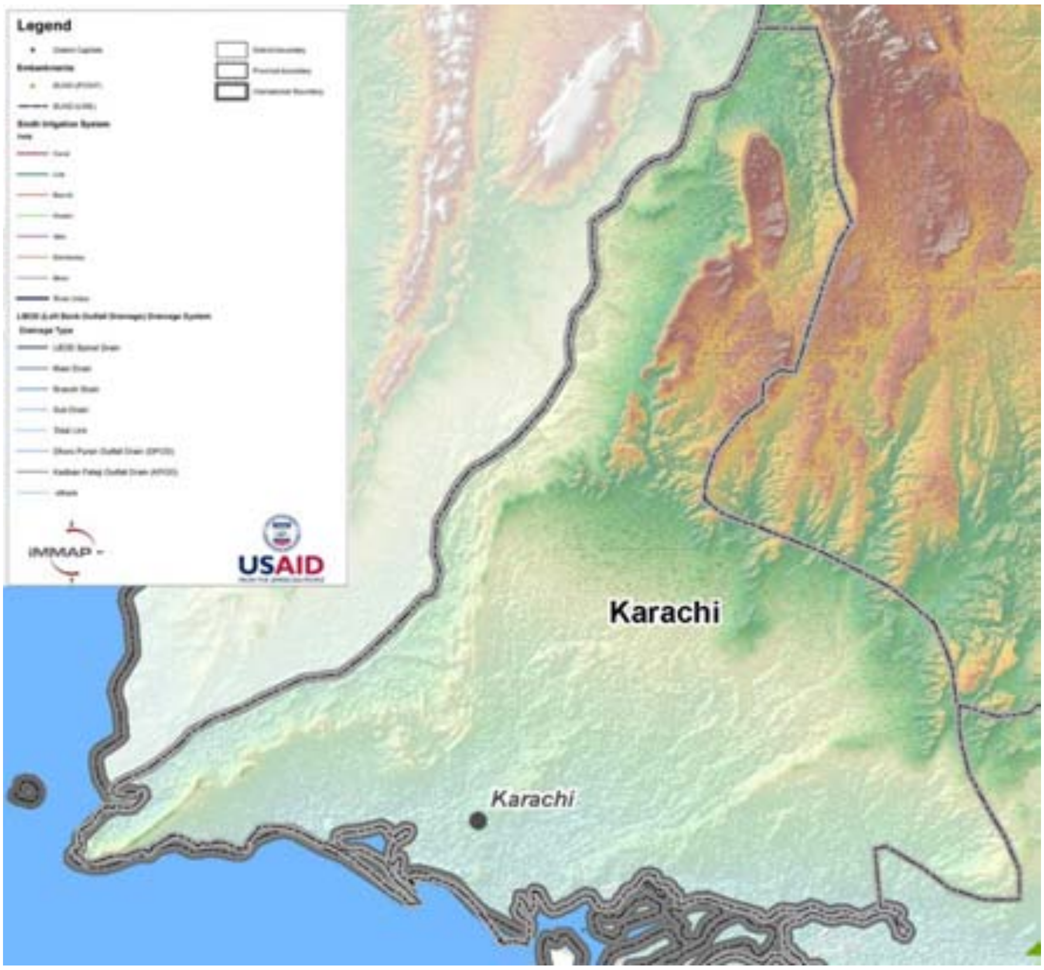

Figure 3.22: Karachi Division surface water resources

3.1.6. Sub-Surface Hydrology

3.1.6.1. Groundwater Use in Lower Indus Plain—A Contrast to Upper Indus[13]

Compared to the situation in the Upper Indus, groundwater use in the Lower Indus is very modest; yet waterlogging (groundwater within 1.5 meter of the soil surface) is common and has been assessed to prevail over 1.5 to 3.5 Mha. While in Punjab groundwater use at field scale is equivalent to canal water use in various canal commands, in Sindh this is not the case. For example, for the Lower Bari Doab Canal, based on the 2005 tube well survey data, total groundwater abstraction was estimated as 4674 MCM (million cubic meter). On the basis of the same data, the Halcrow consultants for LBDC (Lower Bari Doab Canal) calculated the revised estimates of groundwater abstraction for the year 2005 as 4796 MCM, against annual average canal supplies of 4849 MCM (3.93 MAF) diverted to the LBDC at its head. Thus, canal and ground water use in the LBDC irrigation system are at par with each other. In addition, there is no waterlogging in the command, which means that whatever is recharged to the aquifer from the irrigation and rainfall is again pumped for meeting deficit supplies from the irrigation system.

The most recent assessment of overall groundwater abstraction in Sindh was 4.3 BCM. Another study from the same period by the IWMI (International Water Management Institute) estimated the discharge through tube wells to be even lower, i.e., at 2.15 BCM (about 2 MAF). In other words, groundwater use stands at about 4%–8% of surface water use in Sindh, whereas in the canal areas of Punjab, the use of surface and

[13] Resources 2015, 4(4), 831-856 (http://www.mdpi.com/2079-9276/4/4/831/htm)

groundwater at farm level are approximately 50:50. These figures may need to be updated, but in general, groundwater is an underutilized resource in the canal-irrigated areas of Sindh. A large part of the groundwater use in Sindh is in the riverine areas where there are no irrigation canals and the soils are relatively sandy. In contrast, there is relatively limited use of groundwater in the canal command areas due to the high surface water allocations.

Water Management Challenges Being Faced in Lower Indus

The amount of annually renewable groundwater available in Sindh is estimated to be 22 to 27 BCM (18 to 22 MAF); yet only a fraction of this is used—with the groundwater discharge now leading to waterlogging and soil salinity. There is a need to make better use of groundwater in Sindh. One of the reasons for this concerns the challenge of climate change: with more extreme hydrological situations, the buffering role of groundwater becomes important. Another reason is the expected reduced availability of surface water due to sedimentation of the current large storage reservoirs. Over the years, three main water reservoirs in Pakistan have been constructed, Tarbela, Mangla and Chashma, with a total live storage of 20 BCM (16.29 MAF). However, as a result of sedimentation, the effective gross capacity of these reservoirs has been reduced by 5.4 BCM (4.37 MAF) (28%) as of 2012. Moreover, it is expected that the process of sedimentation will continue and gross surface storage loss would reach 7.18 BCM (5.82 MAF) (37%) by 2025. This calls for better management of groundwater reservoirs.

At present, the groundwater buffer is not well managed, with waterlogging being the main manifestation. This suppresses farm yields and keeps cropping intensity relatively low. In Sindh, these cropping intensities have increased significantly over the original intensities. They are, however, considerably lower than they are in Punjab, varying from 116.7% in Sindh Cotton Wheat zone (SCWS) to 234.0% in Punjab Sugarcane Wheat zone (PSW). The impacts are not only limited to agriculture but also extend beyond. Thus, the area is facing multifaceted water management challenges that are interlinked and acting in combination to produce various ill effects regarding water management and the ensuing crop and soil environment. These water management challenges are discussed in detail as follows.

Groundwater Salinity

Groundwater salinity in Sindh is widespread. In 1959, a program of investigations was started by Water and Power Development Authority (WAPDA) by the name of Lower Indus Project (LIP). Bore holes, varying from 30 to 90 m deep, were drilled in the Guddu, Sukkur and Kotri Barrage commands, to determine aquifer characteristics and the quality of groundwater in horizontal and vertical scales. The general pattern of groundwater distribution in the Lower Indus Plains is one of good quality water immediately adjacent to the river, with increasing salinity as we move away from the river (Figure 4.3). A lesser quantity of good quality water is available on the right bank of the river than on the left. This is due to the proximity of limestone hills on the right bank as well as the poor aquifers associated with piedmont plains. Another feature of importance is the complete absence of usable groundwater in the deltaic area south of Hyderabad, with the exception of some shallow pockets in the recently abandoned riverbeds of the Gaja Command.

Throughout the region, the salinity of groundwater increases with depth and no case has been recorded in Sindh where saline water overlies fresh water. Based on the assessments of LIP, it is estimated that 71% of Sindh's irrigated area has groundwater that is too saline (>1500 ppm) for irrigation. However, the picture improves if one looks at shallower depths (<15 m), where salinity is less widespread. According to Ahmad, there are many sites where shallow useable groundwater exists. The total fresh groundwater zones at shallow depth (15 m) are tentatively estimated as spreading over 46% of the area. However, further detailed groundwater investigations are needed for precise assessment of different groundwater qualities at shallow depths.

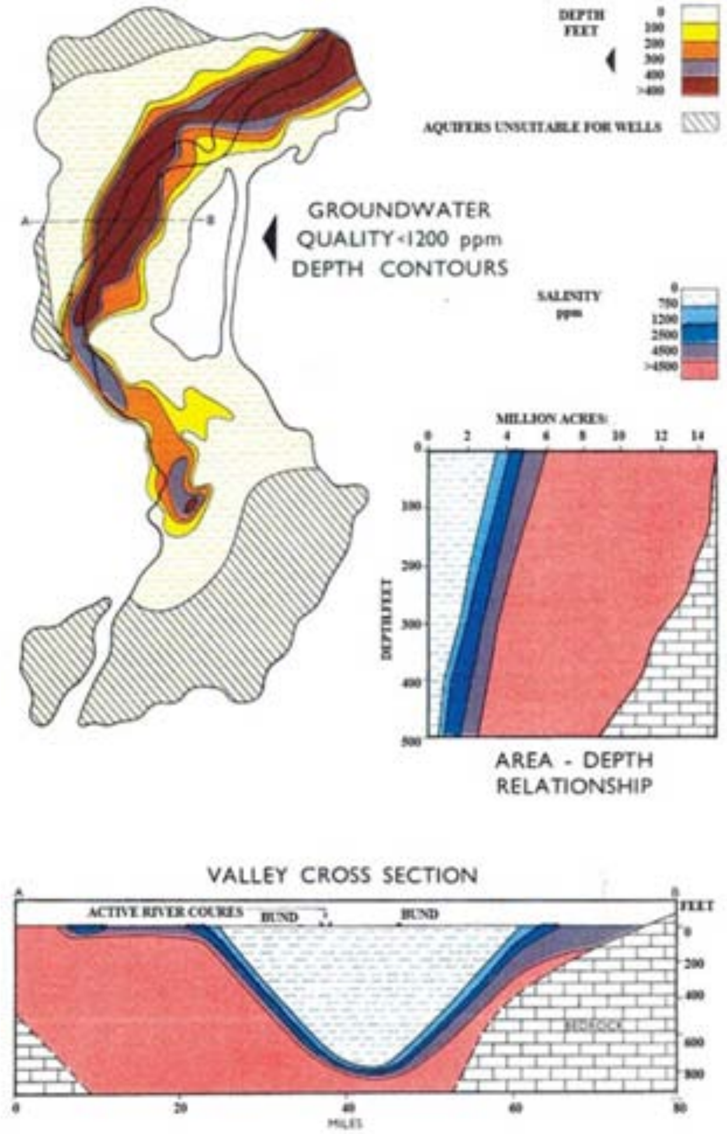

Figure 3.23: Vertical and horizontal extent of groundwater salinity in Lower Indus (Source: Ahmad, N. Groundwater Resources of Pakistan (Revised); Shahzad Nazir: Lahore, Pakistan, 1995)

Waterlogging Situation after 2011 floods

The most prominent element explaining the limited use of groundwater in Lower Indus is the high surface irrigation allowances in several of the canal commands in Sindh (8 to 17 cusecs per 1000 acres). The situation of high allowance is more amplified because in several canal commands, water is diverted in excess of the allowances. The picture is further distorted within the canal commands by unregulated direct outlets, tampered off-takes or in some areas, extensive canal seepage, creating local overabundance of water.

These high surface water deliveries have given rise to widespread waterlogging. In October 2011, for instance, 36% of the command area had a depth to water table of less than 1.0 m, and another 33.6%, a water table within the range of 1.0 to 1.5 m. Thus, in about 70% of the command area in the province, the root zone is waterlogged. This means only about 30.4% area was not waterlogged during October 2011. The extent of waterlogging conditions usually only drops off just before monsoon, due to less canal supplies during the Rabi season. In acreage, the affected area is colossal: 2.19 M ha in post monsoon 2011, with major impacts on the sowing of Rabi crops, especially wheat.

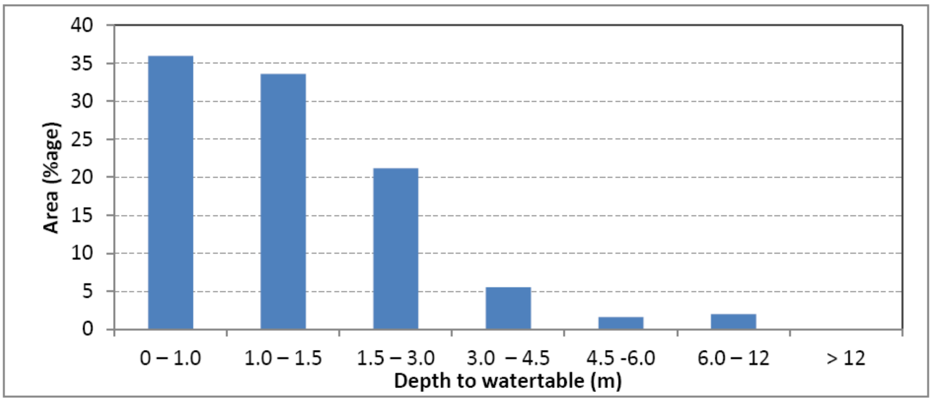

Figure 3.24: Percentage areas under different depth to watertable in Lower Indus, as on October 2011 (Source: IWASRI Publication No. 299, WAPDA)

The overgenerous surface irrigation supplies, especially in some canal commands, reduce the need for additional groundwater irrigation. Several studies have also argued that in many areas of Northern Sindh, a layer of fresh water is present over the more saline water that could be exploited more extensively by skimming wells. Some small tube wells and dug wells already use these lenses along canals and distributaries in several parts of Sindh, where water is relatively short in supply (canal tail ends in the area with low surface irrigation supplies). In many areas, however, surface water supplies in the canals fed from Guddu Barrage are so high that there is little incentive to pump. In the post-monsoon period the entire area is waterlogged, as shown in Figure 4.10. Moreover, within the canal commands, there is no difference in water allowance for fresh and saline areas, which can encourage groundwater pumping.

Waterlogging situation during drought period in Lower Indus

Drought prevailed for four years (1998-2002) in Indus Basin, response of irrigation and drainage in Lower Indus is important in that context. The general pattern of groundwater distribution in the Lower Indus Plains is one of good quality water immediately adjacent to the river with increasing salinity away from the river. A lesser quantity of good quality water is available on the right bank of the river than on the left. This is due to the proximity of limestone hills on the right bank and to the poor aquifers associated with piedmont plains. Another feature of importance is the complete absence of usable groundwater in the deltaic area, south of Hyderabad, except in some shallow pockets in the fairly recently abandoned river beds of the Gaja command. Some of the most saline groundwater of the region is found in the delta where the water samples with salinities twice as high as sea-water have been obtained. Throughout the region the salinity of groundwater increases with depth and no case has been recorded where saline water overlies fresh water. A brief discussion of the groundwater quality in the commands of Guddu, Sukkur and Kotri Barrages are gives below:

Guddu Barrage (Ghotki Canal Command Area – Ghotki, Sukkur Districts): In the Guddu Barrage command, Lower Indus Project (LIP) drilled about 52 bore holes on the right and left banks (WAPDA, 1966). Boreholes drilled on the right bank of Indus River showed good quality water at shallow depths and that too near the river. As the distance increases away from the river, the water quality even at shallower depths worsens along with deeper bad quality water. On the left side of the River, most of the area of Ghotki canal command is fresh.

Sukkur Barrage (Sukkur Barrage Command Area –Khairpur, Naushahro Feroze, Matiari, Shaheed Benazirabad): In Sukkur Barrage command, LIP drilled 38 test holes on the right bank of Indus River (WAPDA, 1966). The behavior of water quality is not altogether un-expected because of the reason of the proximity of limestone hills. Good quality groundwater is available near the Indus River and that too at a shallow depth. LIP drilled about 119 test holes on the left bank of Indus River in Sukkur Command. Here the water quality is good throughout, in the holes located near the protection bund of the Indus river. Water quality is good throughout up to 350 feet depth generally but it worsens with distance away from the river. The Indus river acts as the main source of recharge.

Kotri Command Area (Hyderabad, Tando Allah Yar): LIP drilled about 49 test holes in Kotri command. This is deltaic area and groundwater quality throughout is so bad, that at places the TDS content is twice the TDS of Sea water. The reason for this high salinity of groundwater is the presence of high water tables and concentration of salts because of high rates of evaporation. Only pockets of fresh water are found in Kotri command, which is due to the recently abandoned flood courses of Gaja River. The Lower Indus alluvium is saturated with groundwater, often to within a few feet of ground surface. The quality of this water varies a great deal, both vertically and horizontally. According to Ahmad (1995), there are many sites, where shallow useable groundwater exists.

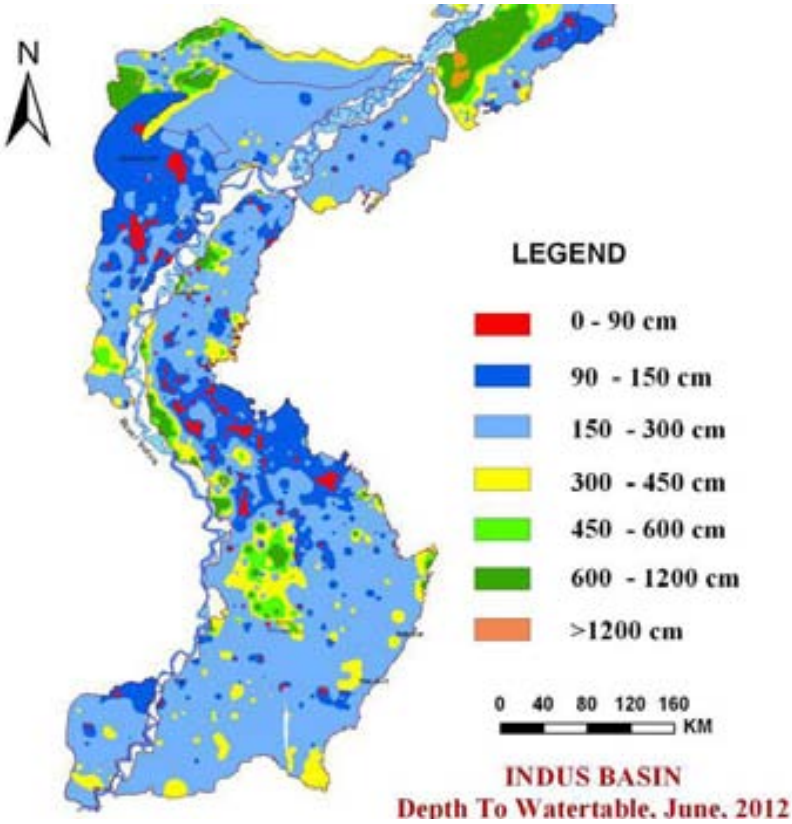

Figure 3.25: Depth to water table map of Lower Indus, pre-monsoon June 2012 (Reference: Basharat M., Hassan D. and Bajkani AA and Sultan S.J. 2014. Surface water and groundwater nexus: groundwater management options for Indus Basin Irrigation System. IWASRI Publication No. 299, WAPDA)

Groundwater Contamination

Concentrations of most fecal microorganism's decline after excretion, but these microorganisms may still impair groundwater quality. Several approaches have been used to define the quantities and transport distances of latrine-derived microbial contaminants. The extent to which microbes from pit latrine wastes may be transported and contaminate groundwater largely depends on the environmental context of the area, particularly hydrological and soil conditions.

In a study of 12 pour/flush latrines, Banerjee (2011) found that transport of total and fecal coliforms increased during the monsoon period and in sandy soils. The author noted that the maximum travel distance of bacteria was 10 m from pits (Figure 3.25).

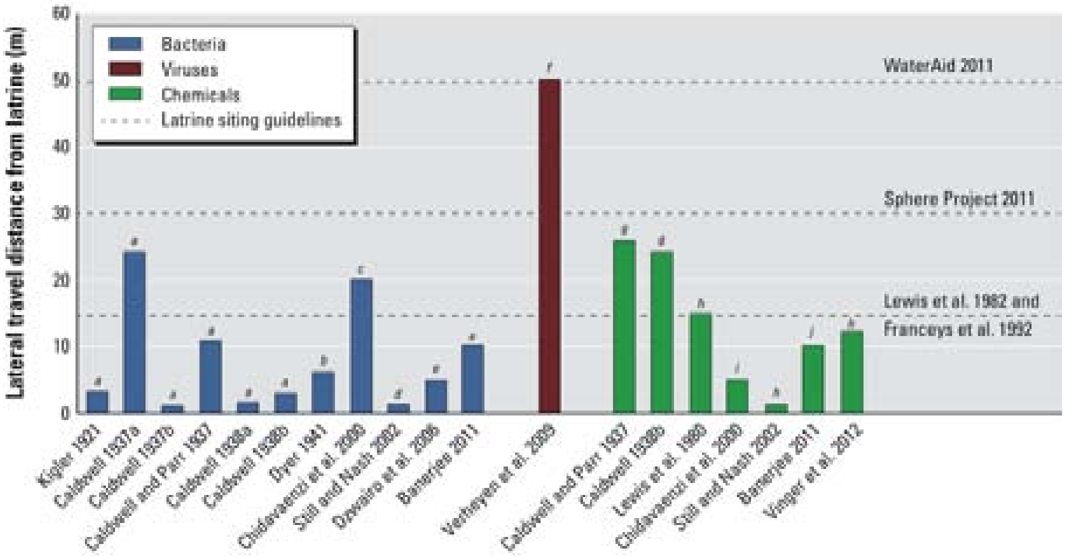

Figure 3.26: Lateral travel distances of different contaminants emanating from pit latrines in relation to select latrine/water-point siting guidelines. Verheyen et al. (2009) and Vinger et al. (2012) used existing wells to approximate distances, whereas all other studies used test wells to measure distances. a) B. coli; b) total coliforms; c) coliforms; d) fecal coliforms; e) total and fecal coliforms; f) adenovirus and rotavirus; g) chemical stream (nitrate, nitrite, and chloride); h) nitrate; i) nitrogen; j) salt tracer (Reference: Banerjee G. 2011. Underground pollution travel from leach pits of on-site sanitation facilities: a case study. Clean Technol Environ Policy 13(3):489–497)

3.1.7. Meteorology & Air Quality

3.1.7.1. Climatic regions of Sindh

Sindh is divided into three climatic regions: Siro (the upper region, centered on Jacobabad), Wicholo (the middle region, centered on Hyderabad), and Lar (the lower region, centered on Karachi). The thermal equator passes through upper Sindh, where the air is generally very dry. Central Sindh's temperatures are generally lower than those of upper Sindh but higher than those of lower Sindh. Dry hot days and cool nights are typical during the summer. Central Sindh's maximum temperature typically reaches 43–44 °C (109–111°F). Lower Sindh has a damper and humid maritime climate affected by the southwestern winds in summer and northeastern winds in winter, with lower rainfall than Central Sindh. Lower Sindh's maximum temperature reaches about 35–38 °C (95–100 F). In the Khirthar range at 1,800 m (5,900 ft) and higher at Gorakh Hill and other peaks in Dadu District temperatures near freezing have been recorded and brief snowfall is received in the winters.

Table 3.2: Mean Monthly Temperature & Rainfall

Months	Mean Annual Temperature (°C)	Mean Annual Rainfall (mm)
Ghotki	26.9	0.25
Hyderabad	27.2	0.38
Khairpur	27.1	0.3
Matirai	26.6	0.35
Nausharo Feroze	27.6	0.30
Shaheed Benazirabad	27.5	0.3

Sukkur	27.1	0.3
Tando Allahyar	27.7	0.4
Karachi Central	26.7	0.37
Karachi East		
Karachi South		
Karachi West		
Karachi Korangi		
Karachi Malir		
Source: weatherspark.com		

3.1.7.2. Ambient Air Quality and Noise

Ghotki

Ambient Air Quality Monitoring was conducted near Hussain Beli Village in Ghotki during the Initial Environmental Examination (IEE) study undertaken by Works & Services Department, Government of Sindh for Ghotki Kandhkot Bridge Project. The results of monitoring under that project are as follows:

Table 3.3: Ambient Air Quality near Ghotki for Ghotki Kandhkot Bridge Project

	SO_2 (ppb)	NO_X (ppb)	CO (ppm)	SPM (µg /m³)	Noise dB(A)
Average	9.7	11.6	1.2	140.6	45.9
Max	13.6	16.3	1.9	163.0	54.0
Min	7.0	8.2	0.2	114.0	41.0

The results show that the area is fairly unpolluted since major air polluting aspects such as industrial units, highways or commercial areas are not located close to the microenvironment where the assessment was conducted.

Sukkur

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 30 June, 2017 near Aror City in Sukkur District for the “EIA of Mining Activities in Sinhd” under ADP scheme of Mines and Minerals Development Department, GOS. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	24.5	9.8	31.2	3.1	43.2	54.2	474	144	35.3	ND
Max	36.2	17.5	41.8	3.5	54.5	64.2				
Min	11.2	4.5	23	2.7	25.7	49.5				

The results show that the area is unpolluted, however, the readings of SPM and PM_{10} are just below the SEQS limits which shows that dust factor exist in Arror City due to rocky terrain and dirt roads. However, the results are within SEQS limits.

Khairpur

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 18 June, 2017 near Kot Banglo Town in Khairpur District for the “EIA of Mining Activities in Sinhd” under ADP scheme of Mines and Minerals Development Department, GOS. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	O_3 ($\mu g/m^3$)	Noise (dB)	SPM ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Lead (mg/m^3)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	32.8	11.2	41.2	3.6	11.5	57.8	410	138	41.2	0.1
Max	44.6	16.2	56.6	3.9	17.5	66.2				
Min	19.7	8.6	33.3	2.8	5.5	51.5				

The results show that the area is unpolluted, however, the readings of SPM and PM_{10} are just below the SEQS limits which shows that dust factor exist in Kot Banglo Town due to rocky terrain and dirt roads. However, the results are within SEQS limits.

Tando Allah Yar

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 18 August, 2017 near Main Bus Stop in Tando Allah Yar for the “Project of Development of Master Plans for District Headquarter Towns of Hyderabad, Mirpurkhas and Shaheed Benazirabad Divisions” with Urban Policy and Strategic Planning. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	O_3 ($\mu g/m^3$)	Noise (dB)	SPM ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Lead (mg/m^3)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**65**	**500**	**150**	**75**	**1.5**
Average	59.6	11.7	54.6	2.4	49.2	62.9	396	147	55	ND
Max	67.7	15.8	65	2.8	76	77				
Min	45.1	7.9	41	2.1	19	56				

The results show that the area is unpolluted, however, the readings of SPM and PM_{10} are just below the SEQS limits and higher values of SO_2 and NO_2 which shows dust blown on dirt roads and traffic congestion in that area where the air quality investigation was conducted. However, the results are within SEQS limits.

Shaheed Benazirabad

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 20 August, 2017 at 60 Mile Chowk in Nawabshah for the “Project of Development of Master Plans for District Headquarter Towns of Hyderabad, Mirpurkhas and Shaheed Benazirabad Divisions” with Urban Policy and Strategic Planning. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	O_3 ($\mu g/m^3$)	Noise (dB)	SPM ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Lead (mg/m^3)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**65**	**500**	**150**	**75**	**1.5**
Average	84.1	14.0	50.0	2.7	55.9	64.1	399	174	59	0.1
Max	98.7	18.5	59	3.2	80.2	78				
Min	64.9	10.6	41	2.1	16.9	52				

The results show that the area is fairly unpolluted in terms of dust emissions, however, the values of SO_2, NOx and Noise are slightly on higher side which shows traffic emissions and traffic movemement in that area where the air quality investigation was conducted. However, the results are within SEQS limits.

Naushahro Feroze

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 22 August, 2017 at Allah Wali Chowk in Naushahro Feroze for the “Project of Development of Master Plans for District Headquarter Towns of Hyderabad, Mirpurkhas and Shaheed Benazirabad Divisions” with Urban

Policy and Strategic Planning. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**65**	**500**	**150**	**75**	**1.5**
Average	77.6	14.4	46.7	2.5	44.2	64.0	425	184	50	0.2
Max	98.7	19.8	57	3.2	67.5	74				
Min	56.4	10.6	39	2.1	19	52				

The results show that the area is slightly polluted. The readings of SPM and $PM_{2.5}$ are just below the SEQS limits and higher values of SO_2 and NO_2 as well as PM_{10} exceeds SEQS limits which shows dust blown on dirt roads and traffic congestion of the area where the air quality investigation was conducted.

Matiari

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 23 August, 2017 near Peer Noor Shah Colony in Matiari for the "Project of Development of Master Plans for District Headquarter Towns of Hyderabad, Mirpurkhas and Shaheed Benazirabad Divisions" with Urban Policy and Strategic Planning. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	64.0	12.1	49.6	2.6	52.7	59	380	153	48	ND
Max	79	9.2	61	3.2	73.9	74				
Min	53.6	15.8	41	2.1	23.2	52				

The results show that the area is slightly polluted. The readings of SPM and $PM_{2.5}$ are just below the SEQS limits and higher values of SO_2 and NO_2 as well as PM_{10} exceeds SEQS limits which shows dust blown on dirt roads and traffic congestion of the area where the air quality investigation was conducted.

District Shaheed Benazirabad

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 08 hours on 17 October, 2017 near Rohri Canal outside City of Nawabshah in Shaheed Benazirabad District for the "Project of Indement Environmnetal Monitoring for Bahria Town Nawabshah" with Bahria Town Pvt. Ltd. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	41.9	12.55	46.5	2.5	55.5	54.8	412	148	48	ND
Max	54.3	15.8	59	3.1	76	65				
Min	33.0	10.6	41	2.1	21.1	47				

The results show that the area is unpolluted as the readings are just below SEQS limits, however, the values of PM_{10} and $PM_{2.5}$ are slightly on higher side which shows dust emissions due to unpaved tracks and agriculture setup of the area where the air quality investigation was conducted.

District Hyderabad

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on May 2014 near Hyderabad Toll Plaza in Hyderabad District for the "Project of EIA of Karachi – Hyderabad

Motorway M9" with Frontier Works Organization (FWO). The results of monitoring under that project are reproduced here in below table:

Site	SO_2 (µg/m³)	NO_2 (µg/m³)	NO (µg/m³)	CO (mg/m³)	PM_{10} (µg/m³)
Hyderabad (Near Toll Plaza)	111.2	54.8	41.6	6.63	91.20
SEQS Limits	120	80	40	5	150

The results show that the area is unpolluted as the readings are below SEQS levels except CO, however, CO and SO_2 levels are on the higher side showing presence of diesel operated traffic crossing the toll plaza.

Karachi Division

EMC Pakistan Pvt. Ltd. has conducted real-time ambient air quality and noise monitoring for 24 hours on 26 December, 2014 in Sheerin Jinnah Colony, Karachi South for the "EIA of KPT Coal Yard" for Awan Traders Pvt. Ltd. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	10.1	12.7	5.5	1.0	5.2	66	388	98	17.7	-
Max	17.0	14.8	6.5	1.4	16.5	81				
Min	5.0	6.4	2.3	0.6	0.7	50				

The results show that the area is fairly unpolluted since major air polluting aspects such as industrial units, highways or commercial areas are not located close to the microenvironment where the assessment was conducted.

Another Air Quality assessment was conducted by EMC Pakistan Pvt. Ltd. for 24 hours in summer season of year 2013 for the project of EIA of K-2/K-3 for Pakistan Atomic Energy Commission near Abdur Rehman fishing village. The results of monitoring under that project are reproduced here in below table:

	SO_2 (µg /m³)	*NO_X ((µg /m³)*	*CO (ppm)*	*PM10 (µg /m³)*	*PM2.5 (µg /m³)*	*Noise dB(A)*
Average	21.13	30.68	0.653	64.37	27.13	50.53
Max	49	73.4	1.49	100	40	64.0
Min	9	7.9	0.23	40	15	41.0

The results show that the area is fairly unpolluted due to the proximity of the sea and calm and quite village life.

Another Air Quality assessment was conducted by EMC Pakistan Pvt. Ltd. for 24 hours in August 2016 for the project of EIA of Fazaia Housing Scheme Karachi Site-II for Pakistan Air Force near Ghulam Muhammad village in Malir District. The results of monitoring under that project are reproduced here in below table:

Readings	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	O_3 (µg/m³)	Noise (dB)	SPM (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Lead (mg/m³)
SEQS (2016)	**120**	**40**	**80**	**5**	**130**	**55**	**500**	**150**	**75**	**1.5**
Average	37.5	9.7	29.1	2.0	44.1	57.8	405	145	44	ND
Max	50.8	11.9	37	2.3	95	66				
Min	28.2	6.6	20	1.2	16.9	50.1				

The results show that the area is unpolluted as the readings are below SEQS, however, dust levels are on the higher side showing rocky terrain of Malir District.

As per initial assessment conducted in AAP districts by the Consultant field team, the air and noise levels are likely to be within the permissible limit of Sindh Environmental Quality Standards (SEQS).

3.2. Ecological Baseline

Sindh is unique in its biodiversity due to its diverse range of landscapes and ecosystems and its location on the flyway of Central Asia, giving it the opportunity to host a multitude of migratory species. The variety of ecosystems is evident as Sindh is home to riverine, scrub, and mangrove forests, deserts, coastal areas, wetlands, and agri-ecosystems. The province is also rich in diverse species of flora and fauna. Plant species play an integral role in the biodiversity of the province, are a source of fodder, and an important source of raw material. Sindh also has a variety of medicinal plants, which are used in healthcare products, traditional medications, dyeing, as culinary spices, and in natural cosmetics and perfumes.

Wildlife species diversity is also apparent throughout Sindh. Migrating birds from the South Asian subcontinent, East Africa, Europe, and much of Asia use the wetlands as wintering grounds. Some fly in to stay for the winter and breed here, while the rest fly through. Therefore, besides Sindh's endemic species, these migrating birds also depend on these important wildlife habitats over the course of a year. Some significant wildlife species, which have come under threat due to loss of habitat, expansion of human settlements, lack of water supplies, and unregulated hunting, include the Houbara bustard, the Sindh urial, the Sindh ibex, the Indus blind dolphin, the marsh crocodile, the Indian cobra and python, and the Oliver Ridley turtles (Lepydochelys olivacea), to name just a few[14].

3.2.1. Flora

The variation in climate between Upper and Lower Sindh is not reflected in any difference in the flora of the two zones. The vegetation is characteristic of edaphic conditions of the region viz. arid climate and sandy and calcareous soil, largely impregnated with salts. A notable feature is the predominance of plants and trees with small leaves, or none at all, and the large proportion of thorny species. The apparent contrast between the verdure of the riverine and irrigated tracts on the one hand, and the hilly and desert tracts on the other; is largely a matter of its intensity and distribution. The dwarf palm, Kher (*Acacia ruprstris*), and Lohirro (*Techoma undulata*) are typical of the western hill region as are Khip (*Periploca aphylla*) and Phog (*Calligonum polygonides*) of the eastern sandy desert. In the central valley, the Babbur (*Acacia nilotica*) tree is the most dominant and occurs in thick forests along the Indus banks. The Nim (*Azadirachta inidica*), Ber (*Ziziphus vulagaris*) or Jujuba, Lai (*Tamarix orientalis*), Kirrir (*Capparis aphyla*) and Kandi (*Prosopis cineraria*) are the more common trees. Mango, date palms, banana, guava, orange and chiku are the typical fruit bearing trees. The coastal strips and the creeks abound in semiaquatic and aquatic plants, and inshore deltaic islands have mangrove forests of Timmar (*Avicennia marina*) and Chaunir (*Ceriops tagal*) trees. Water lilies grow in abundance in the numerous lakes and ponds, particularly in the Lower Sindh region[15].

Table 3.4: Flora of Sindh

Sr.	Technical Name	Local Name
1.	*Azadirachta indica*	Neem
2.	*Alternanthera sessilis*	Bengroo
3.	*Acacia nilotica*	Babul
4.	*Acacia jacquemontii*	Bhaori
5.	*Acacia senegal*	Kumbat
6.	*Aerva javanica*	Bhooh
7.	*Asparagus officinalis*	Kootri
8.	*Achyranthes aspera*	Ubbat kandi/Charchitah

[14] Sindh Strategy for Sustainable Development - IUCN
[15] Forest Department - GOS

9.	*Aloe barbednsis*	Kunwaar Bhooti/Ghee kuwar
10.	*Albizia lebbeck*	Sireenhun
11.	*Alhagi maurorum*	Kandaira
12.	*Cressa cretica*	Unn
13.	*Capparis decidua*	Kirer
14.	*Citrullus colocynthis*	Trooh
15.	*Corchorus depressus*	Mudairi
16.	*Cuscuta compestris*	Bay Paari
17.	*Cordia dichotoma*	Giddori/Lessori
18.	*Calotropis procera*	Akk
19.	*Cordia gharaf*	Liyaar
20.	*Citrus aurantifolia*	Lemun/Nimbu

Ghotki District

Phytogeographically, district Ghotki falls in the Saharo-Sindian region (Ali and Qaiser, 1986), which extends from the Atlantic coast of the Sahara Desert (North Africa) to Pakistan and Rajasthan in India. In Pakistan, this region comprises mainly the flat alluvial plains of the Indus and its adjoining tributaries that cover major parts of Sindh, the Punjab, and the foothills of Balochistan (Nasir and Robina 1995). However, the natural vegetation of this region has been replaced by cultivated species in areas where irrigation system has been developed.

The natural vegetation that exists in the Study Area mostly includes herbaceous vegetation, found along the edges of the agricultural fields and water courses. Along the water canals and other moist places in the Study Area, there are some commercial species of *Desmostychya bipinnat*, *Saccharum spontaneum*, *Tamarix sp.* and *Typha angustata* planted which are used for making ropes, baskets and mats. Mostly, domestic livestock graze in this habitat of the Study Area. Fodder grasses found in the area are *Cynodon dactylon* and *Eleusine degyptica*. Most of the trees that are present along the margins of the agricultural fields were also planted by local communities.

Shisham *Dalbergia sissoo,* and Kikar *Acacia nilotica* are the main fuel wood trees and are much preferred for their hard wood. The trees are planted at the edges of agricultural fields. Other planted trees in the Study Area include some varieties of mulberry, such as shahtut *Morus alba* and tut *Morus idevigata*; ber Z*izyphus jujuba*, dhrek *Melia azadirachta*; and sharin *Albizzia lebbek*, a quick-growing tree. The mulberries and ber are the prefer fodder species for domestic livestock of the Project Area.

Sukkur District

The dominant trees in the district Sukkur are *Azadirachta indica* (Neem), *Acacia nilotica* (Keekar), *Albizia labbek* (Siras), *Ficus religiosa* (Peepal), *Acacia nilotica* (Babul), *Cordia myxa* (Lasura); *Parkinsonia aculeta* (Vilayati kikar), *Salvadora persica* (Khabar) Common vegetation also found in the area includes *Euphorbia nercifolia*, *tamarix gallica*, *acacia nilotica*, *zizyphus numularia*, *prosopis specigena*, *eucalyptus canaldulensis*, *Melica azadirchta indica*, *Calotropis procera*. Other minor produce from the forests are reeds from sar and kanh grasses (Saccharum spontaneum and arundinaceum), *T. Dioca*, *Salvadora oleoides*, *Hyperanthera pterysperma*.

Among the grasses; Lumb (*Arislida depressa*), Chemmer (*Eleusine compressa*), Gorkha (*Lasiurus sindicus*) and Kana (*Saccharum bengalensis*) are found. Koondeor Dib (*Typha augustata*) is found.

Khairpur District

Based on the physical features and vegetation attributes in the Khairpur district, five distinct habitats were identified as:

Crest Habitat: The floristic composition of this habitat include *Calligonum polygonoides*, *Aerva javanica, Dipterygium glaucum, Limeum indicum, Indigofera argentea, Tribulus longipetalus, Aristida adscensionis, A. funiculata, Panicum turgidum, Lasiurus sindicus, Stipagrostis plumosa, Cyperus arenarius* and *C.conglomeratus*.

Slopes/Swale/Flank Habitat: This habitat is also covered with the same type of plant species as those of crest habitat. Few trees are also observed growing in this habitat like *Prosopis cineraria*, *Tamarix aphylla, Salvadora oleoides* and *Capparis decidua*. The common plants which are forming typical vegetation type of this habitat are *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Limeum indicum, Indigofera argentea, Tribulus longipetalus, Aristida adscensionis, A. funiculata, Panicum turgidum, Lasiurus sindicus, Stipagrostis plumosa, Cyperus arenairus* and *C. conglomerates*.

Sandy Plains Habitat (Tarr-Tarai/ Low Lying Flat Area): The most common plant species in this habitat include *Aerva javanica, Aristida adscensionis, A. funiculata, Boerhavia procumbense, Calligonum polygonoides, Capparis decidua, Cassia italica, Cenchrus ciliaris, Cleome brachycarpa, C. scaposa, Corchorus depressus, Cymbopogon jawarancusa, Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium, Heliotropium strigosum, Limeum indicum, Polygala erioptera, Salsola imbricata, Stipagrostis plumosa, Tephrosia uniflora, Tribulus longipetalus*, and *Zaleya pentandra*. Trees are very commonly observed in this habitat forming a mini forest. These include *Prosopis cineraria, Tamarix aphylla, Capparis deciduas* and *Salvadora oleoides*.

Saline/Sodic Land (Kharror): The commonest plants of this habitat are *Tamarix indica, Saccharum spontaneum, Salsola imbricata, Pluchea lanceolata, Prosopis cineraria, Limeum indicum, Aeluropus lagopoides, Desmostachya bipinnata* and *Alhagi maurorum*.

Lake/Wetland Habitat: The edges of lakes are dominated with under story plant community like *Saccharum bengalense, S. spontaneum and Tamarix passernioides. Besides, Aeluropus lagopoides, Cynodon dactylon, Desmostachya bipinnata* and *Phragmites karka* are forming common vegetation in this habitat.

Hyderabad district

Tropical Thorn Forest Ecozone in Hyderabad district. This habitat was the most extensive ecozone of the Indus plain, and currently exists on low lying places where the land has not been converted for habitation or cultivation. This habitat comprises low forests of thorny and hard-wooded tree species, dominated by Acacia spp. The trees of such forests have short boles and low branching crowns. These are usually not close-growth trees hence their canopies touch each other in exceptionally favorable spots. The usual height of the trees is 20-30 feet (6-9 m). Other plants that grow mixed with Acacia include *Salvadora, Prosopis, Capparis, and Tamarix*. The shrubs of the ecozone included *Calotropis, Zizyphus, Suaed*, while herbs of the area included Chenopodium, Calligonum, Haloxylon and various species of grasses.

Outskirts and roadside plantation of Hyderabad: From Hyderabad bypass (Channel mori) to Jamrao Bridge is dominated by *Prosopis glandulosa* and *Salvadora oleoides* along both sides of the road with small patches of *Calotropis procera* and *Aervajavanica*. At certain places, cultivated *Nerium oleander* and *Carissa opaca* are found. Similarly, thick plantation of *Azadirachta indica, Albizia lebbek, Ficusreligiosa,* *Ficusbengalensis*, *Moringaoleifera*, *Eucalyptus camaldulensis* and *Cordiamyxa* are frequently present on both sides of the existing road. Although, at some places old tree plantations are limited. For instance, trees of *Albizia lebbek* (Shrin), *Azadirachta indica* (Neem), *Ficus religiosa* (Peepal) and *Acacia nilotica* (Babur) trees are there present along roadside. Cultivated orchards are also important vegetative areas that have environmental as well as social concerns due to their commercial value. The dominant trees in Hyderabad and Mirpurkhas districts are babul (*Populus euphrafica*), ber (*Zizypuhs numularia*) and several verities of Tamarix like plai (*Tamarix gallica*) and jhao (*Tamarix diocia*), talhi (*Dalbergia sisoo*), kri (*Tamarix gallica*), karir (*Copparis aphylla*).

Ornamental flowers found in farms, gardens and elsewhere in the area are rose (*Rosa damascena*), jasmine (*Jasminum officinale*), and tuberose (*Polianthes tuberose*) etc. The area is mostly covered with weeds like *Tamarix aphylla* and *Salvadora persica* and exotic species like *Prosopis glandulosa*. Cutting/ clearance of these species has least concern.

Riverine Belt of Sindh which comprises AAP districts including District Matiari, part of Shaheed Benazarabad and Naushahro Feroze is rich in different plant species as listed below:

Table 3.5: Plant Species of Riverine Belt of AAP Districts[16]

S No	Scientific name	Common name
1.	*Tamarindus indic*	Imli
2.	*Indigophora paucifolia*	Neel
3.	*Prosopis cineraria*	Kandi
4.	*Alhagi maurorum*	Kandero
5.	*Albiziz lebbek*	Sirehn
6.	*Prosopis glandulosa*	Mesquite
7.	*Prosopis juliflora*	Mesquite
8.	*Calotropis procera*	Ak
9.	*Capparis aphyla*	Kirir
10.	*Leptadenia spartium (Khip)*	Khip
11.	*Tamarix articulate*	Asri Lawo
12.	*Tamarix dioca*	Lai
13.	*Populus euphratica*	Bahan
14.	*Salvadoraoleoides*	Jar
15.	*Salvadora persica*	Khabar
16.	*Phyllanthus reuticulatus*	Kamo
17.	*Salvia spp.*	Kinro
18.	*Salsola foetida*	Lani
19.	*Cardia mixa*	Geduro
20.	*Zizyphus jujube*	Ber
21.	*Gynandrpsis pentaphylla*	Kinro
22.	*Desmostachya bipinnata*	Dubh
23.	*Saccharum spontaneum*	Kanh
24.	*Sacchrum munja*	Munj
25.	*Sacchrum arundinaceum*	Sar

Trees and Shrubs as listed below are located in Irrigated Plain Area of Sindh which comprises AAP districts including Shaheed Benazirabad, Tando Allah Yar and Hyderabad districts.

Table 3.6: Trees and Shrubs in Irrigated Plain Area of AAP Districts

S No.	Botanical Name	Local Name
1.	Acacia nilotica	Babul
2.	Azadrachta indica	Nim
3.	Tamarindus indica	Imli

[16] EMC Pakistan Database

4.	Prosopis cineraria	Kandi
5.	Albiziz lebbek	Sirehn
6.	Eucalyptus	Camaldulensis
7.	Dalbergia sissu	Shisham
8.	Prosopis glandulosa	Mesquite
9.	Prosopis juliflora	Mesquite
10.	Tamarix articulate	Asri Lawo
11.	Tamarix dioca	Lai
12.	Populus euphratica	Bahan
13.	Salvadoraoleoides	Jar
14.	Salvadora persica	Khabar
15.	Phyllanthus reuticulatus	Kamo
16.	Salvia spp.	Kinro
17.	Salsola foetida	Lani
18.	Cardia mixa	Geduro
19.	Zizyphus jujube	Ber
20.	Gynandrpsis pentaphylla	Kinro
21.	Desmostachya bipinnata	Dubh
22.	Saccharum spontaneum	Kanh
23.	Sacchrum munja	Munj
24.	Sacchrum arundinaceum	Sar
25.	Indigophora paucifolia	Neel

Agricultural and Horticultural Crop Species of Canal Irrigated plains of AAP districts including Shaheed Benazirabad, Hyderabad, Tando Allah Yar, Matiari, Naushahro Feroze and Hyderabad districts.

Table 3.7: Agricultural and Horticultural Crop Species of Canal Irrigated plains of AAP Districts

S No.	Botanical Name	Local Name
	Cultivated Crops	
1.	*Triticum vulgare*	Wheat
2.	*Gossypium harbaccium*	Cotton
3.	*Oryza sativa*	Rice
4.	*Saccharum officianarum*	Sugarcane
5.	*Andropogon sorghum*	Sorghum, Jowar
6.	*Pennisetum typhoides*	Millet-Bajra
7.	*Hordeum vulgar*	Barley
8.	*Zea mays*	Maize
	Vegetables	
9.	*Cucurbita pepo*	Pumpkin – Kadu
10.	*Spinacea oleracea*	Spinach
11.	*Lycopersicum esculentum*	Tomato
12.	*Lagennaria vulgaris*	Bottle gourd -Kadu
13.	*Cucumis sativum*	Cucumber – Kheera
14.	*Cucumis utilissima*	Wangi
15.	*Cucumis melo*	Musk melon
16.	*Coriandrum sativum*	Corriander
17.	*Allium cepa*	Onion
18.	*Allium sativum*	Lasan
19.	*Capsicum annum*	Chilly
20.	*Brassica capitata*	Cabbage
21.	*Brassica oleracea*	Cabbage
22.	*Colocassia esculentum*	Kachaloo
23.	*Daucus carota*	Carrot
24.	*Hibiscus esculentus*	Ladies finger
25.	*Raphanus sativus*	Radish- Mooli
	Fodder	Lucern

26.	*Medicago sativa*	Lucern
27.	*Trifolium alexandrinum*	Clover- barseem
	Pulses	
28.	*Phasiolus mungo*	Moong
29.	*Phasiolus trilobus*	Moth
30.	*Phasiolus aconitifolia*	Kidney bean (Dal moth)
31.	*Phasiolus lunata*	Kidney beam Lobia
32.	*Pisum sativum*	Pea
33.	*Cicer arietinum*	Chick pea
	Oil seeds	
34.	*Brassica junceae*	Rape seed
35.	*Brassica campestris*	Mustard
36.	*Eruca sativa*	Black mustard Jambho
37.	*Helianthus annus*	Sun flower
	Fruit Trees	
38.	*Mangifera indica*	Mango
39.	*Musa sapientum*	Banana
40.	*Annona squamosa*	Sita phal
41.	*Phoenix dactylifera*	Date palm
42.	*Scyzigium cumini*	Jaman
43.	*Carica papaya*	Papaya
	Grewia Asiatic	Phalsa

Karachi Division

The vegetation of Greater Karachi can be divided into three edaphic types. The coastal vegetation consists of three main associations. In the protected creeks facing the mouth of the rivers in shallow water is found mangrove vegetation consisting of mainly *Avicennia alba* Blume. In the muddy coastal swamps *Arthroenemum indicum* Moq is the main species. On the coastal sand dunes the main species consist of *Suaeda monoica* Forsk, *Ipomaea pes-caprae* Roth, *Aerua pseudo-tomentosa* Blatt and Hall, *Calotropis procera* Br. and *Tamarix troupii*, Hole. The vegetation of the calcarious rocks consists of mainly *Commiphora mukul* Engl., *Grewia villosa* Willd., *Grewia tenax* (Forsk) Boiss., *Euphorbia caudicifolia* Haines and *Acacia senegal* Willd. In the valleys between the hills where alluvium has been deposited over the basic rock by various rivers, the vegetation consists of *Capparis decidua* (Forsk) Edgew, *Prosopis spicigera L.* and *Salvadora oleoides* Dcne.

Table 3.8: Trees and Shrubs of Kohistan/Kirthar /Hilly area of Karachi Districts[17]

Botanical Name	Local Name
Caparis aphyla	Kirir
Salvadora oleoides	Khabar
Acacia Senegal	Kunbhat
Acacia nilotica	Babur/Babul
Acacia jacquemontii	Baori
Prosopis cineraria	Kandi
Prosopis juliflora	Mesquit, devi
Tecoma undulate	Lohiro
Euphorbia caudicifolia	Thuar
Tamarix aphylla	Lai
Tamarix dioca	Lawa
Ziziphus numularia	Ber
Commiphora wightii	Gugal
Saccharum spontaneum	Sar-kana/kaanhn

[17] EMC Pakistan Database

Table 3.9: Grasses and Herbs of Karachi Division[18]

Botanical Name	Local Name
Aristida adscenciones	Lumb
Aristida funiculate	Lumb
Cenchrus biflorus	Bhurt
Cenchrus ciliarus	Dhaman
Chrysopogon aucheri	Putar
Cymbopogon jawarncusa	Poi
Desmostyches bipinnata	Dubh
Dicanthium annulatum	-
Lasiurus sindicus	Sain
Lasiurus hirsutus	-
Leersa spp.	-
Rhazia stricta	Senor
Indigofora oblongifolia	Jhil
Alhaji maurorum	Kandero

The level of anthropogenic activity in the project area is high. Some of the communities in the area have been involved in the practice of cutting the woods (*Prosopis juliflora*) for their livelihood and fuel. This has resulted in loss of natural habitat by transforming the area into barren land. The natural scrub forest once occupying the macroenvironment has been degraded and most of the area has been converted to barren piece of land. As a result of this ecological shift, most of the endemic wildlife has either left or become locally extinct.

3.2.2. Fauna

Among the wild animals, the Sareh or Sindh ibex (*Capra aegagrus blythi*), Urial or Gadh or wild sheep (*Ovis aries vignei*), and black bear (*Ursus thibetanus*) are found in the western rocky range, where the leopard is now rare. The Pirrung (large tiger cat or fishing cat) (*Prionailurus viverrinus*) of the eastern desert plains is also disappearing. Deer (*Cervidae*) live in the lower rocky plains and in the eastern region, as do the Charakh or Striped hyena (*Hyaena hyaena*), Golden jackal (*Canis aureus*), Fox (*Vulpes vulpes*), Indian crested porcupine (*Hystrix indica*), Indian grey mongoose (*Herpestes edwardsii*), and Hedgehog (Erinaceinae). The Sindhi phekari or red lynx or Caracal cat (*Caracal caracal*) is encountered in some areas. Pharrho or Indian hog deer (*Axis porcinus*) and wild boar (Sus scrofa) occur particularly in the central inundation belt. There is a variety of bats, lizards, and reptiles, including the King cobra (*Ophiophagus hannah*), Lundi or Viper (*Viperidae*), and the Peean, the mysterious Sind krait (*Bungarus sindanus*) of the Thar region, which is supposed to suck the victim's breath in his sleep. Crocodiles (*Crocodylinae*) are rare and inhabit only the backwaters of the Indus and its eastern Nara channel. Besides a large variety of marine fish, the Indian humpback dolphin (*S. plumbea*), the beaked dolphin (*Lagenorhynchus albirostris*), Humpback whale (*Megaptera novaeangliae*), and a variety of skates frequent the seas along the Sindh coast. The Pallo Sable fish (*Anoplopoma fimbria*), though a marine fish, ascends the Indus annually from February to April to spawn and returns to the sea in September. The Bulhan or Indus river dolphin (*Platanista gangetica minor*) breeds in the Rohri-Sukkur section of the river[19].

[18] Ibid.
[19] Forest Department - GOS

3.2.2.1. Nara Desert Wildlife Sanctuary, Districts Ghotki, Sukkur and Khairpur[20]

The Nara Desert Wildlife Sanctuary (NDWS) is located in the eastern part of Sindh (Fig.3.26), in the talukas Rohri, Salehpat, Khangarh, Mirpur Mathelo and Nara. The total area of the Sanctuary is about 6300 km^2 covering parts of the Sukkur, Ghotki and Khairpur districts.

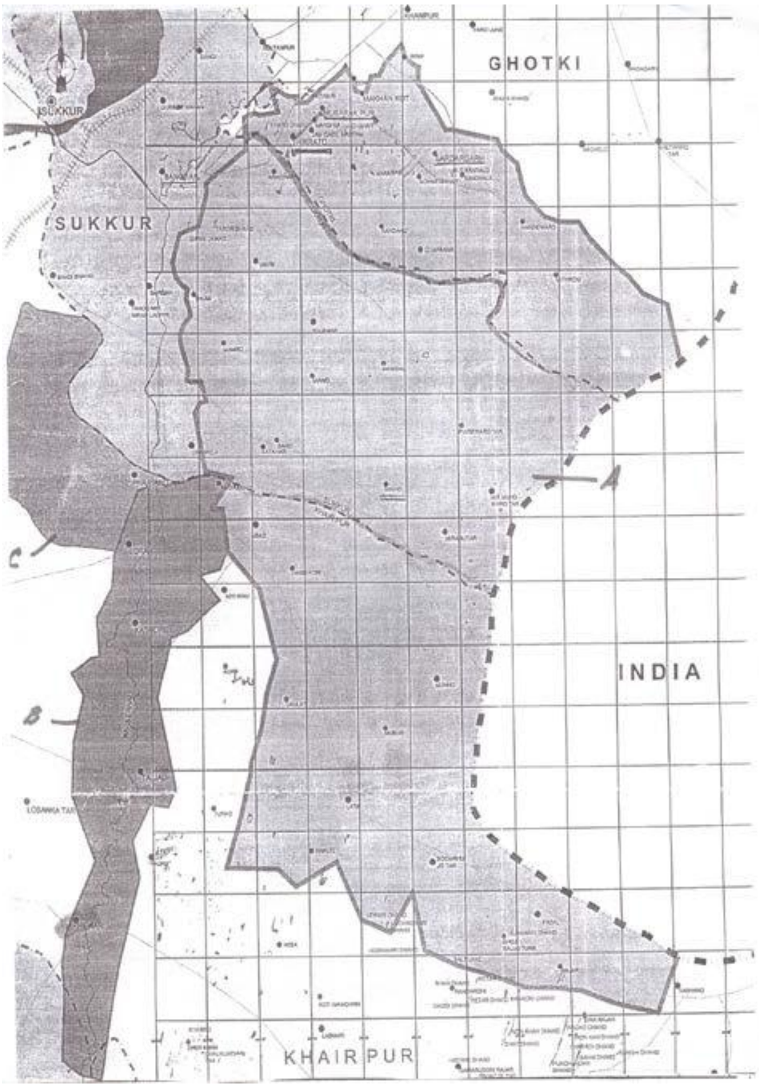

Figure 3.27: The Nara Desert Wildlife Sanctuary is located in the eastern part of Sindh Province

The sanctuary (26° 40'N/69° 05'E) was notified in 1980 to give protection to the key species viz.: chinkara, desert fox, ratel or honey badger, marbled teal, grey partridge, houbara bustard and imperial sand grouse. The NW and western area of the sanctuary is mostly sandy with some agriculture areas. There are several scattered small villages. There are some wetlands in the area. The SE and Eastern part of the sanctuary lies along the 10km broad border belt. The area is sandy with scanty vegetation. The central part of the sanctuary comprises of sand dunes area with some interdunal flat area having scattered trees and shrubs. There are some villages in the area. As many as 28 species of mammals, 78 species of birds, 16 species of reptiles and 25 species of common plants have been recorded from the area as presented below:

[20] Pakistan J. Zool., vol. 40(1), pp. 37-43, 2008 - Bioecology of Nara Desert Wildlife Sanctuary, Districts Ghotki, Sukkur and Khairpur, Sindh

Table 3.10: List of mammals recorded in Nara Desert Wildlife Sanctuary

S#	Common name	Scientific name	Status*
1.	Long eared desert hedgehog	*Hemiechinus collaris*	LC
2.	Caracal or red lynx	*Felis caracal*	CR
3.	Jungle cat	*Felis chaus prateri*	LC
4.	Indian desert wild cat	*Felis silvestris ornate*	DD
5.	Indian mongoose	*Herpestes edwardsi ferrugineus*	LC
6.	Small, Indian mongoos	*Herpestes javanicus*	LC
7.	Indian wolf or grey wolf	*Canis lupus pallipes*	E
8.	Asiatic jackal	*Canis aureus*	Nt
9.	Indian or Bengal fox	*Vuples bengalensis*	Nt
10.	Desert fox	*Vuples vulpes greffithi*	Nt
11.	Striped hyaena	*Hyaena hyaena*	CR
12.	Ratel or honey badge	*Mellivora capensis*	CR
13.	Indian Pangolin or scaly anteater	*Manis crassicaudata*	VU
14.	Chinkara or Indian gazelle	*Gazella bennettii*	VU
15.	Indian wild boar	*Sus scrofa davidi*	LC
16.	Indian hare or desert hare	*Lepus nigricollis dayanus*	LC
17.	Northern palm squirrel or five – striped palm squirrel	*Funambulus pennanti*	Nt
18.	Indian crested porcupine	*Hystrix indica bylanfordi*	Nt
19.	Soft furred field rat or Matad	*Millardia meltada pallidior*	LC
20.	Sand-coloured rat	*Millardia gleadowi*	LC
21.	Roof rat or house - rat or black rat	*Rattus rattus*	LC
22.	House mouse	*Mus musculus*	LC
23.	Little Indian field mouse	*Mus booduga*	LC
24.	Short tailed mole rat	*Nesokia indica*	LC
25.	Balochistan gerbil or pygmy gerbil	*Gerbillus nanus*	Nt
26.	Indian hairy – footed gerbal	*Gerbillus gleadowi*	LC
27.	Indian gerbil or antilope-rat	*Tatera indica*	LC
28.	Indian desert jird	*Meriones hurrianae*	LC

**Abbreviations used: CR, critically endangered; E, endangered; LC, least concern; Nt, near – threatened; VU, vulnerable*

Table 3.11: A check list of the birds of Nara Desert Wildlife Sanctuary

S#	Scientific name	Common name
1.	*Tachybaptes ruficollis*	Little grebe or dabchick
2.	*Ardea cinerea*	Grey heron
3.	*Anas crecca*	Common teal
4.	*Anas platyrhynchos*	Mallard
5.	*Anas ciypeata*	Shoveller
6.	*Netta rufina*	Red crested pochard
7.	*Elanus caeruleus*	Black winged kite
8.	*Accipiter nisus*	Asiatic sparrow-hawk
9.	*Butastur teesa*	White-eyed buzzard eagle
10.	*Gyps bengalensis*	Indian whitebacked vulture
11.	*Neophron percnopterus*	Egyptian vulture
12.	*Circus aeruginosus*	Marsh harrier
13.	*Circaetus gallicus*	Short-toed eagle
14.	*Falco tinnunculus*	Kestrel
15.	*Francolinus pondicerianus*	*Grey partridge*
16.	*Fulica atra*	*Coot*
17.	*Chlamydotis undulata*	*Houbara bustard*
18.	*Vanellus indicus*	Red wattled lapwing
19.	*Charadrius alexandrinus*	Kentish plover
20.	*Tringa totanus*	Common redshank

21.	*Tringa hypoleucos*	Common sandpiper
22.	*Calidris minutus*	Little stint
23.	*Calidris aipinus*	Dunlin
24.	*Phalaropus lobatus*	Rednecked phalarope
25.	*Himantopus himantopus*	Indian blackwinged stilt
26.	*Streptopelia decaocto*	Ring dove
27.	*Streptopelia senegalensis*	Little brown or senegal dove
28.	*Athene brama*	Northern spotted owlet
29.	*Caprimulgus mahrattensis*	Syke's or sind nightjar
30.	*Alcedo atthis*	Indian small blue kingfisher
31.	*Halcyon smyrnensis*	Whitebreasted kingfisher
32.	*Merops superciliosus*	Blue cheeked bee-eater
33.	*Merops orientalis*	Sind small green bee-eater
34.	*Coracias benghalensis*	Roller or blue jay
35.	*Picoides adsimilis*	Sind pied woodpecker
36.	*Eremopterix nigriceps*	Blackcrowned finch-lark
37.	*Alaemon alaudipes*	Hoopoe lark
38.	*Calendrella brachydactyla*	Great short-toed lark
39.	*Melanocorypha bimaculata*	Calandra lark
40.	*Riparia riparia*	Collared sand martin
41.	*Hirundo rustica*	Western swallow
42.	*Lanius excubitor*	Grey shrike
43.	*Lanius schach*	Rufous-backed Shrike
44.	*Sturnus roseus*	Rosy starling or rosy pastor
45.	*Acridotheres tristis*	Indian myna
46.	*Dendrocitta vagabunda*	Tree pie
47.	*Corvus splendens*	Sind house crow
48.	*Corvus corax*	Raven
49.	*Tephrodomis pondicerianus*	Sind wood shrike
50.	*Pycnonotus ieucogenys*	White-eared bulbul
51.	*Pycnonotus cafer*	Red-vented Bulbul
52.	*Turdoides caudatus*	Common babbler
53.	*Turdoides striatus*	Sind jungle babbler
54.	*Rhipidura aureola*	Northern white browed fantail flycatcher
55.	*Prinia gracilis*	Indian streaked wren-warbler
56.	*Prinia burnesii*	Western longtailed grass warbler
57.	*Sylvia curruca*	Lesser whitethroat
58.	*Sylvia nana*	Desert warbler
59.	*Phylloscopus collybita*	Chiffchaff
60.	*Phylloscopus neglectus*	Plain leaf warbler
61.	*Phoenicurus ochruros*	Black redstart
62.	*Saxicola caprata*	Pied bush chat
63.	*Oenanthe isabellina*	Isabeline wheatear
64.	*Oenanthe xanthoprymna*	Redtailed wheatear
65.	*Oenanthe deserti*	Desert chat or desert wheatear
66.	*Oenanthe picata*	Pied chat
67.	*Oenanthe pleschenka*	Pied white bellied wheatear
68.	*Saxicoloides fulicata*	Brownbacked Indian robin
69.	*Motacilla flava*	Yellow wagtail
70.	*Motacilla maderaspatensis*	Large pied wagtail
71.	*Motacilla alba*	White or pied wagtail
72.	*Motacilla cinerea*	Grey wagtail
73.	*Nectarinia asiatica*	Sind purple sunbird
74.	*Passer domesticus*	House sparrow
75.	*Passer pyrrhonotus*	Sind jungle sparrow
76.	*Petronia xanthocollis*	Sind yellowthroated sparrow

77.	*Lonchura malabarica*	Common silverbill, whitethroated munia
78.	*Emberiza cia*	Rock bunting

Table 3.12: List of reptiles recorded in Nara Desert Wildlife Sanctuary

S#	Scientific name	Common name
1.	Indian fringe-toed sand lizard	*Acanthodactylus cantoris*
2.	Indian desert monitor	*Varanus griseus*
3.	Indian monitor lizard	*Varanus bengalensis*
4.	Indian spiny-tailed lizard	*Uromastix hardwicki i*
5.	Indian sand swimmer	*Ophiomorus tridactylus*
6.	Sind sand gecko	*Crossobamon orientalis*
7.	Indian garden lizard	*Calotes versicolor versicolor*
8.	Black-tailed toed agama	*Brachysoura minor*
9.	Brilliant agama	*Trapelus agilis*
10.	Afghan ground agama	*Trapelus megalonyx*
11.	Indian cobra	*Naja naja*
12.	Russell's viper	*Daboia russelii russelii*
13.	Saw-scaled viper	*Echis carinatus*
14.	Indian sand boa	*Eryx johnii*
15.	Glossy bellied racer	*Platyceps ventromaculatus ventromaculatus*

Sindh Wildlife Management Board has published a map of Wildlife of Sindh Province covering all districts of Sindh. The map is presented below figure. The species recorded in AAP district based on the map are presented in below table:

Table 3.13: Species recorded in AAP Districts as per Sindh Wildlife Management Board Map

S No.	Common name	Scientific name	Status
District Ghotki			
1.	Indian Fox	*Vulpes bengalensis*	Common
2.	Red Fox	*Vulpes vulpes*	Common
3.	Small Indian Civet	*Viverricula Indica*	Rare
4.	Chinkara	*Gazella gazelle bennetti*	Rare
5.	Sandgrouse	*Pteroclididae*	Endangered
District Sukkur			
S No.	**Common name**	**Scientific name**	**Status**
1.	Jackal	*Canis aureus*	Common
2.	Indian Fox	*Vulpes bengalensis*	Common
3.	Jungle Cat	*Felis chaus*	Common
4.	Fishing Cat	*Felis viverrina*	Endangered
5.	Smooth Indian Otter	*Lutra perspicillata*	Rare
6.	Hog Deer	*Axis porcinus*	Endangered
7.	Chinkara	*Gazella gazelle bennetti*	Rare
8.	Indus river dolphin	*Platanista gangetica minor*	Endangered
9.	Grey Partridge	*Francolinus Pondicerianus*	Common
10.	Birds of prey	-	Status uncertain
11.	Houbara Bustard	*Chlamydotis undulata macqueenii*	Endangered
12.	Marsh crocodile	*Crocodylus palustris palustris*	Endangered
13.	Gavial	*Gavialis gangeticus*	Endangered
District Khairpur			
1.	Jackal	*Canis aureus*	Common
2.	Stripped Hyena	*Hyaena hyaena*	Rare
3.	Indian Fox	*Vulpes bengalensis*	Common
4.	Red Fox	*Vulpes vulpes*	Common
5.	Desert Cat	*Fells libyca*	Rare

6.	Jungle Cat	*Felis chaus*	Common
7.	Smooth Indian Otter	*Lutra perspicillata*	Rare
8.	Chinkara	*Gazella gazelle bennetti*	Rare
9.	Black Partridge	*Francolinus francolinus asiae*	Common
10.	Grey Partridge	*Francolinus Pondicerianus*	Common
11.	Birds of prey	-	Status uncertain
12.	Waterfowl	*Anseriformes*	Common
13.	Houbara Bustard	*Chlamydotis undulata macqueenii*	Endangered
14.	Sandgrouse	*Pteroclididae*	Endangered
15.	Marsh crocodile	*Crocodylus palustris palustris*	Endangered
District Naushahro Feroze			
1.	Indian Fox	*Vulpes bengalensis*	Common
2.	Hog Deer	*Axis porcinus*	Endangered
3.	Black Partridge	*Francolinus francolinus asiae*	Common
4.	Grey Partridge	*Francolinus Pondicerianus*	Common
5.	Birds of prey	-	Status uncertain
6.	Waterfowl	*Anseriformes*	Common
District Shaheed Benazirabad			
1.	Jackal	*Canis aureus*	Common
2.	Jungle Cat	*Felis chaus*	Common
3.	Fishing Cat	*Felis viverrina*	Endangered
4.	Hog Deer	*Axis porcinus*	Endangered
5.	Black Partridge	*Francolinus francolinus asiae*	Common
6.	Grey Partridge	*Francolinus Pondicerianus*	Common
7.	Birds of prey	-	Status uncertain
8.	Waterfowl	*Anseriformes*	Common
District Matiari			
1.	Indian Pangolin	*Manis Crassicaudata*	Rare
2.	Jackal	*Canis aureus*	Common
3.	Black Partridge	*Francolinus francolinus asiae*	Common
4.	Grey Partridge	*Francolinus Pondicerianus*	Common
5.	Waterfowl	*Anseriformes*	Common
District Tando Allah Yar			
1.	Indian Pangolin	*Manis Crassicaudata*	Rare
2.	Jungle Cat	*Felis chaus*	Common
3.	Birds of prey	-	Status uncertain
District Hyderabad			
1.	Hog Deer	*Axis porcinus*	Endangered
2.	Black Partridge	*Francolinus francolinus asiae*	Common
3.	Grey Partridge	*Francolinus Pondicerianus*	Common
4.	Birds of prey	-	Status uncertain
District Karachi (Malir)			
1.	Leopard or Panther	*Panthera pardus)*	Endangered
2.	Wolf	*Canis lupus pallipes*	Vulnerable
3.	Red Fox	*Vulpes vulpes*	Common
4.	Jungle Cat	*Felis chaus*	Common
5.	Urial	*Ovis orientallis*	Endangered
6.	Grey Partridge	*Francolinus Pondicerianus*	Common
7.	Birds of prey	-	Status uncertain
8.	Waterfowl	*Anseriformes*	Common
9.	Houbara Bustard	*Chlamydotis undulata macqueenii*	Endangered
District Karachi West			
1.	Jackal	*Canis aureus*	Common
2.	Birds of prey	-	Status uncertain
3.	Waterfowl	*Anseriformes*	Common
4.	Marine turtle	*Chelonioidea*	Endangered

5.	Marsh crocodile	*Crocodylus palustris palustris*	Endangered
District Karachi South			
1.	Marine turtle	*Chelonioidea*	Endangered
2.	Sea snake	*Hydrophiinae*	Common

** Urban areas of Karachi Division lacks wildlife due to urbanization and human interventions.*

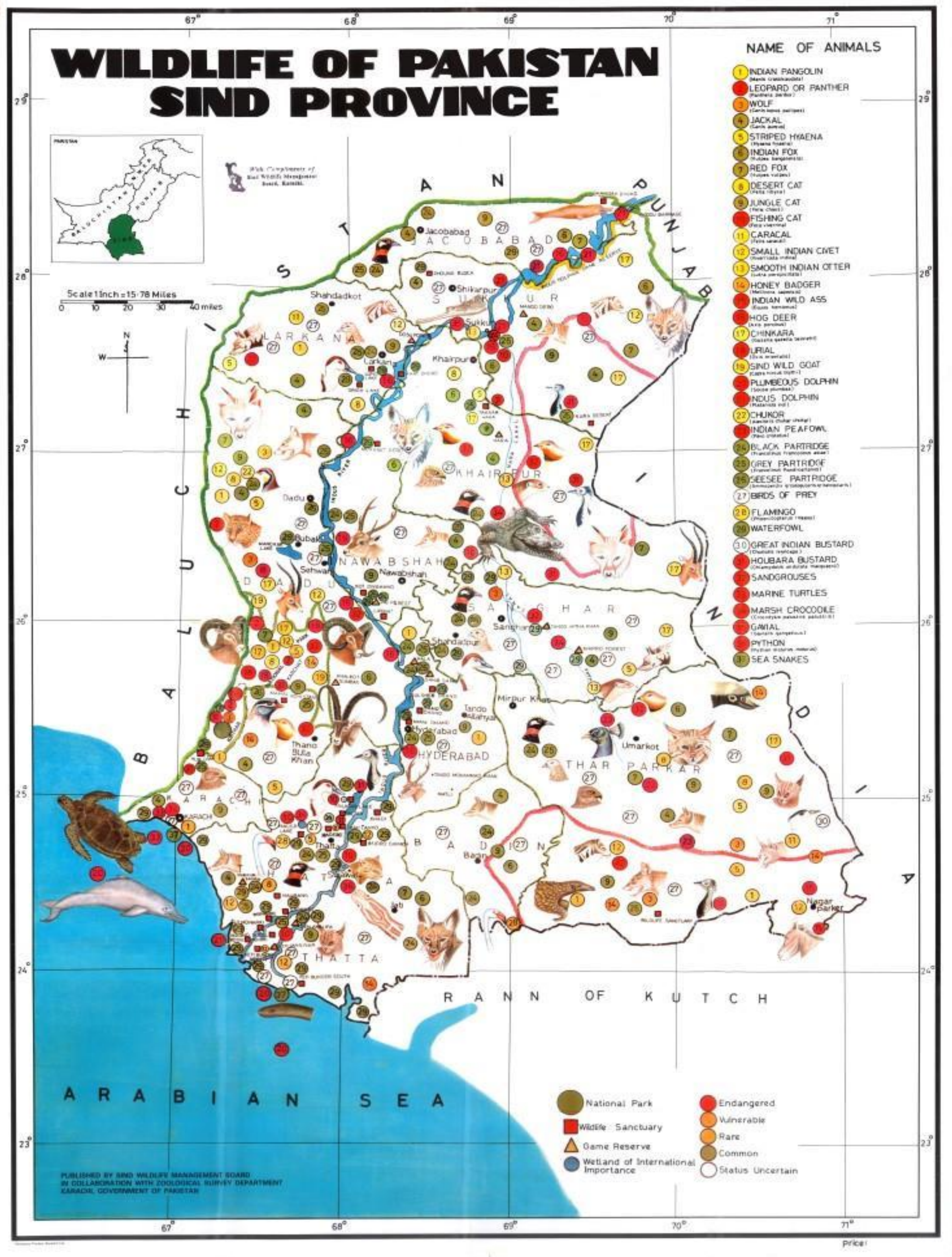

Figure 3.28: Wildlife of Sindh Province[21]

[21] Wildlife of Sindh Province – Published by Sindh Wildlife Management Board

3.2.3. Forests, Habitats and Ecologically Sensitive Areas

3.2.3.1. Protected areas

Wildlife Sanctuaries[22]

There are thirty-three wildlife sanctuaries in Sindh. The list of wildlife sanctuaries is presented in **Annex H**:

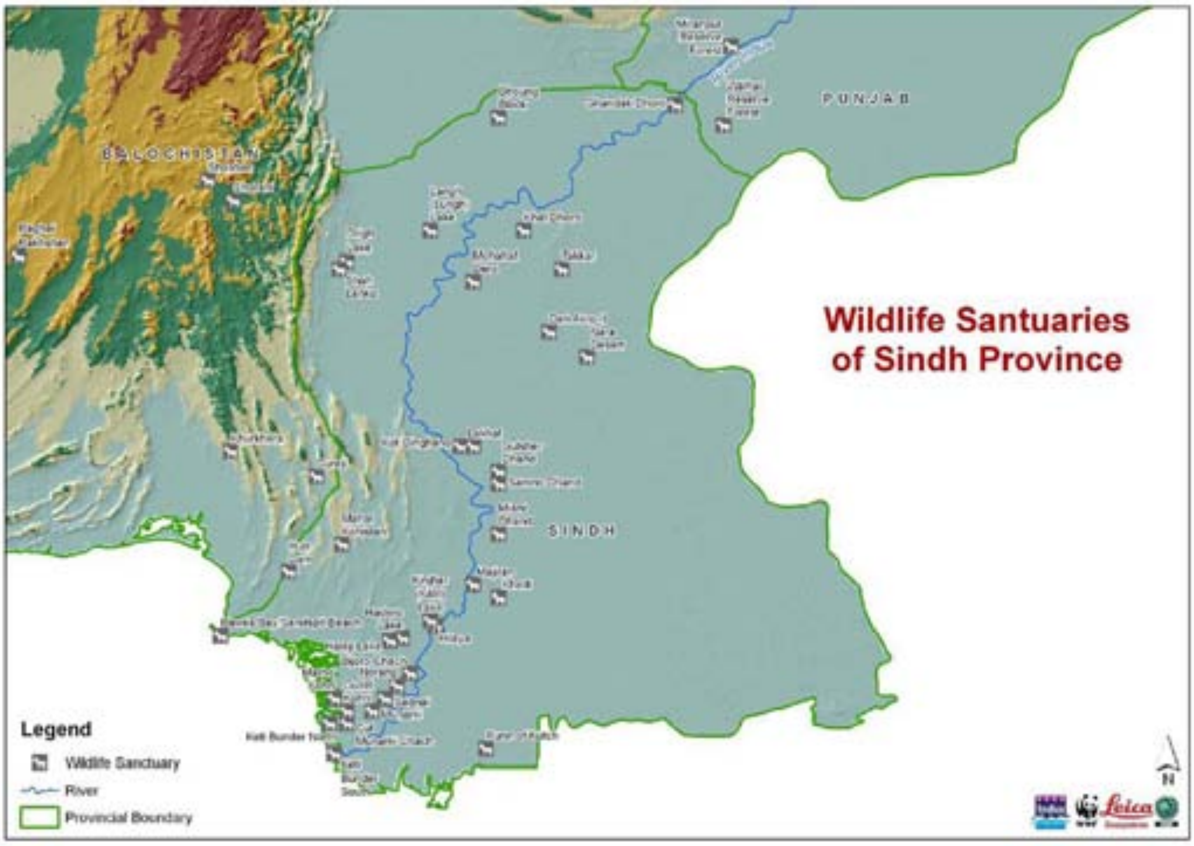

Figure 3.29: Locations of Wildlife Sanctuaries located in Sindh

Game Reserves

The Sindh Wildlife Department recognizes 13 game reserves present in the province of Sindh. The list of these site is presented in **Annex H**.

[22] Sindh Wildlife Department - GOS

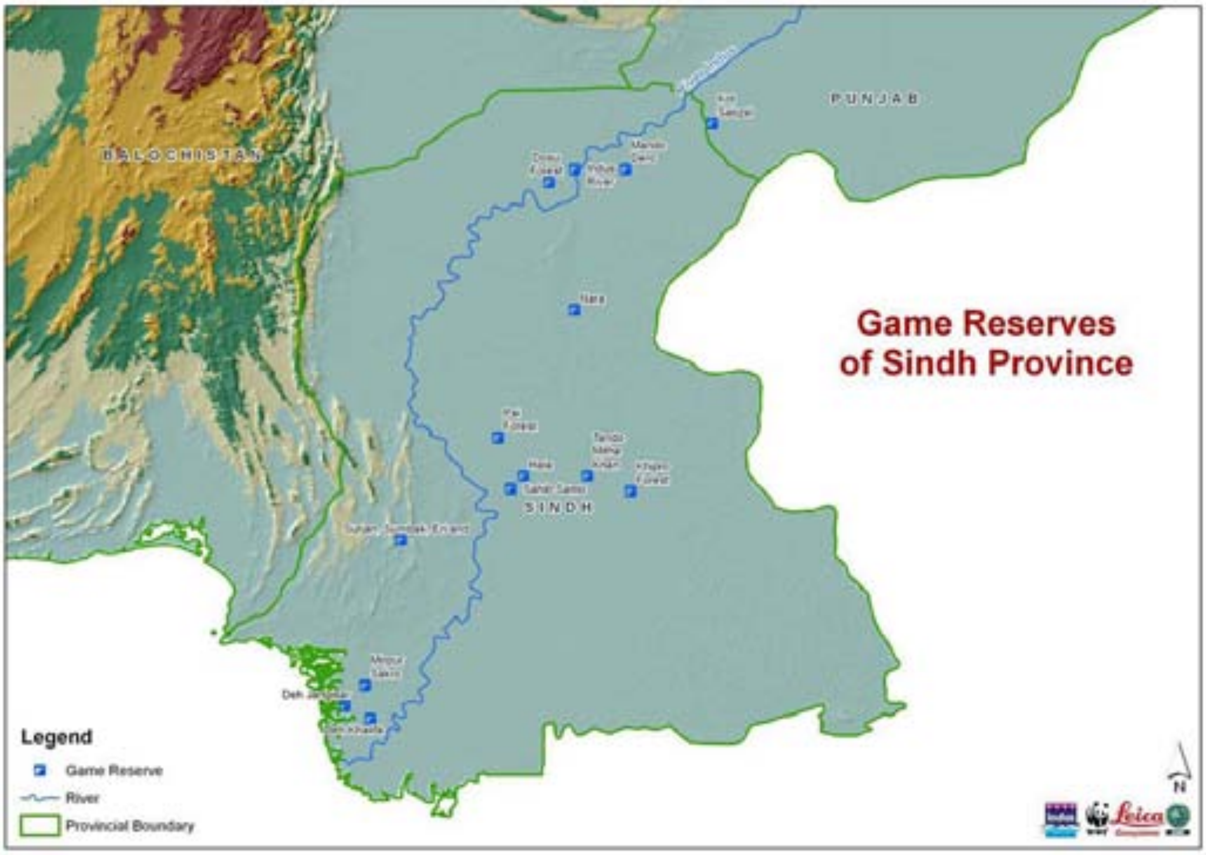

Figure 3.30: Locations of Game Reserves located in Sindh

3.2.3.2. Ramsar Sites

The Ramsar Convention on Wetland protection has been signed in Ramsar, Iran in 1971. As of March 2013, there are nineteen Ramsar sites, covering an area of 1,343,627 hectares (3,320,170 acres) in Pakistan in which 10 are located in Sindh. The list is provided in **Annex H**.

3.2.3.3. Forest Area

In Sindh, forests are under protection of Government of Sindh. The forestry resources of Sindh are classified in four different categories viz. Riverine Forests, Irrigated Plantations, Protected Forests and Mangrove Forests. The Riverine Forests of Sindh are confined to riverine tract of Indus within the protective embankments on both sides of the river. They are stretched from Northeast of the province to South near Arabian Sea where Indus falls in the sea. Irrigated Plantations are the main features of manmade plantations raised on canal irrigation system of river Indus. These plantations were raised mainly to meet the ever increasing demand of wood and wood products in the country in general and the province in particular. The grazing fields and unclassified wastelands of the province were declared as Protected Forests where the rights of the people are allowed more than that of reserved forests. The Indus delta mangroves, also categorized as protected forests, have great environmental value as they protect the coastal population from sea intrusion and serve as shield against cyclones which hit the coasts of Sindh occasionally.

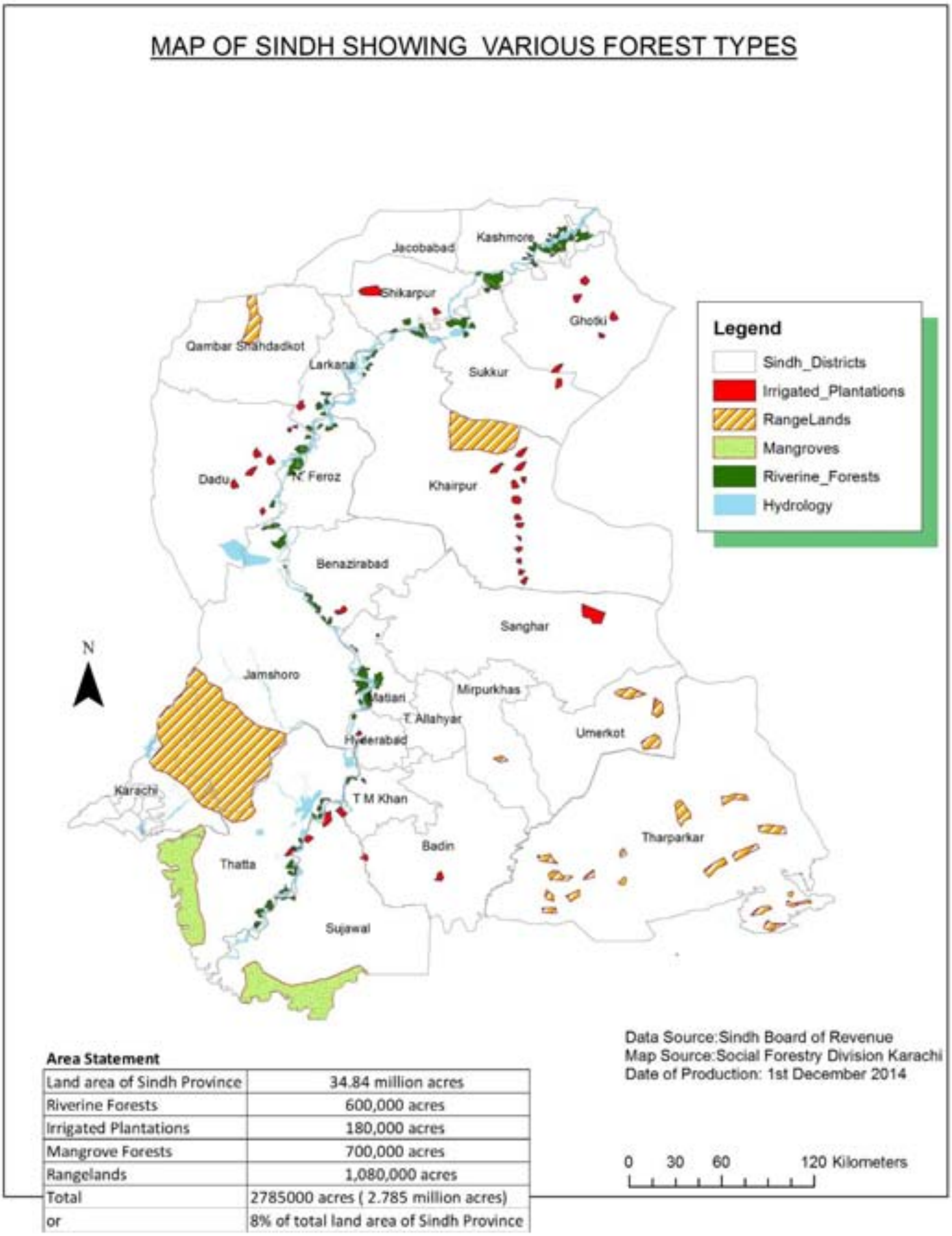

Figure 3.31: Forest areas located in Sindh Province (Source: Website of Forest Department (GOS))

3.3. Socioeconomic Profile

This Chapter presents a broad profile of the prevailing socioeconomic situation in the project districts of Sindh. This baseline has been prepared based upon the secondary literature resources as well as reconnaissance survey conducted in all fourteen (14) districts covered in this addendum. Safeguard instrument (ESMP or Checklist) to be prepared for each subcomponent will include district-specific baseline conditions. The subsequent section will include the existing conditions of sanitation, agriculture, poverty, education, health, available infrastructure, demography, labor and employment etc.

Table 3.14: District-wise administrative profile

District	Area (sq.Km)	No of Talukas	No of Union Councils	No of Mouza
Ghotki	6,432.59	5	42	349
Hyderabad	1,021	3	53	85
Khairpur	15,910	8	76	411
Matiari	1,458.03	3	19	123
Naushahro Feroze	2,945	5	41	233
Shaheed Benazirabad	4,665	5	51	321
Sukkur	5,255	5	46	271
Tando Allahyar	1,588	3	19	87
Karachi Central	3,671.39	-	42	-
Karachi East		-	26	-
Karachi West		-	30	-
Karachi South		-	30	-
Korangi (Karachi)		-	28	-
Malir (Karachi)		-	22	-

Source 1: District, Pakistan Emergency Situation Analysis program, by USAID; Source 2: Development Statistics of Sindh 2013 prepared by the Bureau of Statistics, Government of Sindh, Source

3.3.1. Demographic Profile

The average population density of the 14 districts is 1,010 persons per square km, based on population projection 2013. The population of the selected districts constitutes about 60 percent of province's total population (2013). The population of the Sindh province, which was 30.44 million in the 1998 Census, stands at an estimated 46.06 million (2013). The average population growth rate for the Sindh province was 2.8 percent per annum, as of 1998 census. Table KA1 in **Annex K** provide the district specific data.

3.3.2. Poverty

Poverty is increasing with passage of time in Sindh rural areas. In case of urban areas, poverty is more evident in slums and katchi abadies. The main causes of poverty are traditional agricultural practices, fragmented landholdings, non-availability of safe drinking water and sanitation facilities, low literacy rate, inadequate institutional arrangements for addressing social sector problems, and lack of access to social justice system. Table KB1 in **Annex K** provide the district specific data.

3.3.3. WASH Indicators

In the MICS survey, mothers or caretakers were asked whether their child under age five years had an episode of diarrhoea in the two weeks prior to the survey. In cases where mothers reported that the child had diarrhoea, a series of questions were asked about the treatment of the illness, including what the child had been given to drink and eat during the episode and whether this was more or less than what was usually given to the child.

The overall period-prevalence of diarrhea in children under 5 years of age for selected district is 31.8 percent (Table 4.6). The highest period-prevalence is seen among children age 12-23 months which grossly corresponds to the weaning period.

Table 3.15: Percentage of children age 0-59 months for whom the mother/caretaker reported an episode of diarrhea, fever, and/or symptoms of acute respiratory infection (ARI) in the last two weeks, by district, Sindh, 2014;	
District	**Children (age 0-59 months) with diarrhea (%)**
Ghotki	26.8
Hyderabad	39.0
Khairpur	30.9
Matiari	31.2
Naushahro Feroze	36.8
Shaheed Benazirabad	35.1
Sukkur	33.8
Tando Allahyar	41.1
Karachi Central	24.1
Karachi East	27.2
Karachi West	28.1
Karachi South	30.8
Korangi (Karachi)	-
Malir (Karachi)	28.8
Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh	

The distribution of the population by main source of drinking water is shown in Table 4.7. The population using improved sources of drinking water are those using any of the following types of supply: piped water (into dwelling, compound, yard or plot, to neighbor, public tap/standpipe), tube well/borehole, protected well, protected spring, and rainwater collection. Bottled water is considered as an improved water source only if the household is using an improved water source for hand washing and cooking.

Overall, 94.1 percent of the population of selected districts is using an improved source of drinking water. Access to improved drinking water sources is higher for the population whose household head has higher education and is generally higher amongst those living in richer households.

Table 3.16: Percentage distribution of household population with improved and unimproved sources of drinking water		
District	**HH population with improved sources[23] (%)**	**HH population with unimproved sources[24] (%)**
Ghotki	100.0	0.0
Hyderabad	97.4	2.6
Khairpur	99.6	0.4
Matiari	99.1	0.9
Naushahro Feroze	98.3	1.7
Shaheed Benazirabad	98.7	1.3
Sukkur	99.4	0.6
Tando Allahyar	99.7	0.3
Karachi Central	98.8	1.2
Karachi East	96.4	3.6
Karachi West	57.3	42.7
Karachi South	93.3	6.7
Korangi (Karachi)	-	-
Malir (Karachi)	85.3	14.7
Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh		

In Sindh, 77.5 percent of the population is living in households of selected districts using improved sanitation facilities (Table KC1 in **Annex K)**. The table indicates that use of improved sanitation facilities is strongly

[23] Include piped water, tubewell/bore-hole, hand pump, protected well, rain-water collection, filtration plant, bottled water.
[24] Include unprotected well, tanker truck, cart with tank/drum, surface water, bottled water.

correlated with education of household head, wealth and is profoundly different between urban and rural areas. In Sindh, the most common facility is a flush toilet with connection to a sewage system (57.6 percent); this is the most common facility in both urban and rural areas although prevalence is much higher in urban areas (90 percent) than rural areas (22.1 percent). Open defecation is not uncommon in Sindh as a fifth (20.2 percent) of the population has no access to toilet facilities or does not use it. In rural areas, the percentage of the population practicing open defecation is 39.9 percent. Table FC1 and FC2 in **Annex K** provide the district specific data.

3.3.4. Nutrition Status

More than four out of ten children under the age of five in Sindh are underweight (42 percent) and 17 percent are classified as severely underweight[25].

Table 3.17: Percentage of children under age 5 by nutritional status according to three anthropometric indices: weight for age, height for age, and weight for height, by district, Sindh, 2014

District	Underweight[26] (%)	Stunting[27] (%)	Wasting[28]
Ghotki	42.7	52.8	14.3
Hyderabad	42.3	44.1	19.8
Khairpur	41.0	51.1	10.8
Matiari	51.6	54.8	16.0
Naushahro Feroze	41.4	44.5	17.5
Shaheed Benazirabad	43.5	54.9	14.2
Sukkur	43.7	50.8	13.1
Tando Allahyar	48.2	49.4	19.8
Karachi Central	26.2	24.4	13.1
Karachi East	27.7	29.2	12.0
Karachi West	26.8	35.2	6.8
Karachi South	28.7	34.3	13.3
Korangi (Karachi)	-	-	-
Malir (Karachi)	28.5	32.9	16.5

Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh

In Sindh province, Global Acute Malnutrition (GAM) rate of 17.5% and Severe Acute Malnutrition (SAM) rate of 6.6% was recorded in the NNS 2011[29].

[25] MICS 2014, Sindh
[26] MICS indicator 2.1a and MGD indidcator 1.8 – Underweight prevalence (moderate and severe), percentage below – 2 SD,
[27] MICS indicator 2.2a - Stunting prevalence (moderate and severe), percentage below – 2 SD,
[28] MICS indicator 2.3a - Wasting prevalence (moderate and severe), percentage below – 2 SD,
[29] SQUEAC – Province Sindh, Pakistan; April – May 2013

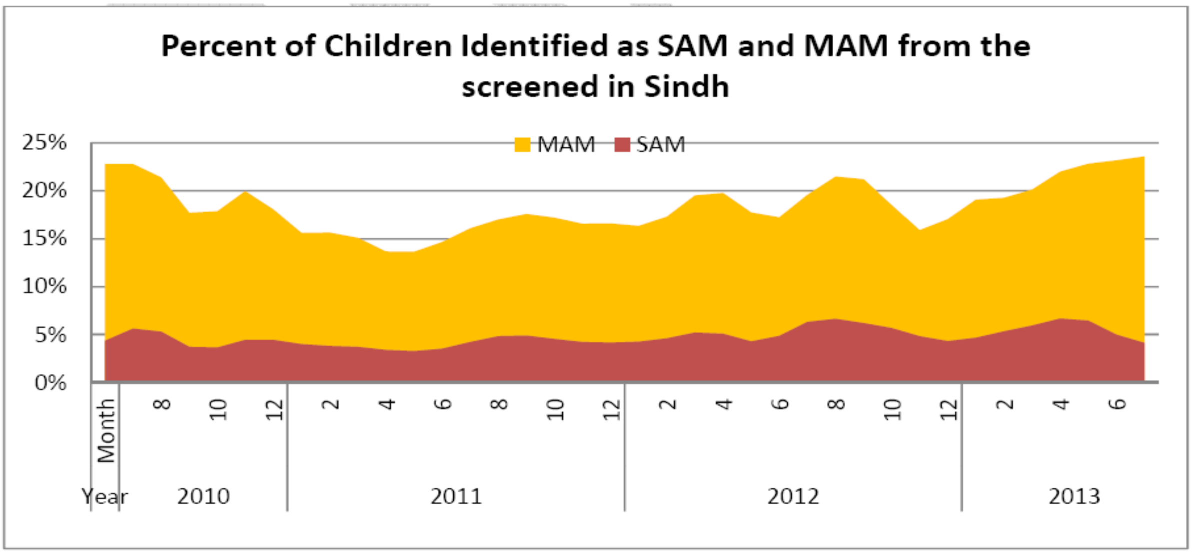

Figure 3.32: Percent of Children Identified as SAM and MAM in Sindh

Table KD in **Annex K** provide the district specific data.

3.3.5. Healthcare Facilities

These districts do not have a satisfactory network of healthcare services in the public sector. Tables OE1 and OE2 present overall status of healthcare facilities in the districts. As for infrastructure, staff residences were not available at the number of BHUs and Taluka Headquarter (THQ) hospitals. There is a shortage of blood banks and adequate number of pediatric nurseries at the THQ hospitals. There is a shortage of human resources at many of the health facility levels. There are severe shortages of general items. Most health facilities do not have the required supplies of drugs, vaccines, etc. Table KE in **Annex K** provide the district specific data.

In Sindh, almost half of children (48 percent) are moderately stunted or too short for their age and 15.4 percent are moderately wasted or too thin for their height. Only 1 percent of children are overweight or too heavy for their height. Table 4.8 depicts that in selected districts, 52.5 percent of children under the age of five are underweight, 60 percent stunted and 18 percent wasted. Proper feeding of infants and young children can increase their chances of survival; it can also promote optimal growth and development, especially in the critical window from birth to 2 years of age. Breastfeeding for the first few years of life protects children from infection, provides an ideal source of nutrients, and is economical and safe. However, many mothers don't start to breastfeed early enough, do not breastfeed exclusively for the recommended 6 months or stop breastfeeding too soon. There are often pressures to switch to infant formula, which can contribute to growth faltering and micronutrient malnutrition and can be unsafe if hygienic conditions, including safe drinking water are not readily available. Studies have shown that, in addition to continued breastfeeding, consumption of appropriate, adequate and safe solid, semi-solid and soft foods from the age of 6 months onwards leads to better health and growth outcomes, with potential to reduce stunting during the first two years of life.[30]

[30] Bhuta Z. et al. (2013). Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? The Lancet June 6, 2013.

3.3.6. Educational Facilities

The education status is quite poor in these districts. There are primary, middle, matric and higher secondary schools in these districts. Most of the schools are understaffed and lack adequate facilities. Low literacy rates in the districts are alarming. Table KF in **Annex K** provide the district specific data.

3.3.7. Labor and Employment

The labor force is divided in rural and urban areas. Migration of people from rural to urban areas for employment opportunities and better socioeconomic conditions is an unending phenomenon in the districts. Growth of urban centers and establishment of some industrial estates / enterprises have all contributed towards increased urban employment opportunities in the districts. The number of unemployed people has recorded unprecedented increase over the years, mainly because of high population growth rate. Investments in social sectors such as education, health, housing, water and sanitation, agriculture, transport, infrastructure, and communications, etc. have not kept pace with rapidly growing population. District specific data for Sources of Employment has been extracted from the Report on Mouza Census 2008 (Sindh Province), published by Pakistan Bureau of Statistics (PBS) and is presented in Table KG in **Annex K**.

3.3.8. Agriculture, Livestock Activities and Use of Pesticide in Sindh

Agriculture is the predominant economic activity of most of the rural population of the districts. The principal sources of irrigation are the surface channels supplemented by tube-wells. Rainfall accounts only for a small proportion of the irrigation sources. Horticulture and aviculture are gaining popularity. Investments in sheep-, goat-, fish-, poultry-, and dairy-farming also exist.

The major field crops sown in Sindh consist of wheat, cotton, rice, and sugarcane which utilize 68% of the total cropped area. Sindh also produces horticulture crops of mango, banana, and chilies are the primary crops grown in this area. Among the horticultural crops, 73% bananas, 34% mangoes, and 88% of chilies are produced in Sindh.

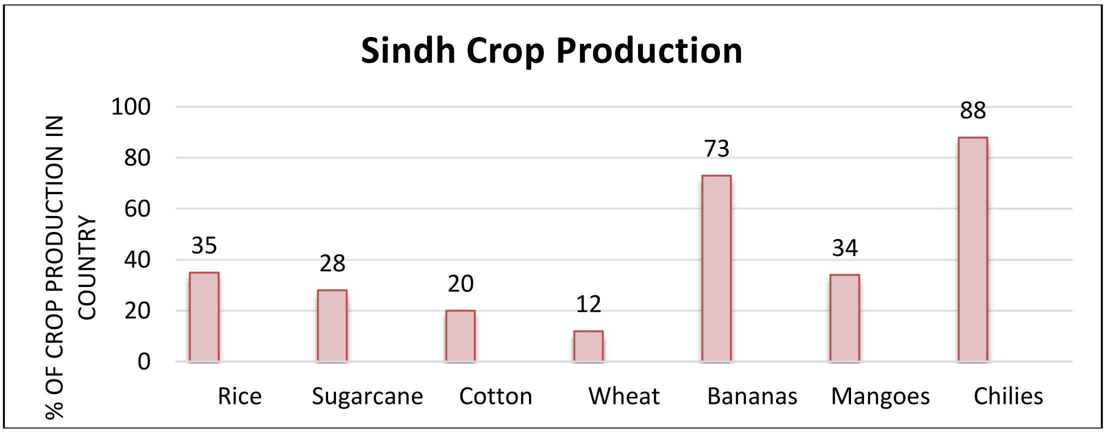

Figure 3.33: Percentage of Crops Production in Sindh

Table 3.18: Crops area and production (2012-13) in target districts

Crop / Area Production	Ghotki	Khairpur	Sukkur	S.B.Abad	Naushahro Feroze	Hyderabad	Matiari	Tando Allah Yar	Karachi
Jowar (Sorghum)									
Area (H)	2,267	2,895	1,925	145	275	37	295	129	250
Production (MT)	2,465	2,947	2,188	123	272	36	213	78	240
Bajra									
Area (H)	9	167	12	126	31	15	343	390	….

Table 3.18: Crops area and production (2012-13) in target districts									
Crop / Area Production	Ghotki	Khairpur	Sukkur	S.B.Abad	Naushahro Feroze	Hyderabad	Matiari	Tando Allah Yar	Karachi
Production (MT)	6	94	7	76	18	10	200	189	….
Maize									
Area (H)	40	142	121	27	208	20	216	212	115
Production (MT)	42	136	128	25	204	22	258	197	126
Gram									
Area (H)	158	435	522	190	190	….	466	….	….
Production (MT)	158	426	500	190	190	….	460	….	….
Barley									
Area (H)	26	511	22	15	13	….	….	….	….
Production (MT)	15	252	11	7	7	….	….	….	….
Rapeseed & Mustard									
Area (H)	195	1,345	310	3,815	874	38	571	460	….
Production (MT)	212	1 ,436	349	4 ,156	907	42	593	459	….

Note: Area (Hectare = H) and Production (Metric Tons = MT): Data for vegetables and pulses on Province Basis could not be segregated; The year 2011 remained abnormal due to heavy monsoon rains in Sindh, mainly in lower Sindh that affected the area under cultivation and production. Source: Development Statistics of Sindh 2012.

Agriculture in Arid Zones of Sindh

Since rain is the main source of water and therefore agriculture and livestock activities are dependent on rainfall, the failure of monsoon means no fodder for the cattle and livestock. The dug well is the only source of drinking water in the area. The underground water is largely brackish with limited spots of sweet water.

The population of cattle, buffaloes, sheep, goats and camels has become steadily more important in the livestock economy of Sindh during the last two livestock census as compared to other provinces.

Sindh is the major agricultural province after Punjab. The productivity of most of the crops of Sindh is higher as compared to Punjab. The population of cattle, buffaloes, sheep, goats and camels increased by more percentage in 1996 as compared to NWFP and Baluchistan. Sindh has a larger percentage of small and medium farmers as compared to Punjab. Since majority of the small and medium farmers are poor therefore they kept their own livestock for draught and milk purposes. Due to small holdings neither they can use machinery nor afford it[31].

Due to the increased population pressure from both (human and livestock) erratic pattern of rainfall, absence of road network, water, electricity, food shortage and its isolation from the rest of Pakistan is adding to the sense of impending doom. With the passage of time land management has become less effective resulting in increased desertification and degradation.

The main crops sowed immediately after the rain in arid zones, are sorghum, Bajra (millet) and Guwar. These crops require at least three rains of 100-150 mm in intensity are required in a one month interval for the crops to reach maturity. A good year in the arid zones is considered when it rains a minimum of three times during the monsoon season. Population in rural areas of arid zones, the major source of Income is rain-

[31] Indus Journal of Management & Social Sciences Vol. 1, No. 1, (Spring, 2007)

fed agriculture and livestock. According to the 1998 census the population of Arid Zones of Sindh is 2.041, arid zones and livestock population of 5.053 million and has a land area of 68,000 sq. km.

In economic terms the livestock sector in the Arid Zone is already significant, contributing about 30% to the value of the provincial livestock sector - mostly in meat, and meat by-products, hides and wool. The annual value of livestock and livestock products marketed each year from the Arid Zone is estimated at Rs. 750 million, contributing nearly 30% of wool production, 55% of meat and10% of all milk production in the province[32].

Use of Pesticides

Pesticide use is widely practiced in Sindh, intended to assist farmers in getting rid of pests, extended and indiscriminate has resulted in pest outbreaks as well as negative effects on people working in the agricultural fields and the surrounding environments. It has also disturbed the agro-ecosystem and killed non-target bio-control agents and environment friendly organisms including birds. Such a disturbance in agro-ecosystem has induced pest resurgence and increased the resistance in resident pest populations. Natural enemies of persistent common pests have been decreasing due to widespread and unchecked pesticide use. Some of other side effects of increased pesticide use have included the contamination of soil and water and chemical residues in the food chain.

In Sindh, ground plant protection measures (mostly pesticide sprays) are employed on 24% of the cropped area of all field crops including vegetables and orchards as compared to 21% on the national basis. However, plant protection on cotton and sugarcane account for 69% and 15% respectively of their cropped area in the province.

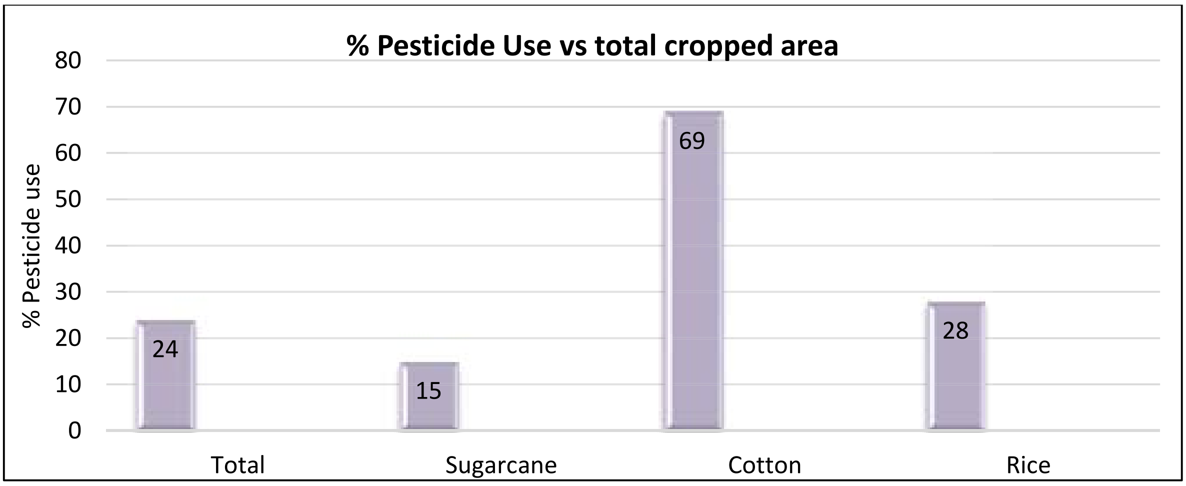

Figure 3.34: % Pesticide Use vs. total cropped area in Sindh

The indiscriminate use of pesticide, in addition to the health hazards, increased the cost of production. Considering the situation, various research organizations including Agricultural Research Institutes and Nuclear Institute of Agriculture recommended alternative techniques to control insect pests and diseases.

[32] Assessment Report on Drought in Arid Zones Of Sindh - TRDP

Government and non-government institutes are involved in pursuing the farmers to reduce the use of pesticide and to adopt sustainable measures such as Integrated Pest Management (IPM) practices.

High dependence on pesticides for pest control by untrained farmers has increased health hazards and polluted the rural environment. Pesticide use poses a threat to farmers, children, and women workers in fields who are at high risk of being poisoned (UNDP, 2001). The chronic poisoning due to pesticide can cause adverse immune functions, peripheral neuropathies, and allergic sensitization reactions, particularly of skin. The acute poisoning may vary from skin irritation to complex systematic illness resulting in death. Accidental exposure in homes from inappropriate storage of pesticides, poisoning caused due to the use of empty container of pesticides for carrying water are quite common (Yasmin, 2003).

Chemical-based pest control programs have disturbed the agro-ecosystem and killed the non-target and environment friendly organisms such as parasitoids, predators and birds. Besides, as many as 10,000 farmers are poisoned annually by indiscriminate use of pesticides in cotton growing areas of Pakistan (PARC, 1999). Besides, an excessive inappropriate use has induced pest resistance and resurgence. Studies showed that the populations of natural enemies in cotton growing areas have declined as much as 90% during the last decade (Hasnain, 1999).

The health cost of pesticide use is much higher than the cost of the pesticide itself. The social cost is enormous which is generally disregarded while determining the economic gains in terms of higher crop yields. These costs include: occupational poisoning, food residues, drinking water contamination, pest resistance, loss of biodiversity, cost of prevention and abatement measures and the cost of awareness campaigns. Further, there are health related issues; such as (a) Sickness Incidence of Pesticide Applicators, pesticide-related sickness is very common in the cotton zone as about 63% of households report sickness during the spraying season, mortalities are about 1 per 400 households while main reported ailments were vomiting, dizziness, and breathing problems; (b) Sickness in Women Cotton Pickers, about 87% women pickers complain of a variety of symptoms like headache, nausea, vomiting, skin irritation, general weakness, fever, dizziness, stomach pain, and blisters; (c) Industrial Worker Poisoning, about half of the labor force, working in the pesticide plants report sickness by inhaling pesticide emissions; and (d) Pesticide Residue in Food Chain, fruits and vegetables are contaminated with pesticide residues to the extent of 40% and 63%-70% of these are above the Maximum Residue Limit (MRL).

Pesticide residues also found in irrigation and drinking water, cotton seed, oil, lint and cattle feed, cottonseed cake, animal milk, and soil. Increased pesticide resistance is resulting in additional applications of pesticides to maintain expected crop yields. The consequences are lower yields and higher production costs. Pesticide use is affecting biodiversity too but it is little understood and appreciated.

Use of Fertilizers, Manures, Pesticides and Herbicides by Size of Farm

Following table provides the data on use of pesticides of overall Sindh and selected districts. The highest use of pesticides is in Matiari comprising 58 % of the total farms. The highest use of herbicide is in Ghotki comprising 47 % of total farms.

Area	Total Farms	Farms reporting use of									
		Fertilizers & Manures		Fertilizers Only		Manures Only		Pesticides		Herbicides	
		Number	%	Number	%	Number	%	Number	%	Number	%
Sindh	*1115285*	*187513*	*17*	*671206*	*60*	*13587*	*1*	*412430*	*37*	*196495*	*18*
Khairpur	122395	16370	13	79659	65	-	-	54710	45	26582	22
Hyderabad	16641	2765	17	12972	78	47	*	13574	82	2342	14
Shaheed Benazirbad	44961	4664	10	16482	37	899	2	15829	35	7481	17

Karachi	2837	121	4	35	1	6	*	62	2	9	*
Ghotki	94305	23179	25	63409	67	-	-	47870	51	44273	47
Khairpur	122395	16370	13	79659	65	-	-	54710	45	26582	22
Naushero Feroze	86777	21172	24	55937	64	377	*	42616	49	43626	50
Tando Allahyar	33339	8636	26	17692	53	9	*	16421	49	4406	13
Matiari	17646	1796	10	12657	72	6	*	10175	58	4203	24
Sukkur	37195	339	1	23530	63	22	*	9372	25	3031	8

* value less than 0.5

Source: Agricultural Census 2010: Government of Pakistan, Statistics Division, Agricultural Census Organization

3.3.8.1. Agro-Ecological Zones

The irrigated areas of the province have been divided into three major agro-ecological zones, two of which are further divided into sub-zones, as given below:

Zone A: Rice/wheat zone of the right bank of river Indus (upper Sindh) Sub-zone A1 Main area Sub-zone A2 Piedmont soil region

Zone B: Cotton/wheat zone of the left bank of river Indus Sub-zone B1 Guddu Barrage command area Sub-zone B2 Sukkur Barrage command area

Zone C: Rice/wheat/sugarcane zone of lower Sindh.

In addition to the above three zones, there are two more zones in Sindh. Zone D is a desert area in the east of Sindh, and Zone E is the western hilly zone. Main agricultural activities are, therefore, concentrated in the Zones A, B and C.

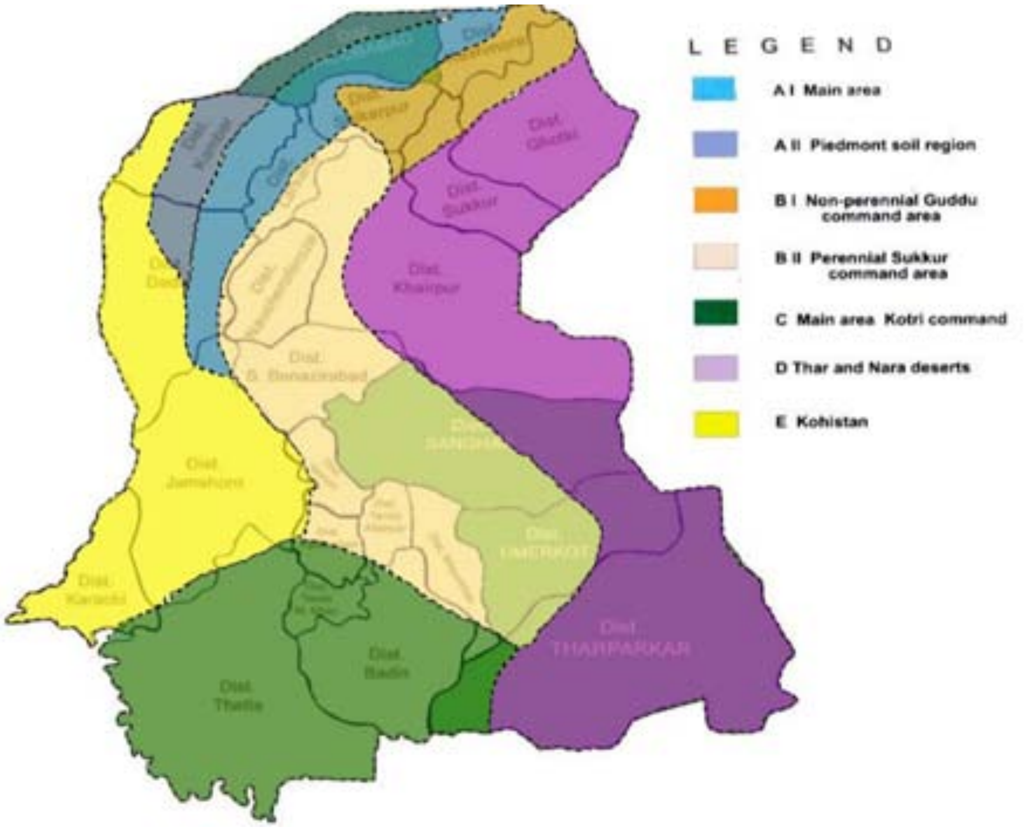

Figure 3.35: A4N Component Districts with overlapping of Agro-ecological Zones

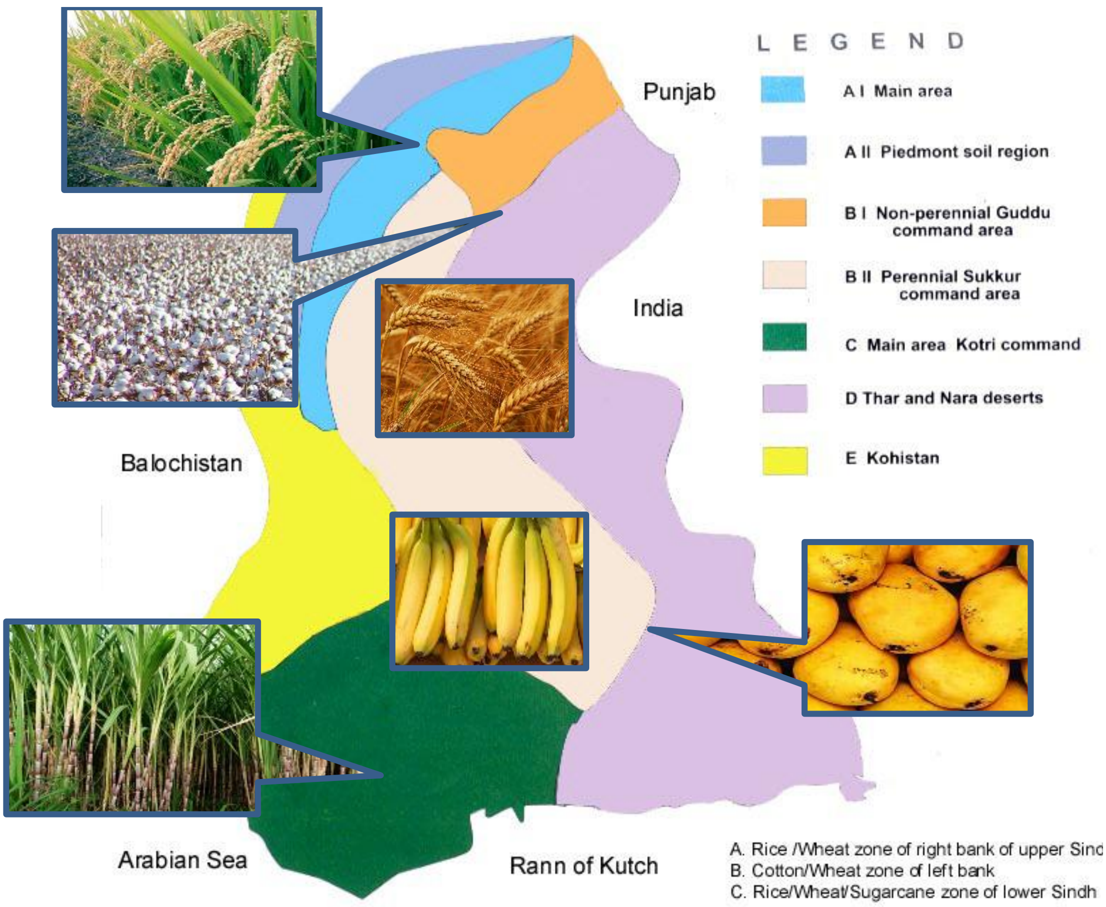

Figure 3.36: Agro-ecological Zones of Sindh[33]

3.3.9. Culture, Religion, Customs

These districts are rich with magnificent cultural heritage of ancient times and of early Islamic period, reflected through specimens of art, craft, literature, and architect. The population predominantly consists of Muslims. Sindhi is the native language and spoken widely, particularly in rural areas. However, other languages like Urdu, Balochi, Saraiki and Punjabi are also spoken in certain areas.

3.3.10. Indigenous People

Pakistan does not have any separate policy to define indigenous peoples or to protect their rights and cultural identities. However, the World Bank's Policy OP 4.10 on `Indigenous Peoples' defines indigenous peoples, in a generic sense of the term, to a distinct, vulnerable, social and cultural group possessing the following characteristics:

- Self-identification as member of a distinct indigenous cultural group and recognition of this identity by others;
- Collective attachment to geographically distinct habitat or ancestral territories in the project area and to the natural resources in these habitats and territories;
- Customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- An indigenous language, often different from the official language of the country of region.

[33] Pakistan Agricultural Research Council (PARC)

There are no indigenous people in the project districts.

3.3.11. Gender Issues

Generally, women in Pakistan are among the poorest and the most vulnerable sections of the society. Women's access and control over productive resources is limited, which ranks Pakistan amongst the countries with high maternal and infant mortality rates[34]. According to WB, the maternal mortality ration (MMR) was 178 per 100,000 live births in 2015, down from 431 in 1990[35]. Vulnerability of women to discriminatory treatment varies across classes, region, and the urban / rural populations. The indicators for Gender Issues are concerned with gender parity in wage employment, political representation and education[36].

Presently, women comprise a small percent of the public sector employees in the province; the quota for women in government jobs was 7%, as of 2015[37]. Those who are employed have limited horizontal mobility and are limited to social sector departments like education and health. Labor force participation rates remain low for women overall, at just 15.88 percent for the province as whole, compared to 70.3 percent for men[38]. Representation of women at the decision making level is also low. The provincial assembly of Sindh has 168 members, of which 29 are women; all of the women legislators have been nominated against seats reserved for women[39].

There is high evidence of gender disparity across the province of Sindh. The problem is more acute in rural areas, which needs to be addressed. GPIs for rural areas are likely to be much lower than those recorded for urban areas[40]. Gender disparity in education is a considerable and complex challenge for the Government of Sindh. The problem persists across all education indicators (literacy, net primary enrolment, and particularly primary school completion). Furthermore, Gender Parity Index (GPI[41]) for primary and matric schools (high school) for the province consistently fall below the national average, and the extreme variation across the districts requires policy measures to address these disparities and even out the progress.

Table 3.19: GPIs at Different Levels of Education (Females per Male)

District	GPI Primary	GPI Middle	GPI Matric	GPI Higher Secondary	Overall
Ghotki	0.49	0.64	0.27	0.73	0.48
Hyderabad	0.93	1.08	1.12	1.04	0.98
Khairpur	0.70	0.79	0.49	0.32	0.65
Matiari	0.67	0.58	0.56	0.08	0.64
Naushahro Feroze	0.72	0.89	0.36	0.66	0.68
Shaheed Benazirabad	0.61	0.79	0.47	0.63	0.60
Sukkur	0.67	1.12	0.47	0.86	0.68
Tando Allahyar	0.60	0.65	0.29	0.94	0.58
Karachi East Karachi West	1.09	1.52	1.58	1.49	1.27

[34] World Bank Indicators - Data
[35] Maternal mortality ratio (modeled estimate, per 100,000 live births) by World Bank
[36] Report On The Status Of Millennium Development Goals Sindh – October 2012 UNDP
[37] Sindh increases women's job quota to 7pc – The News
[38] Report On The Status Of Millennium Development Goals Sindh – October 2012 UNDP
[39] Members by District – Provincial Assembly of Sindh, 2013 till Date
[40] Report On The Status Of Millennium Development Goals Sindh – October 2012 UNDP
[41] Gender Parity Index (GPI) primary or secondary is defined as net enrolment rate of females at primary or secondary level divided by net enrolment rate of males in primary or secondary level

Table 3.19: GPIs at Different Levels of Education (Females per Male)

District	GPI Primary	GPI Middle	GPI Matric	GPI Higher Secondary	Overall
Karachi Central					
Karachi South					
Karachi Malir					
Karachi Korangi					

Source: Pakistan Social and Living Standards Measurement survey 2014-2015

The Gini index of education which measures the Educational inequality, was found to be highest at 0.726 for rural population and to be highest at 0.558 for urban population for Shaheed Benazirabad district in 2011 (as reported by Saeed. N and Fatima. A (2012): *Educational Inequality in Rural – Urban Sindh, PIDE*). About 47 percent of the population of the Sindh in age group 15 and above is illiterate and just 7.5 percent have obtained Graduation and higher degree. There is a clear disparity in educational attainments of the population in rural and urban areas, and across the districts in Sindh. Although, inequality declined between 2004-05 and 2010-11 but the extent of inequality remains high (above 58 percent in 2010-11). The Gini index is higher for rural areas as compare to the urban areas across districts indicating rural – urban disparity in education attainment[42].

3.3.12. Infrastructure Profile

There are wide variations in the availability of infrastructure facilities in the urban and rural areas as well as in different regions of the districts. Whereas availability and condition of roads in the cities is fair, it is quite deplorable in rural areas. As a part of its development agenda, the Government of Sindh is focusing attention on building of infrastructure. Construction of roads under various programs has somehow improved access to the most remote locations in these districts.

Ghotki	Ghotki district covers an area of 6,432 sq. kms yet it has only 394 kilometers of good quality roads, which are inadequate for the area and its population. National Highway (N-5) passes through this district, with a total length of 78km in the district. The existing road network in Ghotki district is fairly good. The district's headquarter, Mirpur Mathelo, is connected with its taluka headquarters of Ghotki, Khan Gharh, Ubauro, Dahakari through metaled roads. Two provincial highways comprising of a total length of 128 km.
Hyderabad	Hyderabad district covers an area of 1,021 sq. kms yet it has only 189 kilometers of good quality roads, which are inadequate for the area and its population. A National Highway (Indus Highway, N55) connects Hyderabad with other major cities of the province. A super highway (M9) connects Hyderabad with the provincial capital Karachi. The district headquarter of Hyderabad is linked with its taluka headquarters through metaled roads. Other important road links in Hyderabad district are given as under: ✓ Road from Hyderabad to Mirpur Khas via Tando Jam and Tando Allahyar. This road is further extended till Umerkot district ✓ Road from Hyderabad to Badin via Tando Muhammad Khan ✓ Road from Hyderabad to Keti Bunder via Thatta, Makli, Gharo ✓ Road from Hyderabad to Upper Sindh (Matiari, Hala, Sakrand, Moro, Nawabshah, Naushahro Feroze, Kandiaro, Ranipur, Khairpur, Sukkur) via national highway (N5) ✓ Road from Hyderabad to Dadu via Indus Highway (N55) ✓ Major towns lying on this road are Jamshoro, Manjhand, Sehwan.
Khairpur	District Khairpur, with an area of 15,910 square kilometers, has a population of 1,146,587. It is divided into eight taulkas: Khairpur, Gambat, Kingri, Sobodero, Kot Digi, Nara, Thari Mirwah and Gaiz Gang. It shares borders with districts of Larkana, Shaheed Banezirabad & Sukkur. National Highway (N-5) intersects the city of Khairpur

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	with a total length of 60km in the district. The existing road network in Khairpur district is fairly good. The district headquarter of Khairpur is connected with its taluka headquarters of Gambat, Kingri, Sobodero, Kot Digi, Nara, Thari Mirwah through metalled roads. Two provincial highways comprising a total length of 200 km.
Matirai	Matiari district covers an area of 141,000 hectares yet it has only 178 kilometers of good quality roads which are grossly inadequate for the area and its population. A National Highway (N5) connects Matiari with Hyderabad and onwards to Karachi (provincial capital of Sindh province). The district headquarter of Matiari is linked with its taluka headquarters of Hala and Saeedabad through metaled roads. Other important road links in Matiari district are given as under: ✓ Road from Matiari to Saanghar via Tando Adam ✓ Road from Matiari to Nawabshah via Hala, Sakrand, Sabu Rahu ✓ Road from Matiari to Dadu via Moro ✓ Road from Matiari to Tando Allahya via Nasrpur
Nausharo Feroze	Naushahro Feroze district covers an area of 2,945 square kilometers yet it has only 472 kilometers of good quality roads, which are grossly inadequate for the area and population. A National Highway (N5) connects Naushahro Feroze with Hyderabad and onwards to Karachi (capital of Sindh province). The district headquarter of Naushahro Feroze is linked with its taluka headquarters of Moro and Kandiaro through metaled roads
Shaheed Benazirabad	Geographically, district Shaheed Benazirabad is the center of Sindh province of Pakistan which makes it a major railways and road transportation hub in the province. By road, the district headquarters of Nawabshah is at a 4 hours' drive from the provincial capital Karachi. National highway (N5) passes through Sakrand and Kazi Ahmad talukas of this district. This district has a well-connected road network and has 349 kilometers of good quality roads in the entire district. District headquarters is connected with other talukas through metalled roads.
Sukkur	Sukkur district covers an area of 5,255 sq. kms yet it has only 267 kilometers of good quality roads, which are inadequate for the area and its population. A National Highway (Indus Highway, N55) connects Sukkur with other major cities of the province. The district headquarter of Sukkur is linked with its taluka headquarters of Rohri, Pani Aqil and Salehpat through metaled roads. Other important road links in Sukkur district are given as under: ✓ Road from Sukkur to Southern Punjab (Rahimyar Khan, Multan) via Pano Aqil and Ghotki ✓ Road from Sukkur to Balochistan via Shikarpur and Jacobabad ✓ Road from Sukkur to Khairpur via National Highway (N5), Therhi Road from Sukkur to Larkana via Madeji, Naudero ✓ Road from Sukkur to Hyderabad, Karachi via N5
Tando Allah Yar	The district is well-connected with other districts through good quality roads and similarly the district headquarters, at Tando Allahyar, is connected with other talukas of the district. The total length of good quality roads is 258 kilometers in this district.
Karachi Central Karachi East Karachi South Karachi West Karachi Korangi Karachi Malir	Karachi Division covers an area of 3,527 sq. kms and is served by a well-established network of major roads. The main seaport at Karachi i.e., Karachi Port Trust (KPT), is the main point from which all the major roads originate. As a principal seaport of Pakistan, almost all the upcountry commercial traffic is routed through Karachi. In order to control this commercial traffic, a mega project of green line (BRT) is under construction which will ameliorate the traffic burden. The commercial centers of Karachi, in the older areas of the city, have most congested traffic within the city. The city government has constructed several flyovers/ bridges and underpasses to control the traffic flow. There are the following three major roads which connect Karachi with the rest of the country: ✓ Super Highway (M9) leading north-west, towards other cities in the provinces of Sindh, Punjab and Khyber Pakhtunkhwa. ✓ National Highway (N5) leading south-west, towards other cities in Sindh and Punjab. ✓ National Highway (N25) leading to the west, and links Karachi with the cities in Balochistan.

3.3.13. Protected Archeological Sites and Monuments

A list of archaeological sites protected under Antiquities Act 1975 is presented in "Guidelines of Sensitive and Critical Area developed by Pak-EPA in 1997". The list is a 1996 Publication by the Pakistan Heritage Society Peshawar-Lahore and has been prepared by Mr. M. Rafique Mughal. There are a total of 248 archaeological sites situated in the project districts. The number and district wise location is summarized in **Annex I**. None of these sites are likely to be affected by the proposed interventions under SSS and A4N.

3.4. Reconnaissance Survey

Profiles of each district were made during the RS depicting varied baseline conditions which is as follows. Open defecation exist in 12 out of 14 surveyed / target districts due to the unavailability of enough latrines in the area. The villagers are well known with the problems associated with open defecation but cannot build latrines because of lack of funds. The details of RS of surveyed villages is attached in **Annex G**. Below, a brief description of each district assessed during RS is presented.

Ghotki

District Ghotki lies in Northern part of Sindh. Half of the district part comprises of alluvial plains of Indus River and agriculture through irrigation, while eastern half of the district comprises of desert region and sand dunes where extreme drought conditions prevail throughout the year which make it difficult for agriculture. Reconnaissance Survey also revealed that the use of pesticide has continued in cash crops e.g. rice, wheat, bananas and cotton in western parts of Ghotki. Open defecation exist in villages surveyed in Ghotki district. The western alluvial plains of the district are also affected with water logging and salinity. The groundwater level observed in the surveyed villages is 60-70 ft.

Sukkur

Similar to Ghotki, Sukkur district south-eastern part comprises of desert region and sand dunes where extreme drought conditions prevail throughout the year which make it difficult for agriculture. Due to the existence of Sukkur Barrage, many large canals originate and pass this district including Nara Canal. The north-eastern part of the district comprises of Indus flood plains and affected with some water logging and salinity. The groundwater level varies and decreases as the distance from the river and major canals increases. Some area located in south western part comprises of limestone rifts and small hills. This section is devoid of vegetation and groundwater. Livelihood of people of the district is mostly rearing of cattle and agriculture where irrigation system is available. Open defecation exists in both surveyed villages and people are usually suffering from many bacteria related ailments.

Khairpur

Like Sukkur district, due to IBIS (Indus Basin Irrigation system), north-western part of district have extensive agriculture through irrigation. Dates are mainly grow in the district and a national scale market of dates is sited in the district annually. The desert region comprises most part of the district where extreme drought conditions prevails and the area is devoid of large trees and thick vegetation. The desert region of the district is interspersed with Nara Canal and in Nara Canal command area, agriculture activities are on-going and a wetland complex exit along the command area. Open defecation exists in both surveyed villages and people are usually suffering from many bacteria related ailments.

Naushahro Feroze

The district located at left bank of River Indus with extensive network of canals and agriculture through irrigation. The district is prone to floods due to extensive spread of canal system and proximity of River Indus flood protection bunds. The canal system comprises of some large canals including Rohri Canal interspersed through the district. The groundwater exist in shallow depths due to seepage from canals. Open defecation exist in both surveyed villages. The main livelihood of people is agriculture and selling of agriculture products.

Shaheed Benazirabad

Most of the part of district is flood plains of Indus River as located at its left bank with extensive agriculture through irrigation. Small part of the district in north-eastern region is desert region and a network of wetlands including Deh Akro II Wildlife Sanctuary. Rohri Canal is also interspersed in the district with few other main canals which causes localized water logging situation. The groundwater in some areas is shallow and increases in depth with distance from River Indus. The main occupation of the people is cattle rearing and agriculture.

Matiari

Like Naushahro Feroze and Shaheed Benazirabad, the Matiari District is located at left bank and flood plains of River Indus and prone of flooding. The district land use is extensive agriculture through irrigation. Rohri canal is also interspersed though this district. The villages surveyed are very poor and open defecation is very common in the villages. There is no systematic infrastructure present in most of the villages. The water table is shallow throughput the district due to IBIS. The district is also rich in natural resources like gas and oil and some oil/gas fields of exploration companies are located in this district. Therefore, road infrastructure is quite better. Along Indus River, riverine forest once existed and some areas are designated by Sindh Wildlife Department as game reserves like Hala Game Reserves. But due to extensive agriculture, these forests are no longer exist.

Tando Allah Yar

Unlike Matiari, Tando Allah Yar district is not located along the banks of River Indus, however, the whole district is located on alluvial plains of the Indus. Due to extensive agriculture through irrigation, the area is prone to water logging and salinity. Sugarcane and Mangos are mainly grow in the district. Due to shallow groundwater table, the farming is also conducted through dug wells and tube wells. Open defecation exist in all surveyed villages. People are mostly suffering from different bacteria related ailments. The main occupation of people is agriculture and cattle grazing. Some Dhoras (natural drains) are also located in the district which will impact in the water logging.

Hyderabad

Like Naushahro Feroze, Shaheed Benazirabad and Matiari Districts, Hyderabad District is located at the left bank of River Indus. Due to the presence of Korti barrage, several large canals originating and traversed through this districts. Therefore, the district also has extensive agriculture setup through irrigation. In the north-west of the district, Hyderabad City lies which is one of the major cities of Pakistan. In the south of the City, Limestone hills named as Ganjo Takkar are located. These hills are devoid of vegetation, agriculture and human population. Mining activities are on-going along these. The groundwater in the district except Ganjo Takkar is shallow and severe water logging exist in the proximity of the Indus River. Many of the agriculture lands are lost due to water logging and salinity. The open defecation persists in villages of the district.

Karachi South

District South comprises of old city of Karachi including Karachi harbor in Chinna Creek and Clifton beach. The city becomes a thickly populated residential and commercial zone of Karachi Division. Along the Chinna creek, the old settlements exists including Sheerin Jinnah Colony and along the Clifton Beach, newly developed Defense Housing Authority (DHA) residential and commercial schemes are located. The district has devoid vegetation due to thick urban setup but few human planted trees can be seen along the medians of arterial roads. The only surface water available in the district is seawater. The ground water exist at different depths which increases as the distance increase from the sea. The ground water is mostly saline due to sea water intrusion and is not fit for human consumption. Old industrial setup exists in the district including Karachi Port and Oil Handling Area which plays a vital role in sustaining Pakistan economy. The overall air quality of the District is good due to the proximity of the sea, however, localized pollution of air and noise persist e.g. at arterials roads where the traffic congestion occurs and at oil handling area. Mangroves which are protected tree species located in Chinna Creek. Sheerin Jinnah Colony is an old settlement located along the shore of Chinna Creek and comprises of fisherman, labor working at the port and oil area and Pakistan Railways. Open defecation is not exist in these old settlements as well as in the City.

Karachi East

East District of Karachi Division affected with extensive urbanization and development with residential and commercial setup. Overall, the district comprises of extensive urban setup and part of Karachi City. However, northeast parts of the district have low population density and few villages exist. The district has devoid of natural vegetation but planted trees are mostly located in NE part of the District. There are few villages exist in Pehalwan Goth and Gulzar-e-Hijri. Few people are living over these hills. The district is devoid of vegetation with extensive urban setup. The existing ground water level is quite deep. The overall air quality of the District is bad due to localized pollution of air and noise persist along arterials roads where the traffic congestion occurs. Open defecation is not exist in these villages as the villages are intermingled with City's lifestyle and basic infrastructure exists in these villages.

Karachi Central

Central District of Karachi Division affected with extensive urbanization and development with residential and commercial setup as the city expands in the north direction and as the government residential schemes were settled. There are few villages exist in Manghopir area where the Manghopir Hills are situated which are the off-shoots of Kirthar Range. Few people are living over these hills. The terrain is rocky with devoid of vegetation. The existing ground water level is quite deep i.e. around 1,000 ft. The overall air quality of the District is bad due to localized pollution of air and noise persist along arterials roads where the traffic congestion occurs.

Karachi West

Karachi West District is mostly devoid of population and barren comprises of shallow sea sedimentary formation from Oligocene to Holocene series and the sedimentary environment of continent to shallow marine. Jhil hill is to the west of Karachi West District, belonging to the hilly terrain, with the asymmetrical ridge in northeast by east, abrupt in the North Slope and gentle in the south slope; it is the watershed of the region. The District west also comprises of coastal belt along its south boundary. The only surface water exist in the district is sea water. The groundwater is too deep as the formation is rocky. Few villages exist in the district along the coastline and engage in fishing. The overall air quality of the District is good due to the proximity of the sea. The district is devoid of large trees due to rocky terrain and only xerophytic species of shrubs and grasses exist. The lowest use of pesticide and chemical fertilizers is in Karachi District due to lack of irrigation water as well as less rainfall and rocky terrain.

Karachi (Korangi)

Almost 60% of the area in south of Korangi district comprises of industrial areas and industrial trading estate. Many large and small industries exist in this zone which provide livelihood to a large population of Karachi Division. Therefore this area comprises of heavy and small traffic and large population influx. The overall air quality of the District is bad due to industrial emissions and traffic movement.

The northern part of the district, unlike the southern part, comprises of Malir River bed and some village population along the bed as well as colonies and societies of residential areas. This part of the district is mainly unpolluted with respect to air quality. The groundwater in this part is shallow due to proximity of Malir River. The Malir River is now a non-perennial drain and only flows in monsoon season.

Karachi (Malir)

Malir District is the largest district of Karachi Division with respect to area. The district has the least population density and comprises of largest rural population with villages spread all over the district. The villages practice agriculture activities and livestock rearing for their livelihood. Some of the villages practice open defecation due to poverty and non-availability of piped water. The whole district comprises xerophytic plantation and some native natural trees spread all over the rocky plains. The north tip of the district forms Kirthar range and also designated as part of Kirthar National Park Wildlife Sanctuary. The surface water available is only during monsoon and in Malir and Hub Rivers. The south boundary of the district comprises of coastal belt were some fisherman communities located. The air quality of the district is good due to lack of anthropogenic sources. Villager use groundwater near perennial drains and main Malir and Hub Rivers for agriculture purposes.

The lowest use of pesticide and chemical fertilizers is in Karachi District due to lack of irrigation water as well as less rainfall and rocky terrain.

General

Most of the surveyed villages are suffering from bacteria and virus related ailments due to lack of sanitation and one of the reason of open defecation. The groundwater is also not suitable for human consumption in some places due to bacteriological contamination or heavy metal poisoning.

The depth of fresh groundwater decreases with distance from the river. There is a very wide range of groundwater quality distribution in Sindh i.e. 0.5 dS/m to 7.1 dS/m. The native groundwater of the Lower Indus Plain is very saline being of marine origin. The depth and quality is variable in all districts of Sindh especially in target districts also varied in pre- and post-monsoon seasons. Water logging prevails in some of the districts especially in Shaheed Benazirabad, Matiari and Hyderabad. The water scarce areas are, Eastern part of Ghoki, Sukkur and Khairpur with water table below 50 ft.

The A4N components will be implemented in some areas where water is scarce and bad groundwater quality prevails. Agriculture activities use pesticides and chemical fertilizers. In Matiari, the use of pesticides is the highest due to the prevalence of agriculture activities through irrigation and higher cropping intensities. Reconnaissance Survey also revealed that the use of pesticide has continued in cash crops e.g. Dates, rice, wheat, bananas, mangoes and cotton in western parts of Khairpur, Ghotki, Shaheed Benazirabad and Matiari.

High dependence on pesticides for pest control by untrained farmers has increased health hazards and polluted the rural environment. Pesticide use poses a threat to farmers, children, and women workers in fields who are at high risk of being poisoned (UNDP, 2001).

Pesticide residues are also found in irrigation and drinking water, cotton seed, oil, lint and cattle feed, cottonseed cake, animal milk, and soil. Increased pesticide resistance is resulting in additional applications of pesticides to maintain expected crop yields. The consequences are lower yields and higher production costs. Pesticide use is affecting biodiversity too but it is little understood and appreciated.

Reconnaissance Survey also revealed that the use of pesticide has continued in cash crops e.g. Dates, rice, wheat, bananas, mangoes and cotton in western parts of Khairpur, Ghotki, Shaheed Benazirabad and Matiari. Recently Pesticide manufacturing companies' especially multinational manufacturers has reached out local farmers and provide awareness to apply fertilizers and pesticides at proper time to increase the yield and save the crops. However, due to inflation and increase in the prices of imported fertilizer and pesticides in recent years, farmers switching over to conventional methods like manure and locally made pesticides. Supply of substandard and adulterated pesticides and fertilizers is also affecting the crop yields and the cost of production. Due to extreme weather conditions, the cropping pattern has also been changed. Increase Floods, droughts and waterlogging and salinity after 2010 impacted the agriculture practices and changed the cropping pattern in Matiari and western parts of Hyderabad, Ghotki, and Khairpur Districts.

Chapter 4 Stakeholder Consultation

4.1. Context

Stakeholder engagement is part and parcel of the development process. Without meaningful consultation with relevant stakeholders, the effectiveness and sustainability of any project is at stake. The participation of project stakeholders is therefore considered an essential component for the preparation of a robust ESMF. Local communities, their representatives, government and national and international NGOs and the civil society at large may all be able to contribute to, and benefit from, the dialogue directed at identifying and resolving key project-related issues. Stakeholder consultation presents an opportunity for mutual information-sharing and dialogue between the project proponent and stakeholders. An effective public consultation process provides concrete suggestions that can help improve project design, resolve conflicts at an early stage, identify management solutions to mitigate potentially adverse consequences and enhance positive impacts, and develop guidelines for effective monitoring and reporting of project activities throughout the project cycle.

In preparation for the ESMF, two major groups of stakeholders were identified: (i) local communities who are the direct beneficiaries of the project interventions and therefore identified as the primary stakeholders (ii) institutions who have an important role in enabling the realization of the project interventions and therefore identified as the secondary stakeholders.

This chapter provides an overview of the stakeholder consultation process that was adopted by the consultants and presents the findings of the stakeholder engagements with primary and secondary stakeholders. The key aspects, including consultation objectives, consultation tools/methodologies and stakeholders' feedback are discussed in the following sections.

4.2. Consultation with Local Communities

Local communities are the direct beneficiaries of the SSS and A4N projects. Community perceptions of the expected outcomes and the implementation process are necessary ingredients for ascertaining project success and adjustments to planned interventions. Moreover, organized community groups (VOs, VDOs, etc.) have an important role in promoting the program concepts, identifying target households, and monitoring project activities at the local level.

Consultations with local communities were carried out in line with the following objectives:

- Inform the local communities of the project concepts and planned project interventions
- Ascertain the community's perceptions of the project concepts and planned project interventions
- Identification of potential positive and negative social and environmental impacts

Communities were of the view that the NGOs can work in the fields and will implement the subprojects fully. The methodology and detailed consultation feedback from communities with photos is presented in **Annex J**. Consultation with communities revealed the following summary:

S#	Comments from Community	Demographic Group
1.	- Improved employment opportunities and skill set trainings for women were identified as the priority areas for future interventions. Once the villagers especially women are secured a respectable and constant source of income, then would be in a better position to participate in other activities.	Women (in water scarce areas of Ghotki, Khairpur, Sukkur and Karachi.

	- Villagers are very poor facing a lack of regular livelihood opportunities. They are aware of the need for proper hygiene for improved health, but due to lack of resources, construction and maintenance of latrines is not their priority - Water scarcity and water quality is another issue in the village that severely affects agricultural productivity, therefore villagers are more reliant to livestock rearing. - Unemployment is quite high in this area and local communities usually do not have enough skills and education to qualify for non-labor employment opportunities. - Need the improvement of Health and education facilities especially for women. - 60-70 % of the population in the villages openly defecate. - NGOs are working diligently in the villages and working in WASH, health and education - Unemployment is the also a main problem for females in villages. In fact, not a single female is educated in the some villages.	
2.	- There is a strong feudal system in the village and farmers have little control over their income and working hours. - Majority of the villagers are associated directly or indirectly to farming activities and therefore, water scarcity is considered the most important issue for these villagers. - Due to saline groundwater quality, agriculture activities are limited to monsoon season. Farmers mainly relying on livestock as the major source of income.	Farmers (in water scarce areas of Ghotki, Khairpur, Sukkur and Karachi)
3.	- Floods affects the most to the agriculture activities. Waterlogging also destroyed most agriculture lands. - Due to waterlogging situation, fish farming becomes a good source of livelihood and many farmers have switched their lands into fish farms. - Farmers are keen to learn good agriculture practices (GAP) because they are unaware of them. - Poultry farming is another source of livelihood of women.	Farmers (in irrigated areas of Matiari, Naushero Feroze, Khairpur, Sukkur, Shaheed Benazirabad and Tando Allah Yar)
4.	- Construction of schools and basic health facilities are more important to villagers than latrines - Villagers have their own male and female committees which resolve the village issues or matters and heads of the committee are selected by mutual consensus of villagers. The disputes are also resolved by these committees. - Compared to open defecation, the villagers view latrine use as time-consuming and troublesome. - Villagers are fully aware of the diseases due to unhygienic conditions and believe that healthy practices can improve the overall village environment. - Villagers showed the support of SSS program and asked if any organization would provide all the facilities in constructing the toilets, they will definitely use the toilets and stop open defecation. - Even some houses have latrines, children usually go for open defecation. - Illnesses in children and women are more frequent than males and young; common diseases in this village are Skin diseases, Malaria and Diarrhea.	Key informants / notables of villages / Teachers / Land Lords
5.	- Villagers affirmed that SERRS can change villagers' health and environment and can save children from diseases. Proper monitoring is main factor in improving the overall environment that must be consider. - People were aware that diseases are cause due to unhygienic conditions but find it very difficult for them to build latrines and enclosed washrooms.	Men in all selected districts

4.3. Consultation with Institutions

Secondary stakeholders play an important role in enabling the implementation of planned project interventions. Their understanding of the proposed interventions and the role they are expected to play in the project increases their ownership of the project and minimizes the risks of project derailment and delays. In light of this context, stakeholder engagement with relevant governmental and non-governmental actors was carried out with the following objectives:

- Appraise the stakeholders of the role of the ESMF Study and the planned project interventions for SERRS components
- Identify opportunities, challenges and limitations of the proposed project interventions
- Identify potential environmental and socio-economic impacts of the proposed project interventions

A Stakeholder Consultation Meeting was held on 30th August, 2016 at Pearl Continental Hotel, Karachi inviting relevant secondary stakeholders from academia, relevant provincial and local government departments, local and international NGOs and development agencies. Project Directors of both the SSS and A4N projects were also invited to the meeting. Relevant project background information was shared with the participants prior to the meeting. Over 40 participants representing over 20 different departments and institutions participated in the meeting.

Consultation with institutions revealed the following summary:

S#	Comments from Institutions	Area where applicable
1.	- Apart from improving the nutritional status of local communities, by involving both male and female family members regardless of age group, kitchen gardens have the potential for strengthening family bonds and intra-community relations. - Best Management Practices (BMP)s in the areas of organic farming should be incorporated. - Local fruit trees provide a viable option for improving the nutritional status of villagers, plantation of such trees should be promoted on a larger scale and made part of the nutrition projects.	Agricultural Practices and Kitchen Gardening
2.	- Pakistan Agriculture Research Council (PARC) was identified as a national research-based institution with extensive experience in improved agricultural practices. Similarly, other relevant departments and institutions with exposure to the planned project activities should be consulted for kitchen gardening, mobilization of Farmer Field Schools, choice of seeds and the like. - Even after a village attains ODF Certification, maintaining this status is a challenge and arrangements should be made to minimize fallout. Trained District, Taluka-level administration and other trained personnel such as LHVs can be play an instrumental role in helping communities maintain ODF status post-project.	Coordination among Institutions
3.	- As the SERRS project places a strong emphasis on behavior change, the root causes for existing undesirable behavioral practices need to be examined thoroughly. This may lead to adjustment of planned project interventions. - Age-old traditions of defecating in open areas or within natural surroundings will be a challenge for the project, especially with the elder folk. Moreover, in some rural areas, proper latrines are still considered taboo. - Behavior change also requires time, more than a couple years at least, if not more. Therefore, the existing project should be designed to ensure rigorous periodic awareness and sensitization sessions.	Behavior Change Communication

4.	- Many water-borne diseases are common in the project districts and result in severe malnourishment of women and children. Therefore, nutrition programs in Sindh should also place emphasis on availability of clean water in these areas. With respect to SERRS, this clean water should be ensured in schools as part of the health and hygiene awareness component. - On the other hand, environmentally safe disposal mechanisms need to be devised to ensure human excreta does not contaminate local water storage/supplies. - In latrine design, septic tanks provide a viable option for use by all households, schools and other local institutions. However, mismanagement of septic tanks can lead to severe environmental problems. Both construct, operation and management aspects need to be carefully reviewed.	Clean Water and Safe Disposal
5.	- UNICEF has conducted a Knowledge Attitude and Practices (KAP) study in certain areas of rural Sindh for the WASH Sector. Similar studies can provide profound knowledge on the social component of sanitation projects for SERRS. - Lesson learning from previous projects and ground realities must be incorporated for SERRS project to ensure result-oriented and long-lasting solutions to combat malnutrition in Sindh's rural areas.	Integration of Ground Realities and Lessons Learnt
6.	- The role of women both for the promotion of health and sanitation awareness and nutrition-sensitive agriculture practices is essential in rural areas of Sindh. Often, women from these areas are not only engaged in domestic chores, but also work on farms and partake in other income-earning activities. At the same time, it is the women that suffer the most from malnourishment and other health problems. - Intensive sensitization and awareness campaigns focused on women of all ages should be part of SERRS. - Participation of certain vulnerable groups, including the elderly, handicapped persons and widows should be ensured in SERRS project.	Gender and Vulnerable groups

Chapter 5 IMPACT ASSESSMENT AND RECOMMENDED MITIGATION MEASURES

This Chapter assesses the potential impacts of the proposed project on environment and people. Also, provided in the Chapter are the generic mitigation measures to minimize if not eliminate the potentially negative impacts, in order to ensure that the interventions under the proposed project do not cause environmental and/or social impacts beyond the acceptable level.

As the interventions under stunting in both Bank funded projects i.e. SERRS and MSAN are similar in type but different geographically, the environmental and social instruments as devised in ESMF of MSAN project can be adopted for SERRS implementation, since AAP have broad mandate of addressing stunting in the entire province, by targeting 5 sectors including sanitation and A4N. The methodologies for implementation of environmental and social safeguard instruments remains same for both the projects as well as the design and mitigation measures.

5.1. Assessment of Potential Impacts and Generic Mitigation

The potentially negative impacts identified with the help of environmental screening discussed in Section 6.2 are assessed in the subsections below. The generic mitigation measures have also been provided here; additional measures may be added as a result of the subproject-specific environmental assessments to be carried out during the Project implementation.

5.1.1. Subprojects Siting and land issues (financed under the project)

It will be ensured through screening checklist (**Annex A&B**) that the subproject avoids any sensitive locations as well as land acquisition.

In case of SSS, Sub-project sites will be located within school compound. However, preliminary screening will be undertaken to ensure that the land used for toilets does indeed belong to the school, there is no dispute over it and that there are no squatters/encroachers using this land. In case of A4N, Sub-project sites will be located on agriculture department land. If joint / community cattle shed will be built for demonstration, it will be acquired through Voluntary Land Donation (VLD). Land donation will be done on stamp paper (**Annex L**) and the same value must be used for all donations. The donation documentation will be registered with the district revenue department.

5.1.2. Impact for Anticipated Subprojects (financed under the project) and Mitigation Measures

Anticipated Subprojects (financed under the project) include implementation of hard components in the field like procurement of material, Toilet construction/rehabilitation, drilling of borehole and installation of hand pumps, establishment of kitchen gardens, livestock sheds and fisheries ponds in demonstration plots and procurement of supplies under A4N fund. The impacts associated with these activities are water/groundwater contamination; solid waste management; air quality issues, primarily related to dust generation; noise; and occupational and community risks. As part of ESMF, generic impact assessment has been conducted in the following sections:

Following a description of impacts on each environmental and social components is described along with mitigation measures:

Anticipated Impacts	Mitigation Measures
Land Issues	
Land on which toilets are to be built may be disputed/not belong to the school or be used by people for accommodation or livelihoods.	- Involuntary Resettlement Screening Checklist to be used to check the land belong to the school or free from any disputes. - Village Organizations and LGD officials will be taken onboard for the identification construction site in schools.
land may be acquired for small-scale interventions that cannot be acquired through Voluntary Land Donation (VLD) procedures	- The subprojects will be established on the land owned by Agriculture department. However, private land if acquired will be through VLD procedure. If VLD will not be possible, the RPF as part of this report will be applied. - It will be ensured that no involuntary resettlement takes place for these subprojects. - Complete documentation will be maintained for VLD. - Valuation and compensation of affected assets of community should be in line with RPF/Sub-projects RAPs and considered before the field activities.
Impediment to access of residents and students	
Any construction in schools can lead to blockage of access for students as well as it may block residents to commute their homes.	- Screening Checklists as presented in existing ESMF of MSAN to be used to check the access. - Adequate monitoring of construction site will ensure that the construction material will not be stacked in the routes of commuting
Labor Issues	
Conflict may arise between construction labor and community if labor not hired locally.	- Preference will be given to labor from locally skilled and unskilled workers of community for the construction of toilets in schools.
Also there could be a possibility that labor is forced to work on the site without providing wages or delayed in payments while performing their job or child labor may be used on site.	- PD and SS under directorates will ensure that certain clauses of all applicable labor laws will be added in the contract documents of IPs i.e. not to force labor to work, no child labor, follow the working hours according to the regulations, women harassment protection in the workplace, and official minimum wages to be paid if the laborers are contracted by the community. - Consultation with labor will be ensured by IPs and ESFPs.
Impacts on Women, Children, and Vulnerable Groups	
Impact on vulnerable groups like Women, poor households, women headed households.	- Women's participation is already included in project interventions like development Female farmer field schools (F3S), construction of girl toilets, focusing on women as the main agriculture producers. - Lady Extension Workers (LEW) will be engaged as contingent staff for short period, so as, to work with women beneficiaries. (PC-I of A4N) - Environmental screening checklist will provide first stage information about impacts on poor, women and other vulnerable groups including needs and priority for social and economic betterment; - IPs and TSPs will ensure the active participation of women in project interventions as well as adequately consulted. - In awareness raising under SSS, women share should be more compared to men.

Anticipated Impacts	Mitigation Measures
	- Ensure participation of vulnerable groups in project activities through consultations, to ensure planned investments take the well-being of such groups into consideration
Conflicts	
It is anticipated that conflicts among communities may arise during project implementation.	- Conflicts resolution will be done through implementation of Grievance Redress Mechanism (GRM) as presented in section 7.10 and 8.13.
Consultation	
It is anticipated that stakeholders and communities may not be participated or consulted in project interventions	- Consultation with stakeholders should be undertaken at project design, inception and implementation stages and as per consultation framework provided in table 7.8.
Air Quality Deterioration	
Handling of cement and other dusty materials and handling and storage of aggregates in concrete plants; during construction of structure of Latrines in schools may lead to dust generation and nuisance to the school children and nearby households. However, localized and relatively minor air quality impacts will occur.	- Soil and temporary spoil piles should be covered or sprayed with water if generating dust. - Latrine Construction sites including Soil piles in schools should be barricaded to avoid material escape, generation of dust and access to children. - Construction machinery, generators, and vehicles will be kept in good working condition, minimizing exhaust emissions. - Tractor loads should be covered with any suitable material.
In Food Production and Management (component B of A4N), it is envisaged that there will be no generation of air emissions caused by the development of Demonstration plots, localized and relatively minor vehicular emissions will occur if vehicles will be used to prepare demo plots but the emissions will be dispersed in open rural environment.	- No measures required.
Water Consumption and Conservation	
Construction activities in case of SSS can have insignificant impact on hydrology and ground water levels of the area due to low water requirements in case of toilet/hand washing station construction.	- No measures required.
Water availability should be considered as key factor while implementing interventions under A4N sub-project. Water Conservation is another component that should be introduced in the program.	- In Matiari and Western parts of Ghotki, Hyderabad, Khairpur and Umerkot districts, water logging persisted due to availability of plenty of water due to the presence of IBIS. Interventions supporting water availability should be considered like fish farming, agriculture through irrigation. However, in water scarce areas like eastern parts of Ghotki, Sukkur and Khairpur districts, careful planning will be required while implementing interventions under A4N. Livestock is the main livelihood of these areas and it should be promoted through better practices. However, to support the Nutrition Sensitive agriculture (NSA), crops which requiring less water and are saline water tolerant may be introduced. This idea will support the scarcity of water in the arid region. - Use of compost, or decomposed organic matter as fertilizer, has been found to improve soil structure, increasing its water-holding capacity.
Surface and Ground Water Quality	

Anticipated Impacts	Mitigation Measures
The construction of Toilets and installation of boreholes for water supply can have following impacts: - Inadequate design of Latrines resulting in contamination of groundwater e.g. in case of pit latrines developed in high water level areas. - Inadequate design of Latrines resulting in contamination of nearby water wells / dug wells. - The contamination chances will be increase in conditions like post-monsoon season, flood conditions, waterlogging, shallow water table and sandy soils - Inadequate disposal of sludge material after filling of pit/septic tank will result in contamination of land, surface water resources, generation of vector and spread of disease; - Sediment laden runoff resulting from borehole drilling; - Groundwater contamination from backfilling of unsuccessful boreholes.	- Guidelines for Construction of Latrines should be followed as presented in **Annex F**. - It will be ensured that the wastes are not released into any drinking water source, cultivation fields, or critical habitat.
- Under A4N, use of harmful pesticides and chemical fertilizer in demo plots leading to water pollution, pesticide residues in crops - contamination of local water body from animal faeces generated via livestock sheds - Inadequate pesticides use and chemical fertilizers in demo Kitchen gardens may contribute in water contamination. Runoff from all categories of agriculture leading to surface and groundwater pollution. Pesticide leaching occurs when pesticides mix with water and move through the soil, ultimately contaminating groundwater. The amount of leaching is correlated with particular soil and pesticide characteristics and the degree of rainfall and irrigation. Leaching is most likely to happen if using a water-soluble pesticide, when the soil tends to be sandy in texture, if excessive watering occurs just after pesticide application, if the adsorption ability of the pesticide to the soil is low. Leaching may not only originate from treated fields, but also from pesticide mixing areas, pesticide application machinery washing sites, or disposal areas. - Runoff of nutrients, especially phosphorus, leading to eutrophication causing taste and odor in public water supply, excess algae growth leading to deoxygenation of water and fish kills. - Agriculture contributes greatly to soil erosion and sediment deposition through intensive management or inefficient land cover. - The environmental impact of Fish farming is primarily a function of feed composition and feed conversion (fecal wastes), plus assorted chemicals used as biocides, disinfectants, medicines, etc. Waste feed and fecal production both add substantial nutrient loadings to aquatic systems.	- *Promotion of the use of Bio-pesticides*: Bio-pesticides are pesticides derived from natural materials (animals, plants, microorganisms, certain minerals). As an alternative to traditional pesticides, bio-pesticides can reduce overall agricultural pollution because they are safe to handle, usually do not strongly affect beneficial invertebrates or vertebrates, and have a short residual time. - *Use of Organic fertilizer*: Organic fertilizers are fertilizers derived from animal matter, human excreta or vegetable matter (e.g. compost, manure). There's little to no risk of toxic buildups of chemicals and salts that can be deadly to plants. Organic fertilizers are renewable, biodegradable, sustainable, and environmentally friendly. - *Integrated Pest Management (IPM)*: Agriculture and Livestock Departments, Government of Sindh has developed Integrated Pest Management Plan (IPMP) for "Sindh Agricultural Growth Project (SAGP)" in August 2013. The SAGP is focused on horticulture crops because these commodities have a small farmer focus, have significant involvement of women in production and processing. The IPMP of SAGP covers features including a) minimize pesticide usage while increase the productivity of agricultural crops targeted in the SAGP through Integrated Pest Management (IPM), Integrated Plant and Soil Nutrient Management (IPSNM) and Good Agricultural Practices (GAP), b) monitor the pesticides management such as their usage before, during and after, and the level of pesticide residues on targeted crops in normally-treated and IPM-treated areas and to disseminate information to stakeholders on the usefulness of undertaking IPM practices, and c) raise awareness of all stakeholders about the IPM approach to crop management, and train extension agents and farmers through FFS system to become practitioners of IPM.

Anticipated Impacts	Mitigation Measures
	- A model IPMP has been prepared under MSAN Project which is based on principals devised in SAGP IPMP which is the principal document of Agriculture and Livestock Departments for horticulture crops as well as based on the provisions of WBG OP 4.09. This model IPMP will be helpful for Directorate of Agriculture to prepare project specific IPMP and to mitigate and include the rational use of pesticides. - Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. Crops are arranged to that a strip of grass or close-growing crop is alternated with a clean-tilled crop or fallow. - Organic debris produced by harvesting is easily mineralized into leachable Nitrogen. Steps to reduce leachable Nitrogen includes planting of "green manure" crops, and delaying ploughing of straw, roots and leaves into the soil.
Solid Waste Management	
Typical solid waste generated during construction include waste concrete, empty cement bags, excavated soil (especially soil from drilling of borehole), etc. This waste has the potential to cause negative impact on the surroundings if not properly managed and disposed of. It is likely to block nearby drainage channels that can ultimately cause localized flooding during the monsoon. Windblown debris is a nuisance to the nearby community. Poor waste management practices would result in short term negative impact on the aesthetics of the surrounding. Inadequate disposal of sludge material after filling of pit/septic tanks connected with the toilets will result in contamination of land, surface water resources, generation of vector and spread of disease;	- Construction sites should be equipped with temporary refuse bins. - Wastes should be routinely collected from the designated area and disposed at waste disposal facilities. - The subprojects will be designed employing technologies that minimize generation of solid wastes - Recycling of solid waste will be carried out as far as possible and practical. - Composting of biodegradable waste will be considered and adopted if practicable. - Disposal of solid waste will be carried out in a manner that does not negatively affect the drinking water sources, cultivation fields, irrigation channels, natural drainage paths, the existing waste management system in the area, local routes, and general aesthetic value of the area.
Establishment of ponds for fish farming will generate excavated soil. Generation of biological solid waste generated from livestock sheds and kitchen gardens (demo plots) may pollute land and water bodies if not handled properly.	
Noise	
During the construction and drilling of borehole, noise will be generated from the operation of machinery. These construction activities may cause discomfort to local residents. Besides the construction works will be encouraged during daytime and the noise would be generated temporarily. Therefore any adverse impact on residents and fauna is negligible.	- Machinery operation and high noise activities should be carefully planned and scheduled. - Where that is not possible, high noise activities should cease between 22:00 and 06:00 hrs.
Occupational Health and Safety	
The construction of civil works such as toilet construction, tilling of demo plots, installation of livestock sheds etc. poses an inherent risk of injury to labor from accidents. Poor housekeeping practices will lead to stagnant water as breeding grounds for insect vectors (causing malaria etc.). Hazards from	To mitigate these potential H&S impacts prior to the commencement of civil works, following measures will be adopted: - Identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers, including communicable diseases such as HIV/AIDs and vector borne diseases;

Anticipated Impacts	Mitigation Measures
handling equipment, ergonometric stress, lifting heavy materials etc. may cause injury to the labor.	- Avoid stagnation of water and initiate drainage/cleanup of stagnant water. - Provide for the provision of appropriately stocked first-aid equipment at work sites; - Provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate outerwear, boots and gloves; safety helmets; - Provide training for workers for the use of PPE; - WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented; - Include procedures for documenting and reporting accidents, diseases, and incidents; and - All safety precautions will be taken to address safety hazards for the nearby community. These precautions may include safety/warning signage, safety barrier around the construction site. - The construction contracts will include appropriate clauses to protect environment and public health. The present ESMF will be included in the bidding document.
Investment for the procurement of supplies and farm implements may contribute to affect environmental components e.g. Procurement and use of adulterated pesticides; Excessive use of chemical Fertilizer; Congregation of livestock near water point and risk of nitrate pollution from their droppings.	Following measures shall be employed to ensure sustainability of the interventions: - Judicious use of the irrigation water, chemical inputs and use of alternate techniques (such as integrated pest management, using disease-resistant seeds, and mulching) will be promoted through awareness raising and capacity building initiatives. - Crop rotation practices will be promoted to avoid soil fertility degradation. - The capacity building program will also include safe handling of hazardous substances such as pesticides. - Banned and adulterated pesticide list will be disseminated to farmers and awareness will be given via FFS.

5.1.3. Impact related to Subproject Exclusions (Not financed under the project) and Mitigation Measures

Subproject Exclusions (i.e. not financed under the project) are mostly comprising soft components i.e.:

- Toilets constructed by communities after awareness raising program
- Sludge management by communities using the toilets
- Use of farm implements including pesticides and fertilizers by communities
- Kitchen Gardens / Livestock pens / Fish ponds developed by communities

Following Potential cases may occur which will compromise the sustainability of the interventions and may impact the environment:

Impacts	Mitigation Measures
Saaf Suthro Sindh (SSS)	
After behavior change activities, households willing to construct toilets may not build such structures which are environmentally/socially	Following measures shall be employed to ensure sustainability of the interventions: - During behavior change activities in the communities, environment friendly designs of toilets

suitable and pose more threat/impact to the locality as compared to open defecation e.g. 1. uncovered open pits attracting vector; 2. after filling of pit/septic tank, it will not be emptied and drainage pipe from the latrine will be diverted in the open land contaminating nearby property and attract vector; 3. Sludge from emptied pit/septic tank will be dumped in the open, water body or someone's property leading to contamination / conflict; 4. septic tank/pit/drainage field will be constructed on another property creating a conflict situation; 5. drainage fields / soakage pits located too close to water bodies/ water table etc. 6. Groundwater depletion caused due to over pumping of water used in flush toilets 7. Public health risks may arise from system failure for example, from excessive visits, and high sludge build up requiring removal and disposal Constructed/Rehabilitated toilets in schools may not be maintained properly and left unattended from repair / emptying the tanks etc.	(suitable for that specific area) will be disseminated within the communities as a guide and unfriendly design impacts shall be communicated. - Monitoring shall be made during project life cycle to check the sustainability of implemented interventions. - Flush toilets should not be encouraged in areas under the project where water is scarce and in dry season. - Sludge Management should be made part ESMPs of each sub-project. Sludge after emptying the tanks/pits should be landfilled at proper location and left for degradation. - During behavior change activities in the communities, this aspect will be communicated and awareness raising workshops will be conducted with the communities.
Agriculture for Nutrition (A4N)	
Health and Safety Hazards for farmers	- Awareness and capacity building regarding Material Safety Data Sheet (MSDS) for each hazardous substance (pesticides and fertilizers) will be promoted. - WB Group's EHS Guidelines will be implemented as appropriate.
Employment	- Preference will be given to the landless farmers. - The capacity building component of the project will include trainings for operation and maintenance of the subproject facilities for supply chains and post-harvest loss control. - GRM will be put in place to amicably resolve any disputes or conflicts related to employment and service provision.
Impacts on Women, Children, and Vulnerable Groups	- The project will generally benefit the households, in addition to improve the sanitary conditions as well as access to nutritious diet. Also supporting for the local community (landless farmers) in agriculture under A4N investment fund. - Women's participation is already included in project interventions like development Female farmer field schools (F3S), focusing on women as the main agriculture producers. - Lady Extension Workers (LEW) will be engaged as contingent staff for short period, so as, to work with women beneficiaries. (PC-I of A4N) - Environmental screening checklist will provide first stage information about impacts on poor, women and other vulnerable groups including needs and priority for social and economic betterment;

	- IPs and TSPs will ensure the active participation of women in project interventions as well as adequately consulted. - Ensure participation of vulnerable groups in project activities through consultations, to ensure planned investments take the well-being of such groups into consideration

5.2. Institutional Arrangements

Project Directors (PD) of SSS and A4N will be overall responsible for the implementation of ESMF compliance throughout the project. Project Coordinator/ Deputy Director will coordinate with the Implementing Partners / technical support partners (IPs/TSPs) and the District Coordination Committee (DCC) of each district will take the prime responsibility to ensure the ESMF implementation across the district and reports to the PD. Environmental Specialists (ES) and Social Specialists (SS) will be hired by the PD under Sanitation / agriculture Directorates, who will assist PD to implement ESMF in letter and spirit Both specialist will directly be responsible for subproject screening, development of subproject specific ESMPs and their implementation, internal monitoring and progress reporting. Environmental and Social Focal Persons (ESFPs) will be designated by the DCC for each district for the implementation of Environmental and social/resettlement issues, addressing grievances, conduct stakeholders consultations and coordination and reporting to Project Coordinator/ Deputy Director. IPs/TSPs will support community participation, consultations and other social activities from the sub-project identification to completion stage.

Table 5.1 shows each position and its responsibilities under proposed implementation framework:

Table 5.1: SSS implementation framework Responsibilities

S#	Position	Responsibilities
1.	Directorate of Sanitation	- PD will be overall responsible for ensuring the ESMF compliance throughout the project - PD will ensure transparent and cost effective monitoring - PD can engage other specialists and/or firms to carry out external monitoring as third party validation
2.	Project Coordinator	- Coordinate with the IPs and the District DC/ESFP to ensure the proper ESMF implementation across the board and reports to the PD
3.	Environmental and Social Specialists	- The Environmental specialist & Social specialist will be directly responsible for subproject screening, development of subproject specific ESMPs and RAPs and their implementation, internal monitoring and progress reporting - Environmental specialist and Social specialist will assist district ESFP in monitoring the effective ESMF implementation - Environmental specialist and social specialist will also execute the training programs under capacity building - They will also be responsible for preparing the reports for each training conducted by various project units
4.	District Coordination Committee (DCC)	- **An Environmental and Social Focal Person (ESFP)** will be designated by the DCC for the implementation of Environmental and social/resettlement issues, addressing grievances, conduct stakeholders consultations and coordination and reporting to Project Coordinator/DC - ESFP will be responsible for the implementation of capacity building training plan - ESFP will document the implementation of training plan and ESMF process
5.	District Monitoring Unit (DMU)	- District Monitoring & Evaluation Unit will responsible for effective monitoring in the district

		- ESFP will carry out monitoring of ESMF in the district and will conduct regular field visits
6.	Village Development Committee	- Village Officer (VO) will responsible for mobile monitoring. Mobile monitoring will be linked to NGOs, ADLG, DC and PD.
7.	Implementing Partners	- Supports community participation, consultations and other social activities from the sub-project identification to completion stage - ES and SS hired by IPs, under the supervision of ESFPs, will ensure the ESMF adherence and monitoring at field level - IP will be responsible to provide capacity building trainings to their field staff and workers - IP will document the trainings

Figure 5.1 presents the overall ESMF implementation framework for SSS.

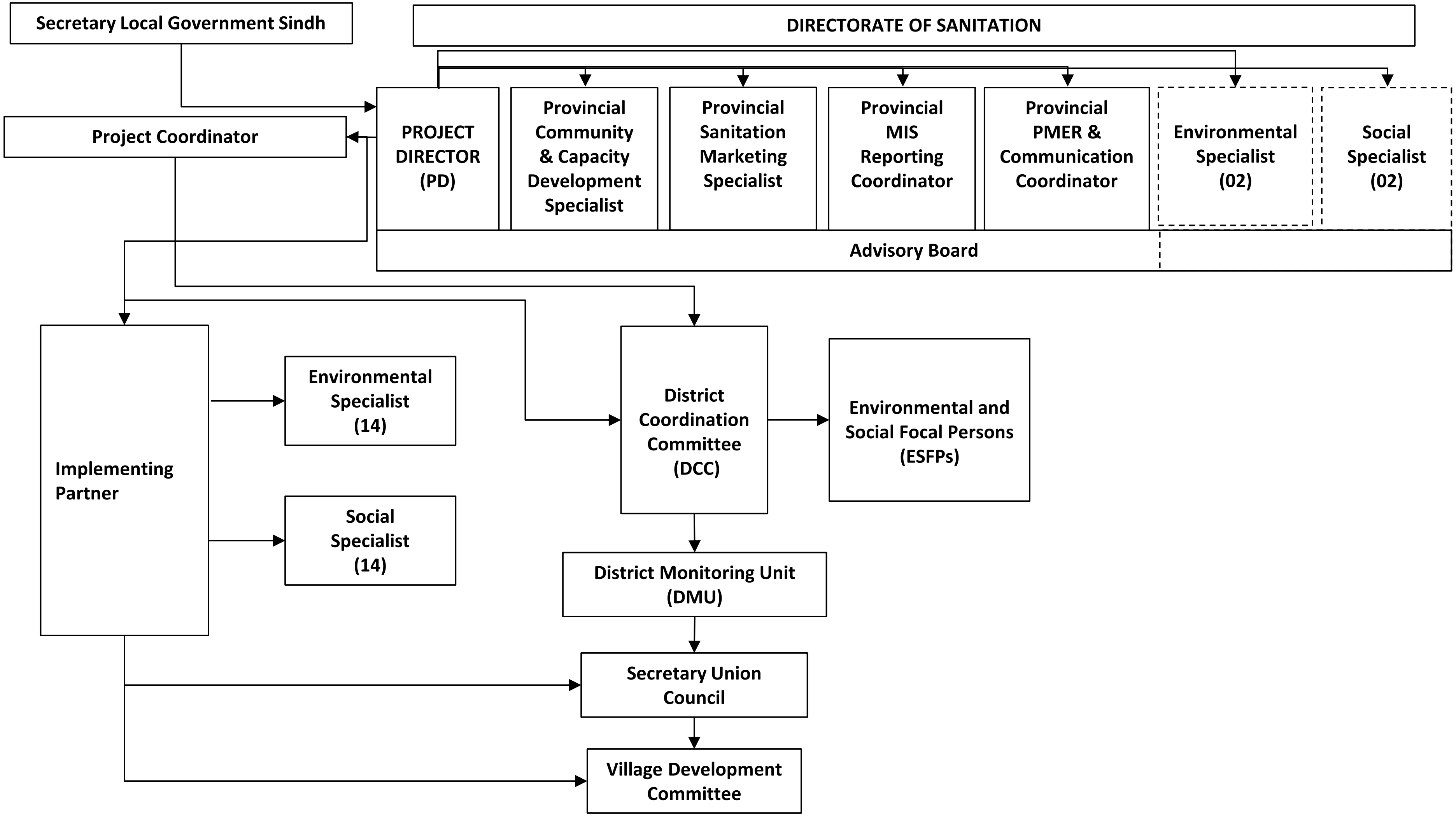

Figure 5.1: Overall ESMF Implementation Framework for SSS

Table 5.2 shows each position and its responsibilities under proposed implementation framework:

Table 5.2: A4N implementation framework Responsibilities

S#	Position	Responsibilities
1.	Project Director (PD)	- PD will be overall responsible for ensuring the ESMF compliance throughout the project including IPMP - Oversee preparation of annual, monthly and quarterly monitoring reports - PD will ensure transparent and cost effective monitoring - PD can engage other specialists and/or firms to carry out external monitoring as third party validation - Prepare Project specific IPMP with assistance of D. Director (Agriculture)
2.	District Nutrition Coordination Committee (DNCC)	- An Environmental and Social Focal Person (ESFP) will be designated by DNCC for the implementation of Environmental and social/resettlement issues, addressing grievances, conduct stakeholder's consultations and coordination and reporting to Project Coordinator/DC - ESFP will be responsible for the implementation of capacity building training plan for agriculture section - ESFP will document the implementation of training plan and ESMF process
3.	D. Director (Agriculture)	- Coordinate with the TSP and the District agriculture officer/ESFP to ensure the proper ESMF implementation across the board and reports to the D.PD (agri.)
4.	D. Director (Livestock & F.)	- Coordinate with the TSP and the District livestock officer/ESFP to ensure the proper ESMF implementation across the board and reports to the D.PD (livestock)
5.	Environmental and Social Specialists (Agriculture)	- The Environmental specialist & Social specialist will be directly responsible for subproject screening, development of subproject specific ESMPs and RAPs and their implementation, internal monitoring and progress reporting for the Agriculture section of A4N - Environmental specialist and Social specialist will assist district ESFP in monitoring the effective ESMF implementation - Environmental specialist and social specialist will also execute the training programs under capacity building - They will also be responsible for preparing the reports for each training conducted by various project units
6.	Environmental and Social Specialists (Livestock)	- The Environmental specialist & Social specialist will be directly responsible for subproject screening, development of subproject specific ESMPs and RAPs and their implementation, internal monitoring and progress reporting for the Livestock section of A4N - Environmental specialist and Social specialist will assist district ESFP in monitoring the effective ESMF implementation - Environmental specialist and social specialist will also execute the training programs under capacity building - They will also be responsible for preparing the reports for each training conducted by various project units
7.	IPM Managers	- placed at the district headquarters level for each district to for the implementation of IPMP
8.	Technical Support Partner (TSP)	- Supports community participation, consultations and other social activities from the sub-project identification to completion stage - ES and SS hired by TSP, under the supervision of ESFPs, will ensure the ESMF adherence and monitoring at field level in each district. - ES and SS hired by TSP will be responsible to provide capacity building trainings to their field staff and workers - ES and SS will document the trainings

Figure 5.2 presents the overall ESMF implementation framework for A4N.

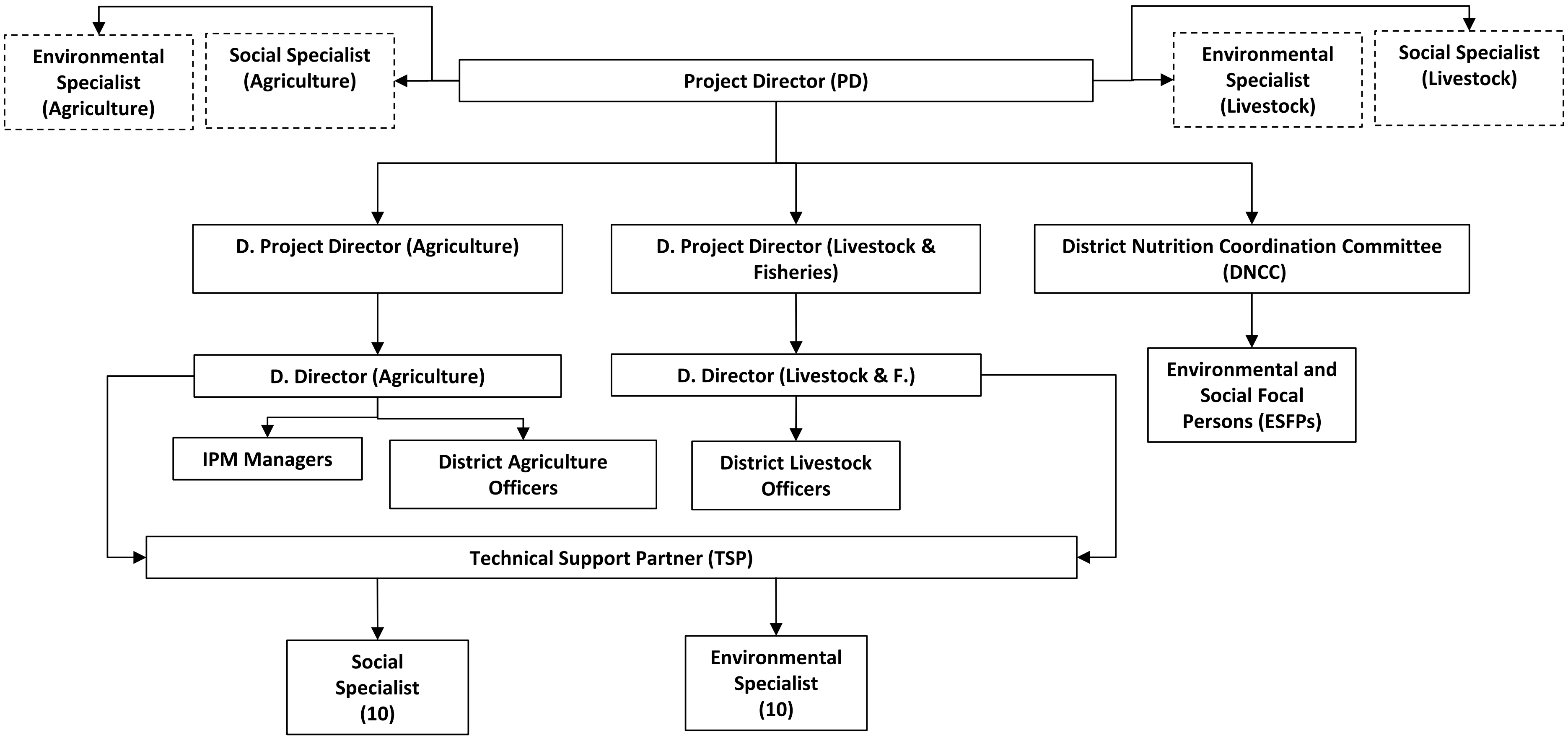

Figure 5.2: Overall ESMF Implementation Framework for A4N

5.3. Generic Environmental and Social Management Plan

Subprojects having negligible environmental and or social impacts will be assessed with the help of a screening checklist included in **Annex A & B**. It will be ensured through screening checklist that the subproject avoids any ecologically sensitive areas, PCRs and involuntary resettlement. Subprojects having some negative but localized environmental and or social impacts will require a generic Environmental and Social Management Plans (ESMPs) which shall form part of the project contract specifications. However, the below table (Table 5.3) will separately present generic ESMPs for subproject for which anticipated environmental impact may occur 1) Improvement/rehabilitation/construction of toilets/pit latrines in 2,800 schools with hand washing facilities, 2) Toilet constructed and managed by communities and 3) Introduction and use of farm implements by communities.

1. Improvement/rehabilitation/construction of toilets/pit latrines in 2,800 Schools

Table 5.3: Generic Environmental and Social Management Plan

S#	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
1.	Air Quality deterioration due to dust emissions	✓Tractor loads should be covered with any suitable material.	Inspect Truck/tractor mobility	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
		✓Soil and temporary spoil piles should be covered or sprayed with water if generating dust.	Inspect construction site	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
		✓Latrine Construction sites including Soil piles in schools should be fenced to avoid material escape, generation of dust and access to children.	Inspect fencing	ES/SS of IPs report to ESFPs	During Construction of toilets	Rs.2,000 per fencing x 2,800 schools = Rs.5,600,000
2.	Surface and Ground Water Quality deterioration due to runoff from school toilets during operation	✓It will be ensured that the wastes are not released into any drinking water source, cultivation fields, or critical habitat.	Inspect discharge points of school toilets	ES/SS of IPs report to ESFPs	During operation of toilets and hand washing facilities	Nil
		✓Effluents from the construction sites will not be released to drinking water sources, cultivation fields, irrigation channels, and critical habitats. Appropriate effluent treatment arrangements such as settling tanks will be made at the site.	Inspect construction site	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil

Table 5.3: Generic Environmental and Social Management Plan

S#	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
3.	Solid Waste Management for school toilets during construction and operation	✓Construction sites should be equipped with temporary refuse bins.	Inspect placement of refuse bins	ES/SS of IPs report to ESFPs	During Construction of toilets	Rs.1,000 x 2,800 schools = Rs.2,800,000
		✓Disposal of solid waste will be carried out in a manner that does not negatively affect the drinking water sources, cultivation fields, irrigation channels, natural drainage paths, the existing waste management system in the area, local routes, and general aesthetic value of the area.	Inspect waste disposal	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
		✓Wastes should be routinely collected from the designated area and disposed at waste disposal facilities.	Inspect waste disposal	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
4.	Possible Noise emissions from running of construction machinery	✓Machinery operation and high noise activities should be carefully planned and scheduled.	Inspect construction activities near communities	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
		✓Where that is not possible, high noise activities should cease between 22:00 and 06:00 hrs.	Inspect working hours	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
5.	Occupational Health and Safety	✓WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented	Audit WB EHS guidelines provisions	ES/SS of Directorate	During Construction of toilets	Nil
		✓The construction contracts will include appropriate clauses to protect environment and public health. The present ESMF will be included in the bidding document.	Inspect bidding documents	ES/SS of Directorate	During Construction of toilets	Nil
		✓Avoid stagnation of water and initiate drainage/cleanup of stagnant water.	Inspect construction site	ES/SS of IPs report to ESFPs	During Construction of toilets	Nil
		✓Provide for the provision of appropriately stocked first-aid equipment at work sites;	Inspect First aid provision	ES/SS of IPs report to ESFPs	During Construction of toilets	Rs.1,000 x 2,800 schools = Rs.2,800,000

Table 5.3: Generic Environmental and Social Management Plan

S#	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
		✓Provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate outerwear, boots and gloves; safety helmets;	Inspect PPE provision	ES/SS of IPs report to ESFPs	During Construction of toilets	For each school site, 5 workers will be utilized, so 5 x 2,800 = 14,000 PPE, each sets = Rs.600
		✓Provide training for workers for the use of PPE;	Check training records	ES/SS of Directorate	During Construction of toilets	Biannually, 4-day workshop @ Rs.15,000 per workshop inc. expenses
		✓Include procedures for documenting and reporting accidents, diseases, and incidents.	Check procedures	ES/SS of Directorate	During Construction of toilets	Nil

2. Toilet construction and management by communities

	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
1	Unsuitable toilet construction may lead to water contamination	✓During behavior change activities in the communities, environment friendly designs of toilets (suitable for that specific area) will be disseminated within the communities as a guide and unfriendly design impacts shall be communicated. ✓Monitoring shall be made during project life cycle to check the sustainability of implemented interventions. ✓Flush toilets should not be encouraged in areas under the project where water is scarce and in dry season.	Check and Inspect sustainability	IPs/VOs	During course of project	Behavior change activities included in project cost
2	Pit/septic tank Sludge Management	✓Composting of biodegradable waste will be considered and adopted. Sludge after emptying the tanks/pits should be landfilled at proper location and left for degradation.	Check and Inspect sustainability	IPs/VOs	During course of project	Behavior change activities included in project cost

	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
		✓Sludge will not be disposed of into open land ✓During behavior change activities in the communities, this aspect will be communicated and awareness raising workshops will be conducted in communities.				
3	Surface and Ground Water Quality deterioration due to runoff from community toilets	✓It will be ensured through consultation and awareness that the wastes are not released into any drinking water source, cultivation fields, or critical habitat.	IP/VO	ESFP	During course of project	Awareness raising activities are included in project cost
4	Impacts on Women, Children, and Vulnerable Groups	✓It will be ensured that the subprojects do not have any negative impacts on women, children and vulnerable groups.	FFS/IP/VO/ beneficiary	ESFP	During course of project	Nil

3. Introduction and use of farm implements by communities

	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
1	Use of Adulterated/ banned Pesticide	✓Banned and adulterated pesticide list will be disseminated to farmers and awareness will be given via FFS. ✓Judicious use of the irrigation water, chemical inputs and use of alternate techniques (such as integrated pest management, using disease-resistant seeds, and mulching) will be promoted through awareness raising and capacity building initiatives. ✓Crop rotation practices will be promoted to avoid soil fertility degradation. ✓The capacity building program will also include safe handling of hazardous substances such as pesticides.	Inspect community areas where farm implements are applied	TSPs report to ESFPs	During course of project	Capacity building and training to farmer through FFS included in project cost
2	Water Conservation	✓High efficiency irrigation technologies (e.g. tunnel farming) will be promoted to conserve already scarce irrigation water.	Inspect water scarce areas	TSPs report to ESFPs	During course of project	Cost of farm implements included in project cost
3	Health and Safety Hazards for the farmers	✓Awareness and capacity building regarding Material Safety Data Sheet (MSDS) for each hazardous substance will be promoted.	Inspect community areas where farm	TSPs report to ESFPs	During course of project	Rs.15,000 per workshop inc.

	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
			implements are applied			expenses included in ESMF budget
		✓Awareness and capacity building for use of appropriate personal protective equipment (PPE) will be mandatory while using pesticides.	Inspect community areas where farm implements are applied	TSPs report to ESFPs	During course of project	As above.
		✓WB Group's EHS Guidelines will be implemented as appropriate.	Inspect community areas where farm implements are applied	TSPs report to ESFPs	During course of project	Nil
4	Surface and Ground Water Quality deterioration due to runoff	Following measures will be disseminated to Farmers via FFS and F3S: ✓Waste effluents will be released in irrigation channels only if they do not negatively affect the irrigation water quality. ✓Use of Bio-pesticides will be encouraged ✓Use of Organic fertilizer will be encouraged ✓IPM as part of A4N subcomponent will be implemented ✓Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. Crops are arranged to that a strip of grass or close-growing crop is alternated with a clean-tilled crop or fallow. ✓Organic debris produced by harvesting is easily mineralized into leachable N. Steps to reduce leachable N includes planting of "green manure" crops, and delaying ploughing of straw, roots and leaves into the soil.	Inspect community areas where farm implements are applied	TSPs report to ESFPs	During course of project	Nil
5	Impacts on Women, Children, and Vulnerable Groups	✓It will be ensured that the subprojects do not have any negative impacts on women, children and vulnerable groups.	FFS/IP/VO/ beneficiary	ESFP	During course of project	Nil
6	Employment	✓Preference will be given to the landless farmers. ✓The capacity building component of the project will include trainings for operation and maintenance of the	FFS/IP/VO/ beneficiary/ Contractor	ESFP	During course of project	Nil

	Anticipated Effect	Mitigation Measure(s)	Monitoring	Responsibility	Schedule	Cost and Source of Funds
		subproject facilities for supply chains and post-harvest loss control. ✓GRM will be put in place to amicably resolve any disputes or conflicts related to employment and service provision.				

5.4. Environmental and Social Mitigation and Monitoring Plan

The generic mitigation plan prepared on the basis of impact assessment discussed in the previous section is presented in Table 5.4. The subproject-specific mitigation plans will be implemented in combination with the generic mitigation plan. These mitigation plans will be expanded if needed and finalized once the subproject location is known. These plans will also be included in the subproject ESMPs. The relevant mitigation plans and also the site-specific ESMP will be included in the design of each subproject, and included in the bidding documents in case contracting is involved.

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
Anticipated Subprojects (financed under the project)							
1	Subproject Siting to any sensitive area	Medium	At subproject location under SSS and A4N	✓It will be ensured through screening checklist that the subproject avoids any ecologically sensitive areas, PCRs and involuntary resettlement. ✓Involuntary Resettlement Screening Checklist as presented in existing ESMF of MSAN to be used to check the land belong to the school or government land and free from any disputes. ✓Village Organizations and LGD officials will be taken onboard for the identification construction site in schools. ✓The subprojects will be established on the land owned by Agriculture department. However, private land if acquired will be through VLD	Before the start of each subproject	ES and SS from IPs/ TSPs	ES and SS Directorate

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
				procedure. If VLD will not be possible, the RPF as part of this report will be applied. ✓Complete documentation will be maintained for VLD. ✓Valuation and compensation of affected assets of community should be in line with RPF/Sub-projects RAPs and considered before the field activities. ✓Community consultations will be carried out before establishing the sites.			
2	Air Quality deterioration due to dust emissions	Low	Toilet construction site in schools	✓Construction machinery, generators, and vehicles will be kept in good working condition, minimizing exhaust emissions. ✓Truck/tractor loads should be covered with suitable material. ✓Soil and temporary spoil piles should be covered or sprayed with water to avoid generating dust. ✓Latrine Construction sites including Soil piles in schools should be barricaded to avoid material escape, generation of dust and access to children.	During Construction of toilets	Contractor under supervision of Directorates	ESFP
3	Water Consumption and Conservation	Low	At demonstration plots under A4N	✓Use of compost, or decomposed organic matter as fertilizer, has been found to improve soil structure, increasing its water-holding capacity.	During development of demonstration plots	FFS/IP/VO	ESFP
4	Surface and Ground Water Quality deterioration	Low	Toilet construction site in schools & at demonstration plots under A4N	✓It will be ensured that the wastes are not released into any drinking water source, irrigation channels, cultivation fields, or critical habitat. ✓Effluents from the construction sites will not be released to drinking water sources, cultivation fields, irrigation channels, and	During development of toilets and hand washing facilities and demonstration plots	FFS/IP/VO	ESFP

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
				critical habitats. Appropriate effluent treatment arrangements such as settling tanks will be made at the site. ✓Use of Bio-pesticides will be encouraged ✓Use of Organic fertilizer will be encouraged ✓IPM as part of A4N sub-component will be implemented ✓Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. Crops are arranged to that a strip of grass or close-growing crop is alternated with a clean-tilled crop or fallow. ✓Organic debris produced by harvesting is easily mineralized into leachable Nitrogen. Steps to reduce leachable N includes planting of "green manure" crops, and delaying ploughing of straw, roots and leaves into the soil.			
5	Solid Waste Management	Low	Pits connected with Toilet in schools & at cattle pens in demonstration plots under A4N	✓Recycling of solid waste will be carried out as far as possible and practical. ✓Composting of biodegradable waste will be considered and adopted. ✓Disposal of solid waste will be carried out in a manner that does not negatively affect the drinking water sources, cultivation fields, irrigation channels, natural drainage paths, the existing waste management system in the area, local routes, and general aesthetic value of the area. ✓Construction sites should be equipped with temporary refuse bins.	after toilet development and demonstration plots	Contractor under supervision of Directorates	ESFP

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
				✓Wastes should be routinely collected from the designated area and disposed at waste disposal facilities.			
6	Noise	Low	Toilet construction site in schools	✓Machinery operation and high noise activities should be carefully planned and scheduled. ✓Where that is not possible, high noise activities should cease between 22:00 and 06:00 hrs.	During development of toilets and hand washing facilities	Contractor under supervision of Directorates	ESFP
7	Occupational Health and Safety	Low	Toilet construction site in schools & at demonstration plots under A4N	✓WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented ✓The construction contracts will include appropriate clauses to protect environment and public health. The present ESMF will be included in the bidding document. ✓Avoid stagnation of water and initiate drainage/cleanup of stagnant water. ✓Provide for the provision of appropriately stocked first-aid equipment at work sites; ✓Provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate outerwear, boots and gloves; safety helmets; ✓Provide training for workers for the use of PPE; ✓WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented; ✓Include procedures for documenting and reporting accidents, diseases, and incidents.	Construction phase	Contractor under supervision of Directorates / IP	ESFP

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
8	Labor Issues	Low	Toilet construction site in schools & at demonstration plots under A4N	✓Preference will be given to labor from locally skilled and unskilled workers of community for the construction of toilets in schools. ✓PD and SS under directorates will ensure that certain clauses will be added in the contract documents of IPs i.e. not to force labor to work and official minimum wages to be paid if the laborers are contracted by the community. ✓Consultation with labor will be ensured by IPs and ESFPs.	Construction phase	Contractor under supervision of Directorates / IP	ESFP
Subproject Exclusions (Not financed under the project)							
9	Unsuitable toilet construction may lead to water contamination	Low	All project districts	✓During behavior change activities in the communities, environment friendly designs of toilets (suitable for that specific area) will be disseminated within the communities as a guide and unfriendly design impacts shall be communicated. ✓Monitoring shall be made during project life cycle to check the sustainability of implemented interventions. ✓Flush toilets should not be encouraged in areas under the project where water is scarce and in dry season. It will be ensured to provide these site specific provisions in toilets construction guidelines by the project implementation unit.	During course of project	FFS/IP/VO	ESFP
1	Pit/septic tank Sludge Management	Medium	All project districts	✓Sludge Management should be made part ESMPs of each sub-project. Sludge after emptying the tanks/pits should be landfilled at proper location and left for degradation. ✓During behavior change activities in the communities, this aspect will be communicated and awareness raising workshops will be conducted in communities.	During course of project	FFS/IP/VO/ beneficiary	ESFP

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
1	Use of Adulterated/ banned Pesticide	Medium	All project districts under A4N	✓Judicious use of the irrigation water, chemical inputs and use of alternate techniques (such as integrated pest management, using disease-resistant seeds, and mulching) will be promoted through awareness raising and capacity building initiatives. ✓Crop rotation practices will be promoted to avoid soil fertility degradation. ✓The capacity building program will also include safe handling of hazardous substances such as pesticides.	During course of project	FFS/IP/VO/ beneficiary	ESFP
1	Excessive use of chemical Fertilizer	Low	All project districts under A4N	✓High efficiency irrigation technologies (e.g. tunnel farming) which is included one of the interventions of A4N component will be promoted to conserve already scarce irrigation water. ES of IP and ES from directorates will ensure to promote it in above areas after filling environmental checklists and incorporated in the FFS scope.	During course of project	FFS/IP/VO/ beneficiary	ESFP
1	Health and Safety Hazards for the farmers	Low	All project districts under A4N	✓Awareness and capacity building regarding Material Safety Data Sheet (MSDS) for each hazardous substance will be promoted. ✓WB Group's EHS Guidelines will be implemented as appropriate. ✓Use of appropriate personal protective equipment (PPE) will be mandatory while using pesticides.	During course of project	FFS/IP/VO/ beneficiary	ESFP
1	Impacts on Women, Children, and Vulnerable Groups	Low	All project districts	✓Women's participation is already included in project interventions like development Female farmer field schools (F3S), construction of girl toilets, focusing on women as the main agriculture producers.	During course of project	FFS/IP/VO/ beneficiary	ESFP

Table 5.4: ESMF Mitigation and Monitoring Plan

	Environmental /Social Impact/Issue	Potential Significance	Location	Mitigation Actions	Frequency of Intervention	Responsibility	
						Implementation	Monitoring
				✓Lady Extension Workers (LEW) will be engaged as contingent staff for short period, so as, to work with women beneficiaries. (PC-I of A4N) ✓Environmental screening checklist will provide first stage information about impacts on poor, women and other vulnerable groups including needs and priority for social and economic betterment; ✓IPs and TSPs will ensure the active participation of women in project interventions as well as adequately consulted. ✓In awareness raising under SSS, women share should be more compared to men. ✓Ensure participation of vulnerable groups in project activities through consultations, to ensure planned investments take the well-being of such groups into consideration			
1	Employment	Low	All project districts	✓Preference will be given to the landless farmers. ✓The capacity building component of the project will include trainings for operation and maintenance of the subproject facilities for supply chains and post-harvest loss control. ✓GRM will be put in place to amicably resolve any disputes or conflicts related to employment and service provision.	During course of project	FFS/IP/VO/ beneficiary/ Contractor	ESFP

5.5. Monitoring Framework

5.5.1. Internal Monitoring

ESMF monitoring will be carried out to ensure that the mitigation plans are regularly and effectively implemented. It will be carried out at three levels. The directorate level, district level and at field level. At the directorate level, the environment and social specialists will carry out ESMF monitoring to ensure that the mitigation plans are being effectively implemented, and will conduct field visits on a regular basis. The district monitoring unit (DMU) and District nutrition coordination committee (DNCC) will also be responsible for ESMF implementation monitoring and evaluation. Monitoring checklists will be prepared and the subproject-specific mitigation plans included in the ESMPs. IPs and TSPs will carry out monitoring at field level.

The DMU and DNCC will also conduct consultation with communities especially women. Monitoring checklists will be prepared and the subproject-specific mitigation plans included in the ESMPs.

Table 5.5: Monitoring Levels and Responsibility

Level	Responsibility	Monitoring Tasks
Internal Monitoring		
Directorate Level	Environment and social specialists	ESMF monitoring to ensure that the mitigation plans are being effectively implemented, and will conduct field visits on a regular basis
District Level	ESFPs supervised by District monitoring unit (DMU) and District nutrition coordination committee (DNCC)	ESMF implementation monitoring and evaluation Consultation with communities especially women
Field Level	ES and SS hired by IPs/TSPs	Field level environmental and social aspects

5.5.2. Third Party Validation (TPV)

The project will engage Independent Environmental and Social Monitoring Consultant (IESMC) (specialists/firms) as third party to conduct external monitoring as third party validation throughout the project execution. The IESMC scope includes but not limited to review the implementation status of mitigation measures in the ESMF, ESMPs, and Checklists, and the related documentation and to review the environmental and social monitoring regime as specified in the ESMF and ESMPs, review reports of monitoring carried out by ES/SS/ESFPs, identify non-compliances/gaps, and recommend changes, to improve monitoring mechanisms, if any. This will include providing feedback to improve integration of ESMF in the overall project implementation. IESMC will report on quarterly basis to the Directorates for further submission to WBG and other agencies.

Below table presents the measures/activities to be monitored internally and externally during project lifecycle:

Table 5.6: ESMF Monitoring Framework

S#	Measures/Activities to be monitored	Monitoring						
		Internal						TPV (IESMC)
		Directorate Level	Freq.	District Level	Freq.	Field Level	Freq.	Freq.
Anticipated Subprojects (financed under MSAN project)								
1.	Subproject Siting to any sensitive area ✓Subproject siting ✓VLD procedures if applied and valuation and compensation of affected assets in line with RPF/Sub-projects RAP.	ES/SS of Directorate	Before siting of sub-project	ESFPs	Before siting of sub-project			Quarterly
2.	Air Quality deterioration due to dust emissions ✓Condition of construction machinery, generators, and vehicles in terms of exhaust emissions. ✓Covering and spraying of soil and temporary spoil piles. ✓Access to students of schools and disruption.			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
3.	Surface and Ground Water Quality deterioration ✓Wastewater disposal. ✓IMP measures			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
4.	Solid Waste Management ✓Collection, disposal and management of solid waste.			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
5.	Noise ✓Planning and scheduling of machinery operation and high noise activities.			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
6.	Occupational Health and Safety ✓Provisions of WB Group's Environment, Health and Safety (EHS) Guidelines ✓Signs of stagnation of water if any and site housekeeping. ✓Provision of appropriately stocked first-aid equipment and personal protective equipment (PPE); ✓Check Training records ✓Check accidents records.	ES/SS of Directorate	Monthly	ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
Subproject Exclusions (Not financed under MSAN)								
7.	Unsuitable toilet construction may lead to water contamination ✓Dissemination of environment friendly designs of toilets			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
8.	Pit/septic tank Sludge Management ✓Sludge Management by communities. ✓Awareness raising in communities.			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly

Table 5.6: ESMF Monitoring Framework

S#	Measures/Activities to be monitored	Monitoring						
		Internal						TPV (IESMC)
		Directorate Level	Freq.	District Level	Freq.	Field Level	Freq.	Freq.
9.	Use of Adulterated/ banned Pesticide ✓IPMP implementation.	ES/SS of Directorate	Monthly	ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
10.	Health and Safety Hazards for the farmers ✓Awareness and capacity building for farmers. ✓Use of PPE by the farmers.			ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
11.	Impacts on Women, Children, and Vulnerable Groups ✓Women's participation during project preparation and execution ✓Participation of vulnerable groups	ES/SS of Directorate	Monthly	ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly
12.	GRM Implementation	ES/SS of Directorate	Monthly	ESFPs	Weekly	ES/SS of IPs/TSPs	Daily	Quarterly

5.6. Consultation Framework

The stakeholder consultation is a continuous process, and should be carried out throughout the life of project. The consultations carried out during the SERRS project and reported in this Addendum will adopt the same framework as defined for MSAN project. During the subsequent project phases as well, participation of the project stakeholders need to be ensured.

Table 5.3 charts out the proposed consultation framework during different project phases, while Figure 5.1 provides the conceptual framework employed during the stakeholder's consultation carried out as part of the present study. While the different stages identified in the figure are conceptually separate, in actual effect, many of them, (say individual and group consultations) often merge.

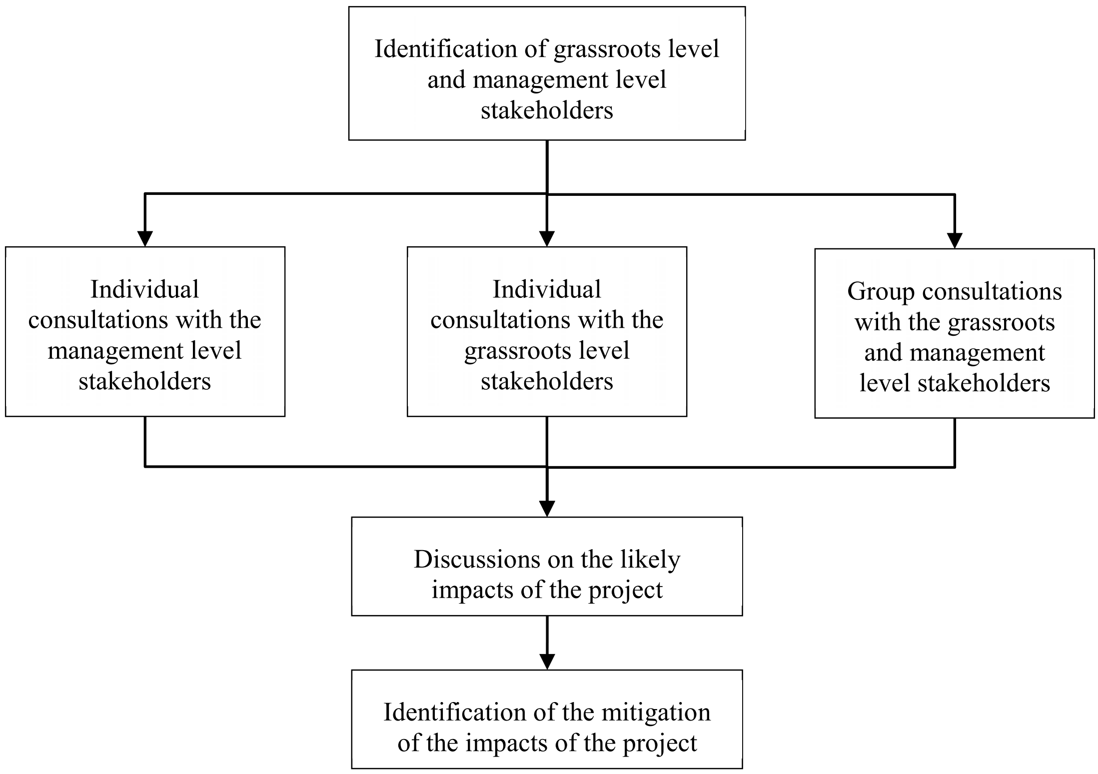

Figure 5.3: Conceptual Framework for ESMF Stakeholder Consultations

Table 5.7: Consultation Framework

Project Stage	Stakeholders	Consultation Tools	Responsibility
Project Design	Institutional Stakeholders: PDs, relevant provincial and local government departments, academia, bonafide development agencies, NGOs and subject experts in A4N and WASH)	Scoping Meeting with Institutional Stakeholders to deliberate on the planned project interventions and potential environmental and social risks	ESMF/ESMP Consultant
	Selected Local Communities from Low-Income backgrounds (including women)	Focus Group Discussions in all districts with Community Representatives on potential environmental and social risks	ESMF/ESMP Consultant
Project Inception	Institutional Stakeholders incuding implementation partners: District Coordination Committees, NGOs, and development agencies	Inception Workshop for: • Discussion on Implementation Plan • Finalization of roles and responsibilities for implementation partners • Finalization of Documentation, M&E, Reporting requirements	SSS Directorate Social Specialist (SS) A4N Directorate Social Specialist (SS)
	Target Communities/VOs (including representation from women and vulnerable groups where relevant)	Focus Group Discussions in all 14 districts: • Information disclosure using BID and Implementation Plan • Community Feedback regardingImplementation Plan, including role of VOs, GRM, Institutional Coordination, and M&E	SSS Directorate Social Mobilizers and ODF District Coordination Committee A4N Directorate Social Mobilizers and A4N District Coordination Committee
Project implementation	Beneficiaries at Local-level and Implementation Parnters	Project Launching Workshop providing all relevant project details as per WB's information disclosure requirements	SSS Directorate PD A4N Directorate PD
	Beneficiaries and field-level implementation teams	Weekly Village-level monitoring and reporting of field-level activities using pre-designed monitoring templates	SSS: Village Officers from the Village Development Committees A4N: Village Officers from the Village Development Committees
	Beneficiaries and field-level implementation teams	Bi-monthly District-level monitoring and reporting for compliance of ESMF and environmental and social issues identified through GRM procedures	SSS: Environmental and Social Focal Person (ESFP) designated by DCC A4N: Environmental and Social Focal Persons (ESFP)s designated by District Agriculture and Livestock Officers

5.7. Grievance Redress Mechanism (GRM)

5.7.1. Overview and Scope

The Grievance Redress Mechanism proposed here spans the entire project implementation and will cater to both the directly and indirectly affected population. Though the GRM proposed here has been designed to address environmental and social problems identified during implementation, it will also cater to manage any disconnects that emerge from the field level and that has significant implications for effective implementation of the sub-project interventions.

In an effort to deter fraud and corruption, the use of a dedicated mobile application has been proposed for reporting of grievances from field level to district and provincial headquarters. This will not only provide a coherent system of checks and balances but will also enable swift redress and effective monitoring of complaints.

The Directorates for both the SSS and A4N projects will serve as the secretariat for the Grievance Redress Committee (GRC-Directorate) that will be responsible for providing oversight on the entire GRM process at a strategic level and monitoring of complaints management.

5.7.2. Objectives of Grievance Redress Mechanism

The grievance redress mechanism (GRM) will be consistent with the requirements of the World Bank safeguard policies to ensure mitigation of community concerns, risk management, and maximization of environmental and social benefits. The overall objective of the GRM is therefore to provide a robust system of procedures and processes that provides for transparent and rapid resolution of concerns and complaints identified at the village level.

The GRM will be accessible to diverse members of the community, including women, senior citizens and other vulnerable groups. Culturally-appropriate communication mechanisms will be used at all sub-project sites both to spread awareness regarding the GRM process as well as complaints management.

5.7.3. Communication & Awareness

The final processes and procedures for the GRM will be translated in to local languages (Sindhi and Urdu) and disseminated at all sub-project locations. These shall be made available (in both leaflet and poster format) to all sub-project locations through the offices of each DCC. Dedicated male and female Grievance Focal Persons for each sub-project location will play an instrumental role in spreading awareness regarding the GRM, including the use of information technology for reporting and monitoring of complaints.

5.7.4. Records and Monitoring

The Project Director's Offices for SSS and A4N will maintain an electronic database at the Directorate that will provide a summary of complaints received and mitigations. The PDs office will also provide an analysis of the grievances at each sub-project location using a pre-designed M&E template that will give insight in to the type of complaints received and qualitative and quantitative review of grievance redress. The PD's office will also be responsible for uploading the actions and results for each grievance for each sub-project location on a periodic basis to the Project website. The dedicated mobile application that will be used to communicate grievances will provide the basis for recording complaints both at the provincial and district levels.

Apart from the electronic database that will be maintained at the Directorate level, a manual register of all complaints and actions taken will be maintained by the Environmental and Social Focal Persons for each District at the Office of the District Coordination Committee.

5.7.5. Proposed Institutional Mechanisms

It is proposed to establish the following prior to commencing project implementation activities including pre-construction activities:

- Grievance Focal Points (GFPs), which will be the ambassador of change and educated people from each community on each sub-project site. Two GFPs (1 male and 1 female) will be selected for each sub-project locations and will be community members who are easily approached by the community
- A Public Complaints Center (PCC), which will be responsible to receive, log, and resolve complaints;
- A Grievance Redress Committee (GRC-District) will be established for each district that will manage GRM aspects for all sub-project locations in each district including decisions to be taken, actions and monitoring of complaints resolution at sub-project level. The ESFPs will play an instrumental role in steering the GRC functions at the district levels.
- A Grievance Redress Committee (GRC-Directorate), responsible to oversee the overall function of the GRM at a strategic level including monthly review.

Grievance Focal Points (GFPs)

The GFPs will be literate people from each community that will assist and facilitate the community members in reporting grievances resulting from project activities. The GFPs will use **smart phones** for lodging and reporting of grievances by any members of the local community. The GFPs will be provided training by the directorate (through ES/SS) in facilitating grievance redress.

Public Complaints Center (PCC)

PD-A4N & PD-SSS will establish a Public Complaints Centers (PCC) in their offices. The Directorate and the local government bodies will issues public notices to inform the public within the project area of the Grievance Redress Mechanism. The PCC's phone number, fax, address, email address will be disseminated to the people through displays at the respective DC offices of target district.

The PCC will be staffed by a full-time officer from the Directorate and will be independent of the ESFPs and IPs/TSPs. The officer will be provided training in dealing with complaints and mediation of disputes. The PCC officer will have resources and facilities to maintain a complaints database and communicate with ESFPs, IPs/TSPs, and DC offices and also with complainants.

The PCC will be responsible to receive, log, and resolve grievances. Given that the female community members have restricted mobility outside of their villages and homes, the female PD office staff will be required to undertake visits to the local communities. The frequency of visits will depend on the nature and magnitude of activity in an area and the frequency of grievances.

- The PCC will log complaint and date of receipt onto the complaint database and inform the ESFP;

- The PCC will instruct IPs/TSPs and ESFPs to refer any complaints that they have received directly to the PCC. Similarly, the PCC will coordinate with local government to "capture" complaints made directly to them;
- The PCC, with the IPs/TSPs and ESFPs, will investigate the complaint to determine its validity, and to assess whether the source of the problem is due to project activities, and identify appropriate corrective measures. If corrective measures are necessary, PCC, through the ESFPs, will instruct the IP/TSP to take necessary action;
- The PCC will inform the Complainant of investigation results and the action taken;
- If complaint is transferred from local government agencies, the PCC will submit interim report to local government agencies on status of the complaint investigation and follow-up action within the time frame assigned by the above agencies;
- The PCC will review the Contractors response on the identified mitigation measures, and the updated situation;
- The PCC will undertake additional monitoring, as necessary, to verify as well as review that any valid reason for complaint does not recur.
- During the complaint investigation, the PCC should work together with the IPs/TSPs and ESPFs. If mitigation measures are identified in the investigation, the IPs/TSPs will promptly carry out the mitigation. ESFPs will ensure that the measures are carried out by the IPs/TSPs.

Grievance Redress Committee (GRC-District)

A Grievance Redress Committee will be notified under the project for all participating districts. The GRC-District will be chaired by the Assistant Commissioner (AC) for each district and will include proportionate representation from district government, community representatives, civil society organizations and project team.

Grievance Redress Committee (GRC-Directorate)

Two separate GRCs will be developed at the Directorate levels for both SSS and A4N components. The GRC would be notified by Project effectiveness date. The PD offices will be the secretariat of the GRC. The GRC will function as an independent body that will regulate the grievance redress process. It will comprise of, ES and SS of Directorates, Senior Engineers from LGD/DOA/DOLF, Representative of DC offices of concerned districts and senior members from civil society in sub-project areas.

5.7.6. Procedures

The tracking and documenting of grievance resolutions will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the IPs/TSPs and into the monthly ESMP Compliance monitoring report to the World Bank.

- Grievance Focal Persons will be trained to address grievances on the spot to discourage lengthy procedures and inconvenience to the local community. However, where the case cannot be dealt with by GFPs on an ad-hoc basis, GFPs will use smart phones to lodge and communicate those complaints at the district and directorate levels. The Grievance Redress Committee at the district level will review and identify actions to be taken to address the complaints at its weekly meeting.

- Also Public Complaints Center (PCC), which will be responsible to receive, log, and resolve complaints via its number(s) disseminated in local DC offices.
- If not satisfactorily resolved by the Grievance Redress Committee-District, the grievance will be referred to consideration by GRC at the Directorate level within one week.
- Every effort will be made to address or resolve grievances within the following fixed time-lines, which will be an indicator against the performance of the handling system. Acknowledgement of a written submission will be issued to the complainant within three working days. If not resolved earlier by the IP/TSP/ LGD/DOA/DOLF officers on site, grievances will be tabled for discussion/resolution during Committee meeting within one week of receipt of the written submission.
- If the complainant is not satisfied, the complaint will have the option to seek redress through court of law.

Chapter 6 ESMF Implementation Budget

The cost estimates to implement addendum to ESMF is provided in Table 6.1 below. Most of the cost of the project like Implementation of IPMP, trainings, and reporting as prescribed in the MSAN ESMF will be same for these 14 additional districts. However additional cost implied is provided in the below table. This cost will be included in the overall project cost. Additional costs could be included in the sub-project specific ESMPs.

Table 6.1: ESMF Implementation Budget for 3 year Project ('000s)

Activity	*Year*			*Total*	*Notes*
	1	*2*	*3*		
Mitigation Measures					
Provision of PPEs for Toilet construction	8,400	-	-	8,400	For each school site, 5 workers will be utilized, so 5 x 2,800 schools = 14,000 PPE each sets = Rs.600
Barricade for school toilet construction site	5,600	-	-	5,600	Rs.2,000 x 2,800 schools
Temporary refuse bins	3,580	-	-	3,580	Rs.1,000 x 2,800 schools Rs.1,000 x 780 demo plots
First Aid Box	3,580	-	-	3,580	Rs.1,000 x 3,000 schools Rs.1,000 x 468 demo plots
Capacity Development					
Environmental Specialist (28)	8,400	8,400	8,400	25,200	Total 28 ES (16 for SSS and 12 for A4N) will be hired for 3 years contract period @ 25,000 /month
Social Specialist (25)	8,400	8,400	8,400	25,200	Total 28 SS (16 for SSS and 12 for A4N) will be hired for 3 years contract period @ 25,000 /month
IPM Managers (06)	3,000	3,000	3,000	9,000	Total 10 IPM managers will be hired for 3 years contract period @ 25,000 /month
IESMC	1,200	1,200	1,200	3,600	Rs.100,000 per month
Total	**42,160**	**21,000**	**21,000**	**84,160**	

Chapter 7 Resettlement Policy Framework (RPF)

This Resettlement Policy Framework (RPF) has been prepared under MSAN project where land may be acquired for small-scale interventions if land will be needed that cannot be acquired through VLD procedures.

Voluntary Land Donation: Directorate of Agriculture will completely avoid land acquisition. Whenever there is additional land requirement, the directorate will interact with the land owners and facilitate voluntary donation of land required for taking up sub-projects under the project. This use of voluntary donation option will be limited to demonstration plots used by Farmer Field Schools (FFS). Under no circumstances, the titleholder shall be subjected to any pressure, directly or indirectly, to part with the land. These actions are expected to minimize adverse impacts on the local population and help in project benefits reaching all sections of community. The directorate will ensure that the process of voluntary donation of land is meticulously documented to avoid confusions, misunderstandings, litigations, etc. at a later stage. The procedure for VLS is specified below. A format for this purpose is enclosed as Annex-L.

7.1.1.1. Voluntary Land Donation Protocol

Directorate of Agriculture will completely avoid land acquisition. Whenever there is additional land requirement, the directorate will interact with the land owners and facilitate voluntary donation of land required for taking up sub-projects under A4N. This use of voluntary donation option will be limited to small piece of land for demonstration plots. Under no circumstances, shall the titleholder be subjected to any pressure, directly or indirectly, to part with the land. These actions are expected to minimize adverse impacts on the local population and help in project benefits reaching all sections of community. The SERRS project will ensure that the process of voluntary donation of land is meticulously documented to avoid confusions, misunderstandings, litigations, etc. at a later stage. Original copies of all documentation of voluntary donation of land will be kept with the Directorates of Sanitation and Agriculture. Complete documentation along with a copy of the final document will be sent to Directorate for records and for inspection at a later date.

VLD is only suitable for community driven projects where the landowner and/or community wish to 'gift' land parcels or small areas for small-scale community infrastructure that will be of direct benefit to the donor's community.

1. When VLD is Applicable

For land donation the following rule will apply:

- Alternatives and the viability of other locations or sites have been considered;
- The Titleholder should not belong to the vulnerable sections. i.e.
- households (with a valid proof), as per provincial poverty line for rural/urban areas;
- households without a proof of the same and belonging to the following social categories
- Women headed households with women as sole earner
- minority /Handicapped persons, and is subject to any of the following impacts; Loses land holding, Loses shelter and Loses source of livelihood.
- The Titleholder should be holding more than the minimum prescribed land,

- The impacts must be minor. The voluntary donation should not be more than 10 percent of the area of that particular holding of the Titleholder.
- This should not require any physical relocation of the Titleholder.
- The land must be jointly identified by the Revenue Department/Project Affected Committee / Directorates Representative or project authorities. However, the project technical authorities should ensure that the land is appropriate for sub-project purposes and that the sub-project will not invite any adverse social, health, environment, safety, etc. related impacts by procuring this land.
- The land in question must be free of squatters, encroachers, or other claims or encumbrances.
- Verification of the voluntary nature of land donations must be obtained from each of the persons donating land. This should be in the form of notarized witnessed statements.
- In case of any loss of income or physical displacement is envisaged, verification of voluntary acceptance of community devised migratory measures must be obtained from those expected to be adversely affected.
- The Titleholders donating land should be made to understand that they will have equal access to the infrastructure built on the donated land like any other community member and that they cannot claim for any priority treatment.
- Grievance Redress Mechanism must be available.
- The donations and the process followed is documented, monitored and reflected in the monitoring reports.

2. When VLD is NOT Applicable

VLD is not applicable under the following scenarios:

- Where inadequate consultation with donors results in lack of understanding about the terms and conditions of the donation;
- In lieu of formal procedures for land acquisition where these do not exist;
- Where donor property owners, landowners or customary rights holders do not support, or will not directly benefit from, the Project;
- Where conflicts over land exist, including customary collective ownership;
- Conflicting land titling that make it difficult to establish with certainty who has a right to own, donate and use a specific parcel of land;
- Where donors did not provide their informed consent and were subject to political or social pressure and coerced into making the donation.

3. Process for Voluntary Donation

This section provides guidance on the process for VLD, namely on how to:

- Determine and document the appropriateness of VLD in the project context;
- Verify the requirements of the donation and the formalization of the donation;
- Carry out due diligence on the owners and users of land donated;
- Ensure appropriate consultation and disclosure;
- Establish informed consent of the person donating the land; and

- Establish grievance redress mechanism.

This section outlines the process that should be followed once the threshold considerations set out in Section 1 have been considered, and it has been determined that it is appropriate for the land to be provided to the project by voluntary donation.

It is necessary to follow a clear process for the donation, and to prepare and maintain documents that demonstrate such process. Each step set out below should be addressed in the context of the specific project, and fully documented.

(i) Determine and document that VLD is appropriate in the circumstances of the project.

The team should record the reasons why it thinks that the donation of land is appropriate for the project. In certain cases, only some of the land the project requires will be donated or alternatives to land donation exist.

The project team should identify (in as much detail as possible):

- What the land will be used for;
- How much land the project will require on both a permanent and temporary basis;
- How much of the land will be donated;
- What alternatives to donation exist (e.g., right of use, right of way);
- The terms of the donation;
- The identities of the parties who intend to donate;
- The beneficiary of the donation; and
- Any details that are relevant to why donation may be appropriate.

(ii) Verify the requirements to transfer, and formalize the transfer of the land

It is important to understand the process that should be followed to transfer the land, and appropriate ways to formalize the transfer so as to achieve certainty for both the transferee of the land and the project. An important consideration will be how transparent the process and the decision making process actually is, and what can be done to enhance the process.

(iii) Conduct due diligence on who owns and uses the land

Given the specific issues surrounding land ownership, it is important that the project team carries out careful due diligence to understand the type of land rights that exist in the project area, and to identify any particular issues relating to land ownership and use. Thereafter, a more specific due diligence must be conducted on each parcel of land proposed for donation to identify:

- The owner or owners of the land;
- The users of the land, or any parties that occupy the land (either physically or through ownership of an asset or conduct of livelihood or business activities on the land);
- Any competing claims of ownership or use;
- Structures and assets on the land;
- Any encumbrances on the land.

(iv) Disclosure and Consultation

The decision to donate must be taken on the basis of a full understanding of the project and the consequences of agreeing to donate the land. Accordingly, the parties that will be affected by the donation (the owners and users of the land) must be provided with accurate and accessible information regarding what the land will be used for, for how long, and the impact the donation will have on them and their families. It is important that prior written notification indicating the location and amount of land that is sought be provided and that its intended use for the project is disclosed.

There should be a clear agreement as to which party will pay the costs associated with the donated land. This could include measurement costs, documentation and notarial fees, transfer taxes, registration fees. It should also include the costs of re-measuring/re-titling the transferee’s remaining land and any new documentation relating to it.

(v) Establishing Informed Consent

It is crucial that the project team is confident that the decision to donate was taken in circumstances of informed consent or power of choice. As discussed earlier, this means being confident that the owner(s) or user(s) of the land understand:

- What the land is going to be used for, by whom and for how long;
- That they will be deprived of the ownership or right to use the land, and what this really means;
- That they have a right to refuse to donate the land;
- Whether there are alternatives to using this land;
- What they will need to do to donate the land (e.g., execute documents, get spousal consents, pay taxes);
- The effect of the donation on their family, and what they can do if they (or their family or heirs) want the land back.
- The exact demarcation of land boundary for the project’s use;
- Whether there are proposals which would allow other land to be used;
- What they will need to do to donate the land;
- The intergenerational effect of the donation on their family, what they can do if they (or their family or heirs) want the land back.

The terms and conditions of the land donation must be mutually agreed upon and detailing in a written agreement.

(vi) Documentation

It is necessary to distinguish between: (a) the agreement to donate the land; and (b) the document that carries out and evidences the legal transfer of the land. While it is important to have evidence of an intention and agreement to donate the land, it is equally important to ensure, where required and appropriate, that the land is legally transferred. While the process relating to the legal transfer of the land is frequently complicated and time consuming, it must be addressed.

The Format of VLD form is attached in **Annex L**.

Community consultations will also be carried out before establishing the sites.

7.2. Purpose of Resettlement Policy Framework

The purpose of this RPF is to provide policy and legal framework and procedures to mitigate unavoidable resettlement impacts. These procedures are in conformity to the World Bank OP/PB 4.12 on Involuntary Resettlement, as well as the applicable laws and regulations of Government of Sindh.

7.3. World Bank Resettlement Policy

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. The OP 4.12 provides safeguards to address and mitigate these impoverishments risks. The overall objectives of the Policy are:

The policy guidelines for resettlement process for the Project are principally derived from the World Bank OP 4.12, "Involuntary Resettlement". Summary of general policy guidelines, which are being adopted for the Project, is as follows:

- Involuntary resettlement is to be dealt with from the earliest stages of the Project preparation.
- Involuntary resettlement should be avoided or minimized wherever feasible; exploring all viable alternate Project designs.
- Where unavoidable, resettlement plans should be conceived, developed and executed as development programs, with resettled people provided sufficient investment resources and opportunities to share in the Project benefits.
- Persons to be displaced should have their former living standards and income earning capacity improved, or at least restored, and should be provided adequate support during the transition period.
- Community participation in the planning and implementation of resettlement should be encouraged and facilitated. The compensation process should be fully transparent.
- Given the complexity of resettlement in development projects, the concerned government agencies and departments should upgrade their institutional capacity to design and implement Resettlement Action Plans.

The key principles of World Bank Involuntary Resettlement Policy are:

- The need to screen the project early on in the planning stage;
- Carry out meaningful consultation;
- At the minimum restore livelihood levels to what PAPs were before the project, improve the livelihoods of affected vulnerable groups;
- prompt compensation at full replacement cost is to be paid;
- Ensure that PAPs who have no statutory rights to the land that they are working, are eligible for resettlement assistance and compensation for the loss of land or assets; and
- Disclose all reports.

Scope and Triggers: OP 4.12 is NOT triggered for the Project as a whole because there is no large scale land acquisition. The RPF will only apply to interventions where land may be acquired for small-scale interventions that cannot be acquired through VLD procedures.

7.4. Resettlement Processing Requirements

- identify possibility of land acquisition and resettlement during screening of sub-projects;
- minimize resettlement through relocation of the sub-project site, where possible;
- Acquire land through Voluntary Land Donation (VLD) process (see **Annex L**)
- If resettlement is unavoidable, prepare a Resettlement Action Plan (RAP) in line with World Bank OP 4.12;
- undertake meaningful consultation with project affected persons (PAPs);
- ensure PAPs are clearly identified including those with no formal rights;
- restore their livelihood;
- pay compensation in time before land is acquired, and;
- disclose all relevant information.

7.5. Criteria for Eligibility of PAPs

The criteria for eligibility of Project Affected Person (PAPs) in accordance with the World Bank OP 4.12 are:

- those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
- those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets--provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan; and;
- those who have no recognizable legal right or claim to the land they are occupying.

All of the above categories of the PAPs will be eligible for compensation under the RAPs.

7.6. Compensation Eligibility and Entitlements for Affected Persons

7.6.1. Eligibility

The project-affected persons, including displaced persons, eligible for compensation or rehabilitation provisions under A4N are:

(i) All land owning displaced persons losing land or non-land assets, i.e., crops and trees whether covered by legal title or traditional land rights, whether for temporary or permanent acquisition.

(ii) Tenants and share-croppers, whether registered or not; for all non-land assets, based on prevailing tenancy arrangements.

(iii) Displaced persons losing the use of structures and utilities, including titled and non-titled owners, registered, unregistered, tenants and lease holders plus encroachers and squatters.

(iv) Displaced persons losing business, income and salaries of workers, or a person or business suffering temporary effects, such as disturbance to land, crops, and business operations both permanently and also temporarily during commencement.

(v) Loss of communal property, lands and public infrastructure.

(vi) Vulnerable PAPs identified through the social impact assessment (SIA).

(vii) The affected persons will be eligible for rehabilitation subsidies and for the compensation of lost land, structures and utilities along with re-establishment of livelihood.

(viii) There will also be special provisions for vulnerable displaced persons i.e. very old, physically or mentally handicapped, poor below the poverty line, widows, and women headed household, and socially isolated.

The following entitlements are applicable for displaced persons losing land, houses and incurring income losses. Compensation and rehabilitation entitlements are summarized in the Entitlement Matrix in table below:

Table 7.1: Entitlement Matrix

Asset	Specification	Affected People	Compensation Entitlements
Permanent land acquisition	The landowner will have a title to the land.	Landowner	• Full compensation for land to be acquired accordance to the latest market rate. • Compensation will be at replacement cost[38] WITHOUT any deductions on depreciation
Arable Land Temporary land use during project commencement	Access is not restricted and existing or current land use will remain unchanged	Farmer/Titleholder	• Monthly Rent is accordance to the latest market rate; • Compensation, in cash, for all damaged crops and trees as per item below plus 15% compulsory acquisition surcharge
		Leaseholder *(registered or not)*	• Monthly Rent is accordance to the latest market rate; • Compensation, in cash, for all damaged crops and trees as per item below
		Sharecroppers *(registered or not)*	• Monthly Rent is accordance to the latest market rate; • Compensation, in cash or kind, for all damaged crops and trees as per item below
		Agricultural workers	• Compensation, in cash or kind, for all damaged crops and trees as per item below
		Squatters	• Compensation, in cash, for all damaged crops and trees as per item below
Arable Land where access is restricted and/or land use will be affected	All adverse effects on land use independent of severity of impact	Farmer/Titleholder	• Land for land compensation with plots of equal value and productivity to the plots lost; or; • Cash compensation for affected land at replacement cost[43] based on market value free of taxes, registration, and transfer costs

[43] **Description of "replacement cost" is as follows.**

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

Table 7.1: Entitlement Matrix

Asset	Specification	Affected People	Compensation Entitlements
		Leaseholder *(registered or not)*	• Renewal of lease in other plots of equal value/productivity of plots lost, or Cash equivalent to market value of gross yield of affected land for the remaining lease years (up to a maximum of 3 years).
		Sharecroppers *(registered or not)*	• Cash compensation equal to the market value of the lost harvest share once (temporary impact) or twice (permanent impact)
		Agricultural workers losing their contract	• Cash indemnity corresponding to their salary (including portions in kind) for the remaining part of the agricultural year.
		Squatters	• 1 rehabilitation allowance equal to market value of 1 gross harvest (in addition to crop compensation) for land use loss.
	Additional provisions for severe impacts (More than 10% of land loss)	Farmer/Titleholder Leaseholder	• 1 severe impact allowance equal to market value of gross harvest of the affected land for 1 year (inclusive of winter and summer crop and additional to standard crop compensation)
		Sharecroppers *(registered or not)*	• 1 severe impact allowance equal to market value of share of harvest lost (additional to standard crop compensation)
		Squatters	• 1 severe impact allowance equal to market value of gross harvest of the affected land for 1 year (inclusive of winter and summer crop and additional to standard crop compensation)
Houses and Structures		All relevant APs (including squatters)	• Cash compensation at replacement rates (to be determined by Agriculture Dept, Sindh) for affected structure and other fixed assets free of salvageable materials, depreciation and transaction costs. In case of partial impacts full cash assistance to restore remaining structure.
Crops	Crops affected	All APs (including squatters	• Crop compensation in cash at full market rate for one harvest (either winter or summer). • All other crop losses will be compensated at market rates based on actual losses.
Trees	Trees affected	All APs (including squatters)	• Where trees are cut down, the rate for wood and loss of income from tree products e.g. fruit will be provided. • Cash compensation shall reflect income replacement
Ruminants/ Livestock Sheds	Sheds affected	All PAPs (including squatters and encroaches)	• Cash compensation at replacement cost for affected structure and other fixed assets free of salvageable materials, depreciation and transaction costs. In case of partial impacts full cash

Table 7.1: Entitlement Matrix			
Asset	**Specification**	**Affected People**	**Compensation Entitlements**
			assistance to restore remaining structure. No compensation for land will be provided if land is not acquired.
Business Employment	Temporary or permanent loss of business or employment	All PAPs including squatters and encroachers	• Business owner: (i) Cash compensation equal to one year income, if loss is permanent based on type of business; (ii) cash compensation for the period of business interruption, if loss is temporary. • Worker/employees: Indemnity for lost wages for the period of business interruption up to a maximum of 3 months. • Temporary workers e.g. Hawkers/street vendors: Opportunity cost compensation equivalent to 2 months net income, or the relocation allowance, whichever is higher. Relocation assistance (costs of shifting) Assistance to obtain alternative site to re-establish the business
Relocation	Transport and transitional livelihood costs	All PAPs affected by relocation	• Provision of allowance to cover transport expenses based on the latest transportation rates and livelihood expenses (based on type and nature of livelihood) for one month.
Community assets		Any community structures will be rebuilt at a community-agreed location	• Rehabilitation/substitution of the affected structures/utilities (i.e. mosques, footbridges, roads, schools, health centers, etc.)
Vulnerable AP livelihood			• Subsistence grants to displace, poor /vulnerable families like (i) female headed households with dependents, (ii) disabled household heads, (iii) households falling under the generally accepted indicator for poverty, and (iv) ethnic minorities and indigenous peoples. • Subsistence grants will be equal to official Minimum Wage per month for the fiscal year per earning member in the household. Additionally, those with no earning members will be compensated according to the Official Poverty Line per person per month.
Unforeseen / unanticipated impacts			• Any unanticipated consequence of the project will be documented and mitigated based on the spirit of the principles agreed upon in this policy framework.

7.7. Cut-off Date

The cut-off date shall be set to prevent false claims for compensation or rehabilitation appearing after disclosure of the resettlement action plan. Compensation eligibility for non-land losses will be limited by a cut-off date for each subproject on the day of the beginning of the census survey for the impact assessment in order to avoid an influx of outsiders. The cut-off date will be announced through local means of communication including face-to-face communication with communities. Any persons who would settle/or build assets on encroached lands in the affected areas after the cut-off date will not be eligible for compensation.

7.8. Valuation and Replacement of Assets

The following methodology will be adopted for assessing unit compensation rates:

- Land will be valued at replacement cost based on current market values by carrying out a survey of transactions.
- Rent for temporary use of land will be fixed as per prevailing market rate in agreement of affected person.
- Houses, buildings and other structures will be valued at replacement cost plus labor cost based on the area, type and material of the affected item. No deductions will be made for depreciation, salvageable materials or transaction costs and taxes Rates for building structures will be evaluated by the Works and Services Department where relevant using the latest/current Composite Schedule Rates that are regularly published by the Works and Services Department, Government of Sindh.
- Crops will be valued at current market rates of gross value of harvest as valued by the Agricultural Department.
- The loss of fruit and non-fruit bearing trees will be compensated for based on their type, productive age and the market value of the produce for the remaining period of its average life. The value of younger fruit trees will be based on the expenditure made to bring the tree to its current state. This will be assessed by the Horticultural Wing of the Agriculture Department.
- The value of trees that would have been used for timber will be calculated based on the average volume and quality of wood produced and taking into consideration the size classes as determined by girth, diameter at breast, height and volume as assessed by the Forest Department, Government of Sindh.

7.9. RAP Preparation

The RAP preparation activities will be initiated as part of the preparation of each new sub-project involving resettlement impacts. The procedures will be to take the land requirements for each proposed sub-project and carry out a measurement survey and enumeration. The SS/Directorate staff will acquire map of the land from the Revenue Department and overlay sub-project site requirements with clear demarcation of government and private land, and also carryout demarcation on the ground in the presence of local community representatives in a transparent manner to avoid any confusion. The appraisal will entail the following studies and investigations:

- **Socioeconomic Survey**: A socio-economic survey will be carried out to provide a detailed socio-economic profile of the population in the project areas. The information gathered will include but not be restricted to the following aspects:
  i. household composition;
  ii. demography and ethnicity;
  iii. health and education;
  iv. community assets;

v. livelihood patterns and income baseline;

vi. land ownership patterns;

vii. affected persons income levels and expenditure patterns;

viii. affected persons views on the subproject and various resettlement and rehabilitation options;

ix. specific impacts on the poor, women and other vulnerable groups.

- **Census Survey**: A census of all people/households to be displaced or resettled will be undertaken based on the categorizations in the entitlement matrix. The Census will determine the exact number of PAHs/PAPs and how they will be affected by the specific impacts of a subproject. The Census will also identify all severely and vulnerable PAHs.
- **Social Impact Assessment and Inventory**: This task will be based on a Detailed Measurement Survey (DMS) which identifies the nature and magnitude of loss. The survey will include all losses including encroached land (residential and agricultural), immovable structures, communal, public and cultural/religious facilities, crops, trees and business incomes and wages. The impact assessment will also include a survey of compensation rates as detailed above and also the incomes of the PAHs.
- **Mitigation of Impacts**: The project will endeavor to avoid resettlement by changing the sub-project site locations. If unavoidable, a RAP or ARAP shall be prepared in line with this RPF, World Bank OP 4.12 and LAA (1894) and will cover all resettlement related impacts. The ARAP/RAP shall be implemented and monitored by the project proponent before contractor mobilization or physical works commencement.
- **Gender Impacts, Social Inclusion and Mitigation Measures**: RAP will include measures ensuring that the socio-economic needs and priorities of women are identified, addressed and mitigated. The following gender provisions will be incorporated to safeguard the specific needs and problems of women displaced persons during subproject implementation. The socio-economic data gathered will be gender-disaggregated. Female staff will be hired to collect data and assist women in resettlement activities. Female household heads will be registered as the recipients of compensation and rehabilitation measures due to their households. Women will be included in the consultation process through meetings held with women and will be encouraged to participate in the RAP planning and implementation process.
- **RAP Preparation**. All RAPs will be based on the provision outlined in this RPF. The RAPs may need to be updated to take into account changes in the final site locations. If needed, the RAPs should be updated (i) on finalization of sub-project site location but prior to the mobilization of TSP/FFS/F3S in the field and (ii) during the subproject operations (imparting training packages) where changes result in changes to the resettlement impacts.
- **RAP Approval**. Land will not be possessed until all RAPs are approved by the World Bank, payments made, replacement land found, replacement structures provided and displaced persons relocated. All RAPs/ARAPs are subject to final review and approval by the World Bank in order to ensure compliance with Bank safeguards. At its sole discretion the World Bank may delegate through the Government to the Local Governments this responsibility to ensure compliance with the provisions in this RPF after it is satisfied that effective monitoring of this process is in place.

7.10. Consultation, Participation and Disclosure/ Access to Information

7.10.1. Stakeholder Consultation

Consultations with potential affected persons and beneficiaries were carried out including communities, potential affectees, district governments and provincial line departments, and further consultations will be carried out particularly with affected persons and other key stakeholders during preparation and implementation of RAPs as mentioned in this RPF. The timing and nature of these consultations will vary depending upon the implementation program. Stakeholders will be identified through the initial social impact assessment for subprojects.

Table 8.2 charts out the proposed consultation framework for this RPF during different project phases.

Table 7.2: Consultation Framework for RPF

RPF Stages	Stakeholders	Consultation Tools	Responsibility
Project Design	Institutional Stakeholders: PDs, relevant provincial and local government departments, academia, bonafide development agencies, NGOs and subject experts in Agriculture and WASH)	Scoping Meeting with Institutional Stakeholders to deliberate on the planned project interventions and potential risks regarding land acquisition and resettlement	RFP Consultant
	Selected Local Communities from Low-Income backgrounds (including women)	Focus Group Discussions in all districts with Community Representatives on potential risks regarding land acquisition and resettlement	RFP Consultant
Project Inception (determining compensation entitlements, eligibility criteria)	Institutional Stakeholders incuding implementation partners: DCO, Revenue department of GOS, Patwari, Land Acquisition Collector	• Scoping Meetings at directorate level and district level	SSS Directorate Social Specialist (SS) A4N Directorate Social Specialist (SS)
	Affected Persons	• Focus group discussions and informed consultation meetings • Provision of information dissemination brouchures	SS/ESFPs of Directorate/DCC & DNCC
Project implementation (land and asset acquisition process, income restoration measures and delivery of compensation)	Affected Persons	Focus group discussions and informed consultation meetings Provision of information dissemination brouchures	SS of IPs and TSPs
	Institutional Stakeholders incuding implementation partners: DCO, Revenue department of GOS, Patwari, Land Acquisition Collector	Scoping Meetings at directorate level and district level	SSS Directorate Social Specialist (SS) A4N Directorate Social Specialist (SS)

7.10.2. Information Disclosure Plan

The entire RPF, after its clearance from the World Bank, as well as sub-project RAPs will be translated into Urdu/Sindhi and disclosed to the public through websites of the DOA/LGD, the World Bank InfoShop and shared with institutional stakeholders, APs and beneficiary communities.

Before the socio-economic baseline surveys are mobilized, the PD-A4N will need to have developed a workable strategy for public consultation and information disclosure, the Social Specialist of the project will take lead in assuming this responsibility. During the census and DMS, each affected household will be directly informed about the subproject entitlements and procedures.

The consultation process will need to outline the legal procedures that are to be followed for land acquisition and relocation. The details of the process will have to be clearly communicated to any displaced/affected people and in a form that can be easily understood. The information given should also include the provisions of the OP 4.12 principles and outline the rights and obligations of PAPs.

7.11. Institutional Arrangements and Implementation Mechanism

A Resettlement Unit will be formed under each Directorates. The Directorate of Agriculture under A4N component will have the overall responsibility for implementation of all resettlement tasks. The Directorate will be assisted by SS for implementation of RAPs. The SS under Directorate of Agriculture will oversee and direct all the activities during the implementation of RAPs. ESFPs at the district level will be responsible for implementing the RAP according to the agreed principles and procedures.

The Executive District Officer of Revenue Department, along with his staff, will be responsible for the acquisition of private land under Land Acquisition Act of Pakistan. The ESFPs will be responsible for coordination with the Revenue Department.

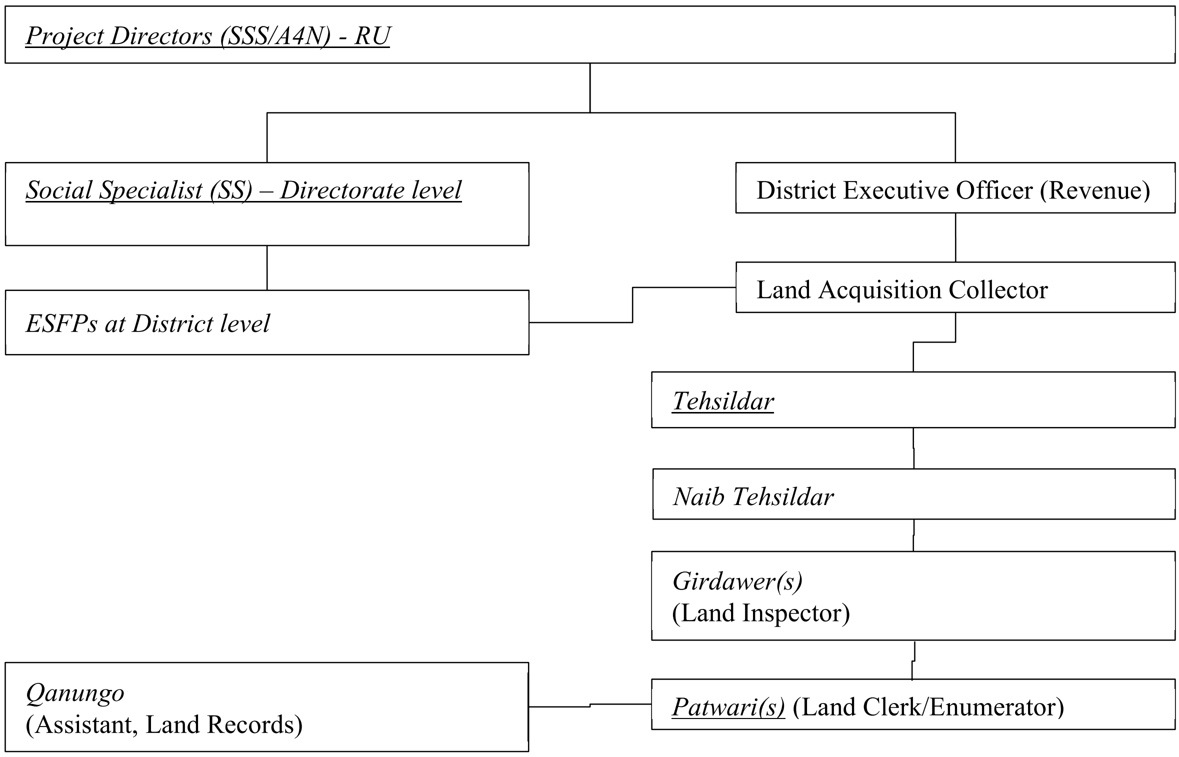

Figure 7.1: Institutional Organization of Resettlement Unit (RU)

LAR Process

Step	Action	Responsibility	Monitoring
1	Initial screening indicating for a specific subproject whether LAR is needed.	SS of Directorates with the assistance of ESFPs	PDs of Directorates
2	Proposal to Revenue Department with Brief Description of subproject including LAR.	SS of Directorates	PDs of Directorates
3	Prepare impacts/AP surveys forms and establish coordination with relevant local government agencies.	ESFPs with the assistance of SS of IPs and TSPs	SS of Directorates
4	Verify land records in affected areas, conduct DMS and carry out impacts and valuation surveys, identify land classification for affected areas	LAC, Patwari, ESFPs	
5	Conduct public consultations and negotiations	SS of IPs and TSPs	
6	Preparation and Finalization of sub-project RAPs/ARAPs	SS of Directorates	
7	RAPs/ARAPs disclosure to Aps	SS of IPs and TSPs	
8	Compensation Disbursement	LAC/ SS of IPs and TSPs	
9	Relocation	IPs/TSPs	

7.12. Resettlement Budget and Financing

All RAP preparation and implementation costs, including cost of compensation, various eligible allowances, monitoring, evaluation, grievances redress, as well as contingencies, will be estimated and included as an integral part of each subproject cost. RAPs of each subproject will include a budget section indicating (i) unit compensation rates for all affected items and allowances, (ii) methodology followed for the computation of unit compensation rates, and (iii) a cost table for all compensation expenses including administrative costs and contingencies.

Financing for each subproject specific RAP cost, including compensation, allowances, and administration of RAP preparation and implementation, will be provided by the Government of Sindh as counterpart funds. Costs for external monitoring tasks can be allocated under the loan. In order to ensure that sufficient funds are available for RAP tasks, the local governments will have to allocate 100% of the cost of compensation at replacement cost and expected allowances estimated in each RAP plus 5% of contingencies before RAP implementation.

Allocations will be reviewed twice a year based on the budget requirements indicated in RAPs. Regarding the flow of RAP finances, it is noted that the budget for land, crops, trees, structures compensation will be disbursed by DOA/DOLF, through the ESFPs will be responsible to disburse the compensation to the PAPs with assistance from the field offices. A timetable will be set within RAP and the compensation will be done before award of contract, commencement of the physical works or acquiring the land.

7.13. Monitoring and Reporting

RAP tasks under each sub-project will be subjected to both internal and external monitoring. Internal monitoring will be conducted by the SS, assisted by the ESFPs. External monitoring will be assigned to Independent Environmental and Social Monitoring Consultant (IESMC) to be hired by Directorate under A4N, and approved by WB. The IESMC will be chosen among local consultants.

7.13.1. Internal Monitoring

Internal monitoring will be carried out routinely by the ESFPs at the district level their results will be communicated to concerned Affected People, SS and to WB through the quarterly project implementation reports. The monthly reports will be quarterly consolidated in the standard supervision reports to WB. Specific monitoring benchmarks will be:

a) Information campaign and consultation with PAPs;
b) Status of land acquisition and payments on land compensation;
c) Compensation for affected structures and other assets;
d) Payments for loss of income;
e) Selection and distribution of replacement land areas; and
f) Income restoration activities
g) People's views and feedback on RAP implementation process
h) Other relevant aspects

7.13.2. External Monitoring

External monitoring will be carried out twice a year, and its results will be communicated to all concerned PAPs, the Agriculture Directorate and WB through semi-annual reports. Subprojects whose implementation time-frame will be under 6 months will be monitored only once. Indicators for External Monitoring tasks include:

a) Review and verify internal monitoring reports prepared by ESFPs and its field offices;
b) Review of the socio-economic baseline census information of pre-displaced persons;
c) Identification and selection of impact indicators;
d) Impact assessment through formal and informal surveys with the affected persons;
e) Consultation with PAPs, officials, community leaders for preparing review report; and
f) Assess the resettlement efficiency, effectiveness, impact and sustainability, drawing lessons for future resettlement policy formulation and planning.

The IESMC will also assess the status of project affected vulnerable groups such as female-headed households, disabled/elderly and families below the poverty line. The IESMC will carry out a post-implementation evaluation of the RAP after completion of its implementation. The compelling reason for this study is to find out if the objectives of the RAPs have been attained or not. The benchmark data of socioeconomic survey of severely affected PAPs conducted during the preparation of the RAPs will be used to compare the pre and post project conditions. The IESMC will recommend appropriate supplemental assistance for the PAPs should the outcome of the study show that the objectives of the RAPs have not been attained.

7.14. Grievances Redress Mechanism

The key objectives of the grievance redress mechanisms are to establish procedures for filing any grievances and disputes on social safeguards and other entitlement issues arising out of the implementation of the project. It outlines the modalities and mechanisms for resolution of grievances within a defined timeline.

Affected persons may disputes over entitlement processes due to issues associated with – for example, (i) lack of land record systems in selected districts; (ii) titles over communal lands; (iii) Delay in payment for permanent land acquisition, (iv) delay in payment of compensation to APs.

The GRCs will deal with grievances and disputes to resolve such cases locally to facilitate smooth implementation of the social and environmental action plans. As a result, the GRC system will make the project accountable to the local people. Further, it will also democratize the development processes at the local level.

The GRCs are to ensure accessibility, fairness and independence of the procedures. The GRCs will be built on a "bottom up" system that would include: (i) Village-level GRC, (ii) Union Council level GRC, (iii) District-level GRC and (iii) Project-level GRC. First, GRC at the village level consisting of local representatives of the affected people and maliks of village elders, project staff, and local government representatives and will receive cases and resolve locally within a defined timeline. Cases which are not satisfactorily resolved or affected persons have still grievances will be forwarded to the Union Council GRC for disposal. The District level GRC with review cases unresolved at the UC Level GRC. Finally, an independent GRC headed by a retired civil judge will review cases sent to the project level GRC.

The Directorates for both the SSS and A4N projects will serve as the secretariat for the Grievance Redress Committee (GRC-Directorate) that will be responsible for providing oversight on the entire GRM process at a strategic level and monitoring of complaints management.

The committee is responsible for the facilitation of resolution of disputes and grievances which may arise during the implementation. The committee shall be formed of the following members:

Table 7.3: Grievance Redress Committee (GRC-Directorate)

Representative	Members
Assistant Commissioner	Chairman
Project Directors, SSS and A4N	Member
Land Acquisition Collector	Member
SS under Directorates	Member
Grievance Focal Points (GFPs)	Member
Patwari(s)	Member
PCC Officer	Member
Grievance Focal Points (GFPs)	Member

The GRM will be accessible to APs. Culturally-appropriate communication mechanisms will be used at all sub-project sites both to spread awareness regarding the GRM process as well as complaints management.

It is proposed to establish the following prior to commencing LAR implementation activities:

- Grievance Focal Points (GFPs), which will be the ambassador of change and educated people from APs on each sub-project site. Two GFPs (1 male and 1 female) will be selected from APs;
- A Public Complaints Center (PCC), which will be responsible to receive, log, and resolve complaints;
- A Grievance Redress Committee (GRC-District) will be established for each district that will manage GRM aspects for all sub-project locations in each district including decisions to be taken, actions and monitoring of complaints resolution at sub-project level. The ESFPs will play an instrumental role in steering the GRC functions at the district levels;
- A Grievance Redress Committee (GRC-Directorate), responsible to oversee the overall function of the GRM at a strategic level including monthly review.

7.14.1. Procedures

- GFPs will be trained to address grievances on the spot to discourage lengthy procedures and inconvenience to the APs. However, where the case cannot be dealt with by GFPs on an ad-hoc basis, GFPs will use smart phones to lodge and communicate those complaints at the district and directorate levels. The Grievance Redress Committee at the district level will review and identify actions to be taken to address the complaints at its weekly meeting.
- Also Public Complaints Center (PCC), which will be responsible to receive, log, and resolve complaints via its number(s) disseminated in local DC offices.
- If not satisfactorily resolved by the Grievance Redress Committee-District, the grievance will be referred to consideration by GRC at the Directorate level within one week.
- Every effort will be made to address or resolve grievances within the following fixed time-lines, which will be an indicator against the performance of the handling system. Acknowledgement of a written submission will be issued to the complainant within three working days. If not resolved earlier by the IP/TSP/LAC/Patwari on site, grievances will be tabled for discussion/resolution during Committee meeting within one week of receipt of the written submission.
- If the complainant is not satisfied, the complaint will have the option to seek redress through court of law.

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Annexures

Annex A: Environmental Screening checklist

The below checklist used is largely subjective, and may be overruled by site specific considerations. (Description in red is for guidance and may be deleted before using the checklist)

Name of Enumerator:_______________________________ Date: ____________________________
Province:____________ District:________________ Project:______________ Sector:_____________
Project Categorization: A B C

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting **Is the project area…**			
Presence of any environmentally sensitive areas? (This aspect will be confirmed for each individual sub-project under SSS & A4N)			
- Protected area			
- Wetland			
- Mangrove			
- Estuarine			
- Buffer zone of protected area			
- Special area for protecting biodiversity			
- Cultural / Heritage sites			
B. Potential environmental impacts **Will the project cause…**			
Pollution of raw water supply from wastewater discharge from communities, agriculture activities? (This aspect will be assessed while designing specific subprojects under SSS & A4N. It will be ensured that the subprojects do not cause significant degradation of water bodies)			
Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? (This aspect will be confirmed for each individual sub-project under SSS & A4N)			
Serious contamination of soil and groundwater due to use of Pesticides? (The project interventions can potentially increase the usage of pesticides and fertilizers. Use of IPMP and appropriate awareness raising and capacity building initiatives will be included in the project design to address the potential impacts)			
Aggravation of solid waste problems in the area? (This aspect will be assessed while designing specific subprojects under SSS & A4N. It will be ensured that solid waste generated from SSS sub-projects and A4N will be handled carefully and disposed in environmental friendly way while avoiding contamination to local waterways and groundwater.)			
Social conflicts arising from displacement of communities? (This aspect will be confirmed for each individual sub-project under A4N)			
Impediment to access of residents and students (This aspect will be confirmed for each individual sub-project under SSS during construction of toilets in schools)			
Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters? (This aspect will be confirmed for each individual sub-project under SSS & A4N. If applicable, the subproject design will include water conservation practices and less water consuming designs to address water scarcity.)			
Unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents) resulting in increased cases of diarrhea and making the program objectives unachievable?			

SCREENING QUESTIONS	Yes	No	REMARKS
(This aspect will be confirmed for each individual sub-project under SSS & A4N.)			
Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents? (It is likely that due to project interventions, the water may accumulate at one place or waste disposal is not adequate. The subproject design will include mitigation measures for proper waste disposal and wastewater discharge.)			
Inadequate protection of sewage collection, leading to pollution of water supply? (It is likely that due to project interventions, the existing water supply may get contaminated. The subproject design will include mitigation measures for proper waste disposal and wastewater discharge.)			
Over pumping of ground water, leading to salinization and ground subsidence? (Unlikely, however this aspect will be confirmed for each individual sub-project under SSS.)			
Environmental degradation (e.g. erosion, soil and water contamination, loss of soil fertility, disruption of wildlife habitat) from intensification of agricultural land use to supply raw materials for plant operation; and modification of natural species diversity as a result of the transformation to monoculture practices? (Unlikely, however this aspect will be confirmed for each individual sub-project under A4N.)			
Dislocation or involuntary resettlement of people? (This aspect will be confirmed for each individual sub-project using involuntary resettlement checklist)			
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?			
Potential social conflicts arising from land tenure and land use issues? (This aspect will be confirmed for each individual sub-project under A4N as it will require land acquisition.)			
Impediments to movements of people and animals? (Unlikely, however this aspect will be confirmed for each individual sub-project under A4N.)			
Noise and dust from construction activities? (This aspect will be assessed while designing specific subprojects under SSS. It will be ensured that the noise/dust emissions from subprojects' construction remains within acceptable limits.)			
Excessive abstraction of water affecting downstream water users? (Unlikely, however this aspect will be confirmed for each individual sub-project under SSS and A4N.)			
Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project commencement? (Unlikely, however this aspect will be confirmed for each individual sub-project under SSS and A4N.)			
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?			

Annex B: Involuntary Resettlement Screening Checklist

Name of Enumerator:______________________________ Date: ___________________________
Province:___________ District:_______________ Project:_____________ Sector:____________
Project Categorization: A B C

SECTION 1	Yes	No	Expected	Remarks
Does the project require land acquisition? Yes/No				
If yes, then describe the type of land being acquired from the categories below:				
Land (Quantify and describe types of land being acquired in "remarks column".				
Government or state owned land free of occupation (agriculture or settlement)				
Private land				
• Residential				
• Commercial				
• Agricultural				
• Communal				
• Others (specify in "remarks").				
• Name of owner/owners and type of ownership document if available.				
If land is being acquired, describe any structures constructed on it				
Land-based assets:				
• Residential structures				
• Commercial structures (specify in "remarks")				
• Community structures (specify in "remarks")				
• Agriculture structures (specify in "remarks")				
• Public utilities (specify in "remarks")				
• Others (specify in "remarks")				
If agricultural land is being acquired, specify the following:				
Agriculture related impacts				
• Crops and vegetables (specify types and cropping area in "remarks).				
• Trees (specify number and types in "remarks").				
• Others (specify in "remarks").				
Affected Persons (DPs)				
Will any people be displaced from the land when acquired? Yes/No				
• Number of DPs				
• Males				
• Females				
• Titled land owners				
• Tenants and sharecroppers				
• Leaseholders				
• Agriculture wage laborers				
• Encroachers and squatters (specify in remarks column)				
• Vulnerable DPs (e.g. women headed households, minors and aged, orphans, disabled persons and those below the poverty line). Specify the number and vulnerability in "remarks".				
• Others (specify in "remarks")				
• How will people be affected?				

Section 2				
Will land be donated voluntarily? Yes/No				
If yes, does the owner been made aware of VLD nature and procedure?				
Has the landowner agreed to sign the VLD documents?				
Can the owner produce land title deeds/documents of ownership?				
Are there any tenants on the land?				
If yes, describe number of tenants, gender and type of tenancy and length of residence.				
If yes, are tenants willing to move?				
Will there be adverse impacts on tenants? Describe in remarks column				
Are there people using the land for livelihoods, cultural activities? Yes/No				
If yes, how many people? Gender? Type of activity?				
How will voluntary land donation effect people using the land?				

Annex C: Monitoring and Supervision Checklist

(This is the sample checklist and can be modified based on the subproject)

Project : ______________________ Site Location : __________

Status during inspection : ______________________ __________

Inspection Date : ______________________ Inspection Time : __________

Inspected by : ______________________ Weather : __________

Inspection Items	Implemented?		N/A	Remarks (i.e. specify location, good practices, problem observed, possible cause of nonconformity and/or proposed corrective/preventative actions)
	Yes	No*		
1. Air Pollution Control				
1.1. Tractor loads covered with any suitable material while transporting construction material?				
1.2. Are stockpiles of dusty materials covered or watered?				
1.3. Are Latrine Construction sites including soil piles in schools fenced to avoid material escape, generation of dust and access to children?				
1.4. Others (please specify)				
2. Surface and Ground Water Pollution Control				
2.1. Area wastes released into any drinking water source, irrigation channels, cultivation fields, or critical habitat?				
2.2. Are effluents from the construction sites released to drinking water sources, cultivation fields, irrigation channels, and critical habitats?				
2.3. Are appropriate effluent treatment arrangements such as settling tanks made at the site?				
2.4. Is IPM as part of A4N sub-component implemented in providing farm implement?				
2.5. Are crops grown in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion?				
2.6. Others (please specify)				
3. Noise Control				

Inspection Items	Implemented?		N/A	**Remarks** (i.e. specify location, good practices, problem observed, possible cause of nonconformity and/or proposed corrective/preventative actions)
	Yes	No*		
3.1. Are machinery operation and high noise activities carefully planned and scheduled?				
3.2. Are high noise activities ceased between 22:00 and 06:00 hrs?				
3.3. Others (please specify)				
4. Solid Waste Management				
4.1. Is recycling of solid waste carried out? 4.2. Is composting of biodegradable waste considered and adopted?				
4.3. Is the wastes routinely collected from the designated area and disposed at waste disposal facilities?				
4.4. Is the construction sites equipped with temporary refuse bins?				
4.5. Is the waste properly disposed in designated areas and not affecting the drinking water sources, cultivation fields, irrigation channels, natural drainage paths, the existing waste management system in the area, local routes, and general aesthetic value of the area?				
4.6. Others (please specify)				
5. Occupational Health and Safety				
5.1. Are WB Group's Environment, Health and Safety (EHS) Guidelines implemented in letter and spirit?				
5.2. Are appropriate personal protective equipment (PPE) provided to minimize risks, such appropriate outerwear, boots and gloves; safety helmets?				
5.3. Are first-aid equipment at work sites provided?				
5.4. Is of water stagnation observed near construction site?				
5.5. Are training for workers for the use of PPE provided? 5.6.				
5.7. Are procedures for documenting and reporting accidents, diseases, and incidents implemented at site?				
5.8. Others (please specify)				

Inspection Items	Implemented?		N/A	Remarks (i.e. specify location, good practices, problem observed, possible cause of nonconformity and/or proposed corrective/preventative actions)
	Yes	No*		
6. Labor Issues				
6.1. Are labor locally procured for the construction of toilets in schools?				
6.2. Is consultation with labor conducted periodically?				
6.3. Others (please specify)				
7. Subproject Exclusions				
7.1. Are environment friendly designs of toilets disseminated within the communities as a guide?				
7.2. Is sludge after emptying the tanks/pits landfilled at proper location?				
7.3. Is adulterated/ banned Pesticide used?				
7.4. Is awareness and capacity building regarding Material Safety Data Sheet (MSDS) for pesticides provided to farmers?				
7.5. Are farmers use PPEs while applying pesticides?				
7.6. Is women and vulnerable group's participation consultation for project interventions ensured?				
7.7. Is the GRM implemented for amicable resolution of disputes or conflicts?				
7.8. Others (please specify)				

*Any "No" recorded represents the potential breach of regulation or improvement needed and details of nonconformity shall be recorded in the Remarks.
* Report nonconformity in the following forms. Each nonconformity should make reference into the checklist as coded. The responsible personnel shall identify the root cause of nonconformity and adopt appropriate corrective and preventive actions for mitigation. Confirmation of the effectiveness of the corrective and preventive actions shall be verified by Environmental/Social Specialist (ES/SS) within an agreed time.

Signature of Environmental/Social Focal Point (ESFP) ____________________ Date ____________________

Reviewed by Project Environmental/Social Specialist (ES/SS) ____________________ Date ____________________

Annex D: Model Integrated Pest Management Plan (IPMP)

Introduction

Agriculture and Livestock Departments, Government of Sindh has developed Integrated Pest Management Plan (IPMP) for “Sindh Agricultural Growth Project (SAGP)” in August 2013. The SAGP is focused on horticulture—particularly chilies (92 percent of national production), onions (33 percent), dates (about 50 percent), and milk production because these commodities have a small farmer focus, have significant involvement of women in production and processing. This model IPMP has been prepared for A4N component of MSAN project which is based on principals devised in SAGP IPMP which is the principal document of Agriculture and Livestock Departments for horticulture crops as well as based on the provisions of WBG OP 4.09.

This model IPMP will be helpful for Directorate of Agriculture to prepare project specific IPMP and to mitigate and include the rational use of pesticides.

25 percent of Pakistan’s fruits and vegetables produced annually go to waste between the farm and the consumer. Only four percent of Pakistan’s total fruit and vegetables are exported and at far lower prices due to poor quality and the reliance on traditional low end markets. In milk production, losses climb to about 30 percent in the summer due to lack of infrastructure and equipment. The introduction of good agricultural practices (GAP) and modest investments in relatively simple technology could substantially increase the quality of production and the potential for increased trade and higher incomes.

As the overall impacts of the MSAN project on the environment were expected to be positive and accordingly MSAN was classified as a category B project under its operational policies (OP 4.01). The EMP as part of ESMF recommended measures to mitigate possible adverse impacts on the environment, including the potential induced impacts of increased pesticide use, an Integrated Pest Management Plan (IPMP) was prepared in compliance of the Bank’s procedures (BP 4.01 - Annex C).

Current Pest and Pesticide Management Approaches

The weedicides/herbicides are not usually used to control weed in IPM program because in Sindh majority of small farms remove weeds and feed to farm animals as cheap fodder. This is best method to control weeds in Sindh conditions. However, pest and disease control needs attention. In chilies pests may be effectively controlled through plain water sprays/ neem oil-water sprays. However, in rare instances third generation eco-friendly insecticides such as Acetamiprid, and diafenthiuron that could be used, In some literature, Imidacloprid, and Emamectin are wrongly categorized as eco-friendly, but in fact these are not eco-friendly and should not be used; particularly the latter Emamectin which is highly toxic to bees and aquatic arthropods. Similarly, third generation fungicides such as Difenoconazole, mancozeb, could also be used as last option. In Onion plain water spray or neem-oil spray is best to control thrips. However, occasionally onion crop is attacked by bulb fly, and certain lepidopterous pests then the pesticides of chloropyrophos, Imidacloprid or any third generation pyrethroid available in the market may be used. There are implications of these crop pests the on pesticide use patterns in vegetables particularly onions. Aphids, mites and thrips are all notorious for developing resistance to most insecticides which tends to put farmers on a “Pesticide Treadmill” with high concentrations and more frequent uses. Therefore it is desirable for an IPM strategy to include a pesticide resistance management strategy as well.

Use of Fertilizers, Manures, Pesticides and Herbicides by Size of Farm

Following table provides the data on use of pesticides of overall Sindh and selected districts. The highest use of pesticides is in matiari comprising 58 % of the total farms. The highest use of herbicide is in Ghotki comprising 47 % of total farms.

Area	Total Farms	Farms reporting use of									
		Fertilizers & Manures		Fertilizers Only		Manures Only		Pesticides		Herbicides	
		Number	%	Number	%	Number	%	Number	%	Number	%
Sindh	*1115285*	*187513*	*17*	*671206*	*60*	*13587*	*1*	*412430*	*37*	*196495*	*18*
Khairpur	122395	16370	13	79659	65	-	-	54710	45	26582	22
Hyderabad	16641	2765	17	12972	78	47	*	13574	82	2342	14
Shaheed Benazirbad	44961	4664	10	16482	37	899	2	15829	35	7481	17
Karachi	2837	121	4	35	1	6	*	62	2	9	*
Ghotki	94305	23179	25	63409	67	-	-	47870	51	44273	47
Khairpur	122395	16370	13	79659	65	-	-	54710	45	26582	22
Naushero Feroze	86777	21172	24	55937	64	377	*	42616	49	43626	50
Tando Allahyar	33339	8636	26	17692	53	9	*	16421	49	4406	13
Matiari	17646	1796	10	12657	72	6	*	10175	58	4203	24
Sukkur	37195	339	1	23530	63	22	*	9372	25	3031	8

* value less than 0.5

Source: Agricultural Census 2010: Government of Pakistan, Statistics Division, Agricultural Census Organization

Externalities of Pesticide Use

The cost of pesticide use is much more than the cost of the pesticide itself. The social cost is enormous which is generally disregarded while determining the economic gains in terms of higher crop yields. These costs include: occupational poisoning, food residues, drinking water contamination, pest resistance, loss of biodiversity, cost of prevention and abatement measures and the cost of awareness campaigns. Further, there are health related issues; such as (a) Sickness Incidence of Pesticide Applicators, (b) Sickness in Women Cotton Pickers, (c) Industrial Worker Poisoning, and (d) Pesticide Residue in Food Chain.

Other externalities. Pesticide residues also found in irrigation and drinking water, cotton seed, oil, lint and cattle feed, cottonseed cake, animal milk, and soil. Increased pesticide resistance is resulting in additional applications of pesticides to maintain expected crop yields. The consequences are lower yields and higher production costs. Pesticide use is affecting biodiversity too but it is little understood and appreciated. Some examples are: pollinator damage (honey bee poisoning), soil fauna, wildlife and birds.

Integrated Pest Management (IPM)

No single method of pest control is adequate to give satisfactory results in all situations. Therefore an integrated approach needs to be adopted. For this purpose, Integrated Pest Management (IPM) is the best available alternative. IPM has no standard definition, but is commonly referred as a diverse mix of approaches to manage pests; keep them below damaging levels by using control options that range from cultural practices to chemicals. Technologies involved, such as use of bio-pesticides (derived from *neem*, *dhatura* and *aak* that are local tree/bushes and tobacco), augmentation releases of predators/parasites, development of pest resistant species, crop rotation, cultural practices, and balanced use of fertilizers.

Integrated Plant and Soil Nutrient Management (IPSNM)

The concept of Integrated Plant and Soil Nutrient Management (IPSNM) entails the management of both organic and inorganic plant nutrients for optimal production of the cultivated crop, forage, and tree species while conserving the natural resource base that is essential for the long-term sustainability of the agro-ecosystems and the environment. Organic fertilizers bring about many useful changes in the chemical, microbiological and physical properties of soil that enhance soil fertility. The effect is long-term and not immediate, and, therefore, farmers hesitate to use organic fertilizers. High levels of organic residue incorporation especially in fine textured soils, improves its structure as indicated by several of the parameters such as soil porosity, pore size distribution, bulk and particle densities, aggregate stability, water holding capacity, aeration, infiltration, and hydraulic conductivity. The recycling of soil derived nutrients is also improved through proper organic residue management.

Policy, Regulatory Framework, and Institutional Capacity

The first law called The Agricultural Pesticide Ordinance, 1971 was promulgated. The Agricultural Pesticide Rules under the law were framed in 1973. The 1971 Ordinance is a comprehensive law for regulating imports, formulation, sale, distribution, and use, and establishing of institutions, ensuring quality control, and prescribing penalties for offences. It was amended in 1979 to let pesticide business transition from public sector to private sector, thereafter in 1992 to allow pesticide imports under generic names, and lastly in 1992 to strengthen the punishment provisions for adulteration.

Banned Pesticides. In 1994, twenty three (23) pesticides were deregistered and their use banned in the country (Appendix 1).

Proposed IPMP for MSAN Project

The Agriculture Department, Sindh has prepared a PC-1 for the Agriculture for Nutrition (A4N) which is one of the component of MSAN project. The “Pest Management Plan (PMP)” is embedded in the A4N component only. Integrated Pest Management (IPM) and Integrated Plant and Soil Nutrient Management (IPSNM) are the core capacity building measures of the technical service providers (TSPs) for promoting of good agriculture practices (GAP) that include both IPM and IPSNM. The IPMP presented here highlights activities designed in the A4N component including training packages delivered using FFS approach on demonstration plots and A4N investment fund which would finance purchase of supplies by farmers needed to start interventions. These activities will have substantial relevance to the IPM.

Objectives

The main objectives of the Pest Management Plan are threefold:

- *Promotion of IPM*: To minimize pesticide usage through Integrated Pest Management (IPM), Integrated Plant and Soil Nutrient Management (IPSNM) and Good Agricultural Practices (GAP), because they include the rational use of chemical pesticides, promote cultural practices and the use of nutrients from organic resources;
- *Management of Pesticides*: To monitor the pesticides management such as their usage before, during and after, and the level of pesticide residues in normally-treated and IPM-treated areas and to disseminate information to stakeholders on the usefulness of undertaking IPM practices.

- *Capacity Building*: To raise awareness of all stakeholders about the IPM approach to crop management, and train extension agents and farmers through FFS system to become practitioners of IPM.

Strategy

The main elements of the strategy would be to promote IPM practices under A4N component of MSAN project, which do not absolutely exclude the use of pesticides yet it promotes an integrated approach to use all available options for controlling pest population with no adverse effect on human beings, animals and the environment that eventually results in attaining sustainable productivity. The strategy calls for sensitizing the farmers and Extension staff also on the importance of IPM, particularly on the promotion of GAP and the rational use of pesticides.

The Farmers Field Schools (FFS) approach as part of A4N includes the promotion and implementation of GAP and IPM approaches. The key elements of FFS entail farmers are trained by facilitators through group participation, known as FFS and F3S in kitchen gardens, small-scale vegetable farming, small-scale livestock rearing (poultry, ruminants, fisheries), and small-scale food storage and preservation. Therefore it is essentially a field-based participatory training where farmers and extension staff work together for the duration of the project. The latter group carries out dialogues with farmer on public interest issues, including environmental conservation and health. The expected output of such training is that farmers/female farmers become self-reliant to NSA and are able to make their own nutritious food.

The concept of Integrated Plant and Soil Nutrient Management (IPSNM) would complement the IPM practices. The strategy for IPSNM would include:

a) maximizing organic matter production through green manure and cover crops;
b) enhancing natural processes of nutrient recycling through managing plant-soil-pest-predator interactions; and
c) providing soil cover (mulch, cover crops) to supply nutrients, reduce weeds, and enhance functions of soil biota and plant roots.

Activities Proposed for the IPMP

Awareness Programs: To disseminate awareness programs through FFS and Demonstration plot method, adequate resources are provided in the A4N component as well as the sub-component i.e. Inter-Sectoral Coordination (component D(ii))which will provide a common platform for harmonization, and multi-sector synergies for effective nutrition response. The main areas that would be covered for the promotion of IPM and IPSNM practices would relate to human health, like pesticide handling, usage, storage and disposal, other health hazards, types of pesticide application.

Technical Transfer Aspects. Department of Agriculture and Department of Livestock and Fisheries (DOLF), with the support of the technical service provider (TSP), will develop information and guidelines on the technology and information needs of communities/households who will participate in the project. The TSP will lead multi-sector teams from DOA, DOLF and DOH to mobilize the villages around nutrition awareness. Information on required technology will be used in the mobilization process to generate informed demand among project beneficiaries, who can receive a grant to purchase the goods that they need. Each target village will form a procurement committee to receive the grant from the government and purchase the technical assets. The government will schedule the FFF/F3S to provide the necessary training to the beneficiaries.

DOA and DOLF have a system of staff within the district and UCs that will provide front-line support of the beneficiaries with support of the TSP. There are some vacant sanctioned positions in all three departments that could be filled to meet the needs of the project. DOA can reassign staff to be dedicated to the implementation of this project as needed, and fill some vacant position on contingency basis with women to meet the outreach needs of the project.

Successful IPM consists of, but not limited to, following key aspects to be included in the curricula for the FFS/F3S:

- Identify pests and monitor progress
- Set action thresholds
- Prevent
- Control
- Documentation
- Responsibility

Integrated Plant and Soil Nutrient Management (IPSNM). The IPSNM approach uses both organic and inorganic fertilizers in proper proportion accompanied by sound cultural management practices and seeks to both increase agricultural production and safeguard the environment for future generations. The application of organic fertilizers needs to be encouraged to increase the soil water holding capacity in view of the ever increasing water scarcity.

Pilot Demonstrations on IPSNM. Training packages on demonstration plots delivered through FFS/F3S would include promotion of the use of organic fertilizers/residues, composting and mulching.

Pesticide Residue. Under the FFS system, samples of pesticide residue on vegetables/pulses would be collected from the control and IPM treated plots and the quantity of pesticide residue determined. The control plots are where prevalent practices of pesticide use are undertaken (i.e. included under IPMP of SAGP Project of Agriculture department) and demonstration plots where farmers practice of IPM are carried out. This would help establish the usefulness of adopting IPM practices. The work of pesticide residue determination would be contracted out to existing research laboratories that possess the desired facilities (National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro,). Monitoring of pesticide residue would be carried out throughout the project period and information disseminated widely to help bring down the level of residue to below the Maximum Residue Limit (MRL). Annual monitoring will be conducted for all project interventions that focus on on-farm productivity enhancements. An analytical study on the work done would be prepared in the last year of the project period.

Curriculum development for the FFS/F3S

DOA and DOLF staff will lead the technical assistance and training of beneficiaries through FFS, F3S, and FBS. The curricula, which will be developed by departmental staff with support of the TA provider, will cover topics relevant to small scale food production, including (but not limited to):

- General information on the link between food and nutrition;
- Elements of a healthy diet;
- Food for complementary feeding;

- Garden preparation and vegetable cultivation methods;
- Integrated pest management (including reducing pesticide residues);
- How to purchase good seeds and breeds in the market;
- Animal nutrition and health;
- Livestock waste management;
- Tunnel farming techniques;
- Food storage techniques;
- Home based preservation of vegetables and fruits (canning, pickling, drying, etc.);
- Storage of food grain and fodder for animals, etc.

Implementation Responsibility and Institutional Arrangements

The Director General (DG), Agriculture Extension Sindh will be responsible for activities of the A4N with major focus on FFS/F3S approach, in which IPM and IPSNM activities would be the principal capacity building measures. The Directorate of agriculture under the DG will help implementing the IPM related activities.

The same structure of Agriculture Department as adopted for IPMP of SAGP will be proposed in this IPMP of A4N component which is as follows:

The Director who is assisted in his work by a Plant Protection Officer and one Agricultural Officers at the Directorate level will prepare Project specific IPMP. The directorate will have additional support of 10 IPM Managers under the A4N, who would be placed at the district headquarters level for each district. In the field, District Governments handle this work through a hierarchical setup: Deputy Director, Agricultural Extension at District level; Assistant Director at Taluka level, Agricultural Officer at Sector level, and Field Assistant at the Union Council level. On the other hand, the actual frontline player who would implement the activities is TSP.

Monitoring and Evaluation

Monitoring would involve agronomic practices particularly cropped area sprayed (number of sprays and quantity of pesticides used), knowledge and adoption of IPM measures; and observing the adoption rates IPM/IPSNM and measuring the impact of project interventions on the kitchen gardens disaggregated by farm type and gender, by over the project period. Mid-term and post-project evaluations would also be carried out. The following key monitoring indicators are suggested: quantity of pesticide used; number of sprays and area sprayed by crop; pesticide residues on vegetables; and the use of banned pesticides, if any. Pesticide residue studies would be carried out for crops where on-farm productivity enhancements are planned on an annual basis.

Cost

The following costs associated with implementation of this IPMP in terms of pesticides usage and residue monitoring shall be included as part of the A4N component of the project. The awareness raising activities shall be streamlined with the capacity building components of the project.

Item	Amount (USD)
Annual Pesticide Residue Surveys (3)	3,000,000
Soil Testing for IPSNM	900,000
Total	**39,000,000**

Appendix 1

Banned Pesticides (Active Ingredients)[44]

1. BHC
2. Binacryl
3. Bromophos ethyl
4. Captafol
5. Chlordimeform
6. Chlorobenzilate
7. Chlorthiophos
8. Cyhexatin
9. Dalapon
10. DDT
11. Dibromochloropropane + Dibromochloropropene
12. Dicrotophos
13. Dieldrin
14. Disulfoton
15. Endrin
16. Ethylene dichloride + Carbontenachloride
17. Leptophos
18. Mercury Compound
19. Mevinphos
20. Toxaphene
21. Zineb
22. Heptachlor
23. Methyl Parathion

[44] Source: Sindh Agricultural Extension Department

Annex E: Checklist for Verification and Certification of ODF & Total Sanitation Communities[45]

Village:………………… Taluka:……………… District:…………………

GENERAL INFORMATION		
S#	**Description**	**Responses**
1.	Total No. of Households in the Community	
2.	No. of Households with latrines	
3.	If not all the households have latrines, where do the households without latrine defecate?	
4.	When was the community triggered?	
5.	Has the community been certified ODF?	
6.	If Yes, when was the community certified ODF?	
7.	Who certified the community ODF?	
8.	Does the Community have hand washing stations?	

General Observation of the Community

GENERAL OBSERVATION OF THE COMMUNITY				
S#	**Description**	**yes**	**No**	**Remarks**
1.	Are the household latrines being used?			
2.	Are the latrines well maintained?			
3.	Are hand washing facilities available near the latrines?			
4.	Are anal cleansing materials properly disposed?			
5.	Are children faeces properly disposed?			
6.	Are there any traces of human faeces in former open defecation sites?			
7.	Apart from former open defecation sites, are there faeces deposited in the open anywhere in the community?			
8.	Are there latrines with hand washing facilities in schools available?			
9.	Are water points (boreholes, dug wells) located 30m from latrines?			

Any other observations and additional comments on the ODF status of the Community:

………
…………………………………………………………………………………….

Recommendations (Give your recommendations on the ODF Status of the Community)

………
……………………………………………………………………………………

Name of Evaluator: Signature: Date:

[45] The ODF Checklist will be modified as required during the implementation phase of the project

For Verification and Certification for Total Sanitation, observe the following;

S#	Description	yes	No	Remarks
1.	households use hygienic latrines			
2.	All households always keep latrines clean			
3.	Schools (where available) have latrines, hand washing facilities and urinals			
4.	Health Centers (where available) have latrines and hand washing facilities			
5.	Markets (where available) have latrines			
6.	Hand washing facilities close to the latrines			
7.	People keep food covered			
8.	People keep drinking water covered			
9.	Community water point surroundings clean			
10.	Proper disposal of solid waste			
11.	Proper disposal of liquid waste			
12.	Proper disposal of animal waste			
13.	Location of water points (borehole, dug well) 30m from latrines			
14.	Community environment generally clean			

Any other observations and additional comments on the ODF status of the Community:

……
……………………………………………………………………………………….

Recommendations (Give your recommendations on the ODF Status of the Community)

……
………………………………………………………………………………………

Name of Evaluator: Signature: Date:

Annex F: Guidelines for Construction of Latrines

1. Selecting the proper location

Effluent passing into the soil from a latrine pit contains large amounts of micro-organisms this may include disease causing bacteria. It also has high nitrates and other salts. There is a possibility for underlying aquifers to be polluted by the effluent infiltrating into the soil from the latrine pits. Hence a number of factors need to be taken into consideration when siting the pit of the latrine in addition to factors such as convenience and privacy of users.

- A latrine pit should be located outside a radius of 15m from a water source such as a well, stream etc.
- It should not be located upstream or up-hill from any water source
- It should not be located in a low-lying area
- Whenever possible a latrine pit should be located at least 4 m from the nearest house or building
- The bottom of the latrine pit should be a minimum of 2 m above the maximum ground water table to minimize the threat of contamination. (this is the groundwater table during peak wet weather)
- The latrine should be oriented in such a way that it receives adequate sunlight

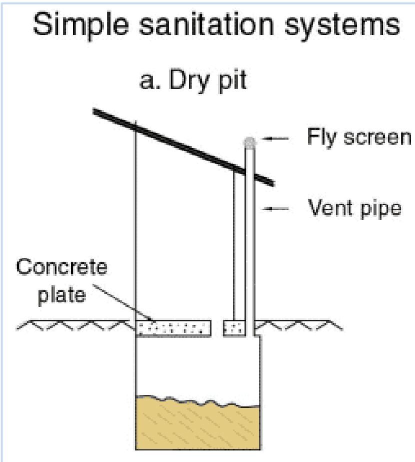
2. Selecting the proper latrine type

Selection of the most appropriate latrine type is equally important as the siting. There are number of factors that are generally considered when selecting the type of sanitation.

- Groundwater situation - The most important consideration here is groundwater pollution. This can particularly be a problem if groundwater is used for drinking purposes and the groundwater table is naturally high.
- The texture of soil, stability, permeability and the general structure of the terrain.
- Affordability
- Cultural acceptance
- Means of disposal of sludge and waste water

Following latrine designs are discussed hereunder:

7.14.1.1. Pit Latrines



A pit latrine or pit toilet is a type of toilet that collects human feces in a hole in the ground. They use either no water or one to three liters per flush with pour-flush pit latrines. The World Health Organization recommends they be built a reasonable distance from the house balancing issues of easy access versus that of smell. The distance from groundwater and surface water should be as large as possible to decrease the risk of groundwater pollution.

When the pit fills to within 0.5 meters (1.6 feet) of the top, it should be either emptied or a new pit constructed and the shelter moved or re-built at the new location. Fecal sludge management involves emptying pits as well as transporting, treating and using the collected fecal sludge. If this is not carried out properly, water pollution and public health risks can occur.

This option of is not preferred due to its environmental consequences in water logged or shallow groundwater areas. Also the fecal sludge should be removed after filling the pit and there is a chance of spreading vector from the pit and odor problems. Also the construction of the latrines has to be outdoor due to odor and vector problems.

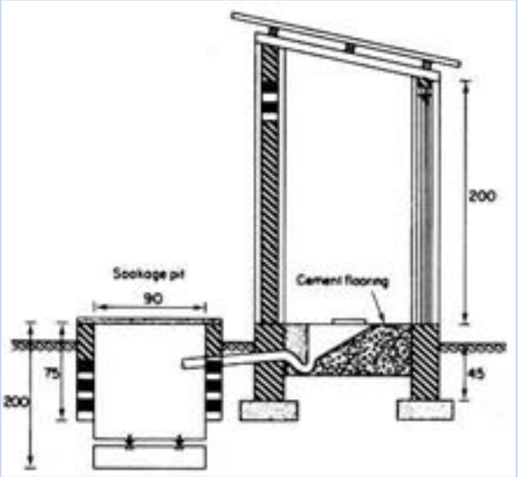
7.14.1.2. Water Flush Toilets[46]

Flush toilets use water to flush human excreta into a leach pit, tank, or sewer. After the toilet is used, a minimum of 2.5 liters of water is poured into the pan to flush the toilet. Flush toilets normally have a U-shaped conduit partly filled with water (U trap) under the pan. The U trap overcomes the problems of flies, mosquitoes, and odor by serving as a water seal. Flush toilets discharge wastewater directly into open water courses. If no specific measures are taken, this can result in pollution of neighboring surface water, which in many cases is also used as a household water source.

The water flush toilet technologies presented in this section are:

- Offset single pit toilet with pour flush
- Offset double pit toilet with pour flush
- Pour-flush toilet with two chamber septic tank with soak-pit
- Pour-flush toilet with two chamber septic tank with drainage field
- Pour-flush toilet with two chamber septic tank with evapo-transpiration mound

Offset single pit toilet with pour flush



The superstructure of an offset single pit toilet with pour flush is half a meter away from the leach pit. A short length of sufficiently sloping (1:10) PVC leads from the U trap down to the pit.

Suitability

The direct single pit toilet with pour-flush is suitable

- For areas where the water table is high, if the toilet is raised and connected to a soak-pit.
- For loose soils, if fully lined.
- For soils with low permeability, if built with a soak pit.
- In areas prone to freshwater or tidal flooding, if raised.

Advantages

- It is relatively inexpensive to construct, operate, and maintain:

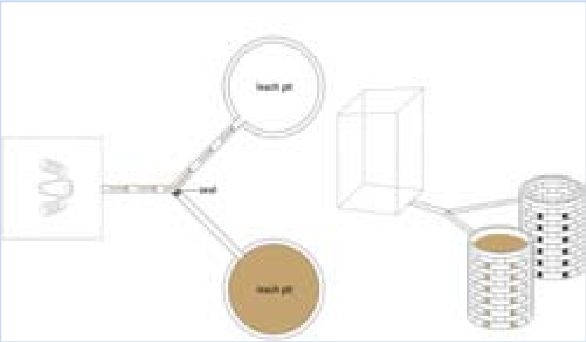
[46] Hygiene-Sanitation-Water-Toolkit - WSP

- ✓ Operation consists of regular water cleansing of the slab (with soap or detergent, if available) to remove any excreta and urine, and daily cleansing of the floor, squatting pan, door handles and other parts of the superstructure.
- ✓ Maintenance consists of monthly inspections to check for cracks in the floor slab and damage to the vent pipe and fly screen, and digging out of part of the feces at the end of the dry season. These feces should be handled with care and buried in a pit covered with soil. After at least a year, when the contents of the pit have decomposed into harmless humus, the humus can be can be used as fertilizer.

Disadvantages

- The U-trap can easily become blocked because of bad design or improper use, or damages by improper unblocking.
- Pour-flush toilets are unsuitable where it is common practice to use bulky materials for anal cleansing which cannot be flushed through the U-trap. Unless those materials are separately collected and safely buried or burned.
- The pit sludge is not safe until it has been left to decompose for at least a year.

Offset double pit toilet with pour flush



An offset double pit toilet with pour flush is an offset single pit toilet with a second pit added. The double offset system enables alternating use of the two pits.

When the first pit is full it should be left for at least twelve months, the period required for adequate pathogen destruction. After this period, the decomposed contents of the first pit can safely be removed by hand and used as organic fertilizer. The first pit can be used again while the contents of the second pit decompose.

Suitability

The offset double pit toilet with pour flush is suitable

- For areas where the water table is high, if the toilet is raised and connected to a soak-pit.
- In areas prone to freshwater or tidal flooding, if raised.
- For loose soils, if fully lined.
- For soils with low permeability, if built with a soak pit.

Advantages

- It is easy to construct, operate, and maintain:

- ✓ Operation consists of regular water cleansing of the slab (with soap or detergent, if available) to remove any excreta and urine, and daily cleansing of the floor, squatting pan, door handles and other parts of the superstructure.
- ✓ Maintenance consists of monthly inspections to check for cracks in the floor slab and damage to the vent pipe and fly screen, and digging out of part of the feces at the end of the dry season. These feces should be handled with care and buried in a pit covered with soil. After at least a year, when the contents of the pit have decomposed into harmless humus, the humus can be can be used as fertilizer.

- It is relatively inexpensive to construct, operate, and maintain.
- The pit sludge is safe.
- The toilet can be connected to a soak pit.

Disadvantages

- The U-trap can easily become blocked because of bad design or improper use, or damages by improper unblocking.
- Pour-flush toilets are unsuitable where it is common practice to use bulky materials for anal cleansing which cannot be flushed through the U-trap. Unless those materials are separately collected and safely buried or burned.
- The contents of the pit may not decompose safely when the double pits are too close to each other without an effective seal between them, allowing liquids to percolate from one pit to the other.

Pour flush toilet with 2-chamber septic tank with soak pit

This type of pour flush toilet is like the offset single pit toilet, but with a septic tank in place of the pit.

A septic tank is a watertight settling tank to which wastes are carried by water flushed down a short PVC pipe. A septic tank does not dispose of wastes; it only helps to separate and digest the solid matter. The liquid effluent flowing out of the tank is as dangerous as raw sewage from a health point of view and must be dispersed by soaking into the ground through the soak pit. The sludge accumulating in the tank must be removed regularly, usually once every one to five years, depending on site, number of users, and kind of use.

In double-compartment septic tanks the first compartment has twice the volume of the second. The total volume of the tank should be at least three times the average volume of water used daily. Every tank must have a ventilation system to allow explosive gases to escape. Septic tanks are more expensive than other on-site sanitation systems and require sufficient piped water.

A soak pit is a pit into which the liquid effluents from the septic tank flow to be filtered into the ground. The capacity of the pit should not be less than that of the septic tank. The pit may be filled with stones or broken bricks, in which case no lining is needed, or lined with pre-cast reinforced cement concrete rings. The top 0.3 m (the topmost ring) should be a non-perforated ring. If no lining is used, the top 0.5 meter should be lined to provide a firm support for the reinforced concrete cover slab.

Suitability

The pour flush toilet with 2-chamber septic tank with soak-pit is suitable

- Where the water table is high, if the toilet is raised.
- In areas prone to freshwater or tidal flooding, if raised.
- For loose soils.
- For soils with low permeability.

Advantages and Disadvantages

The main advantage of the pour flush toilet with septic tank and soak pit is that it is easy to operate. This type of toilet has a number of disadvantages:

- It is relatively expensive and difficult to construct.
- It is relatively expensive and difficult to maintain. On a monthly basis, the floor, squatting pan and U-trap need to be checked, and if necessary small repairs must be carried out.
- Regular cleaning of the toilet with a bit of detergent is unlikely to be harmful, but the use of large amounts of detergents or chemicals may disturb the biochemical process in the tank. The tank must be emptied when solids occupy between one half and two thirds of the total depth between the water level and the bottom of the tank (at least once every five years).
- The sludge is not safe to handle. Removal is best done mechanically; if done manually, the sludge must be handled with extreme care. The sludge must be buried in a pit and covered with soil.
- Many problems are caused by too much disposed liquid. Large flows entering the tank may cause a temporarily high concentration of suspended solids in the effluent owing to disturbance of the solids that have settled out.
- This type of toilet is unsuitable for areas where water is scarce and where financial resources are insufficient for construction of the system, or where emptying of the tank is too expensive or cannot be carried out safely.

Pour flush toilet with 2-chamber septic tank with drainage field

This type of toilet is the same as the pour flush toilet with septic tank and soak pit, but with a drainage field in place of the soak pit.

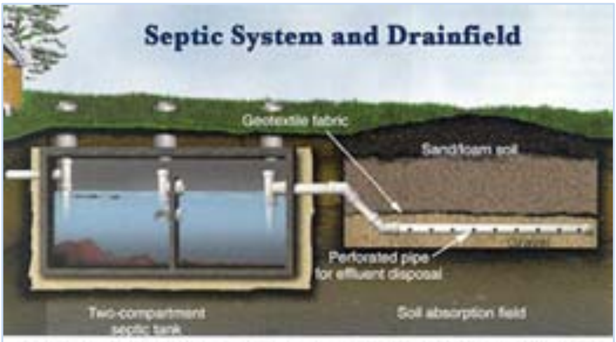


Image Source: Produced by Agricultural Communications, The Texas A&M University System, EPA

A drainage field is often used where larger quantities of liquid effluents are produced. A drainage field consists of gravel-filled underground trenches, into which the liquid effluents coming from the septic tank are led through open-joint (stoneware) or perforated (PVC) pipes, allowing the effluents to filter into the ground. Initially the infiltration into the ground may be high, but after several years the soil will clog and an equilibrium infiltration rate will be reached. If the sewage flow exceeds the equilibrium rate of the soil, eventually the sewage will surface over the drainage field.

Suitability

The pour flush toilet with drainage field is suitable

- In areas prone to freshwater or tidal flooding, if raised.
- For loose soils.
- For soils with low permeability where normal septic tanks cannot work.
- For toilets that require water for flushing.

The pour flush toilet with drainage field is not suitable where the water table is high.

Advantages

- It is easy to operate.
- The drainage field is easy to maintain. The maintenance activities for the drainage field consist of cleaning the tank outflow and ensuring that it is still in order, unblocking the delivery pipe if necessary, cleaning the diversion boxes from time to time, controlling plant growth to prevent roots from entering the trenches, and carrying out any necessary repairs.

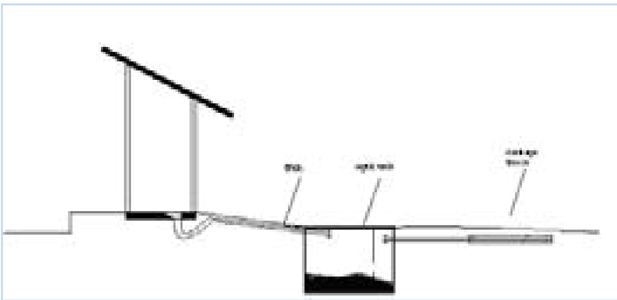
Disadvantages

- On a monthly basis, the floor, squatting pan, and U-trap must be checked, and small repairs carried out if necessary.
- Regular cleaning of the toilet with a bit of detergent is unlikely to be harmful, but the use of large amounts of detergents or chemicals may disturb the biochemical process in the tank.
- The tank must be emptied when solids occupy between one half and two thirds of the total depth between the water level and the bottom of the tank (at least once every five years).
- The sludge is not safe to handle. Removal is best done mechanically; if done manually, the sludge must be handled with extreme care. The sludge must be buried in a pit and covered with soil.
- The problems that can occur are overflowing leach lines, unpleasant odor, groundwater contamination, and social conflict over location of the drainage fields.
- A drainage field is unsuitable where insufficient space, water or financial resources for construction are available, or where bedrock or groundwater are at shallow depth.

Pour flush toilet with 2-chamber septic tank and evapo-transpiration mound

This type of toilet is the same as the pour flush toilet with septic tank and soak pit, but with an evapo-transpiration mound in place of the soak pit. The evapo-transpiration mound is shown in figure 6.6.

Where the soil is impermeable or difficult to excavate, or where the water table is near the surface, a possible solution is the use of an evaporation mound. An evaporation mound is filled with sand and gravel into which the liquid effluents coming from the septic tank are led through perforated laterals allowing the effluents to filtrate into the ground or to evaporate.



This ensures a greater depth and wider dispersion of the effluent and removes much of its water content through evaporation from the plants growing on top of the mound.

Suitability

The pour flush toilet with evapo-transpiration mound is suitable

- Where the water table is high, if the toilet is raised.
- In areas prone to freshwater or tidal flooding, if raised.
- For loose soils.

Advantages and Disadvantages

The pour flush toilet with evapo-transpiration mound has the same advantages as the pour flush toilet with drainage field, and the same disadvantages with respect to the need to empty the tank and dispose of the sludge with care. The principal advantage of a transpiration mound over a drainage field is that a transpiration mound can be constructed where bedrock or the water table are at a shallow depth.

3. Construction of latrine pits to replace existing latrine pits:

If new latrine pits are being constructed to replace existing latrine pits then following needs to be followed:

- Old latrine pits must be demolished and unsuitable debris disposed of in sites assigned by the local authority in a manner that does not cause harm or will spread waterborne diseases.
- If asbestos roofing has been used, proper removal and disposal of sheets are required. Workers involved in removal, should wear proper masks to minimize inhalation.
- All material that can be re-used and re-cycled should be done in a manner that is environmentally friendly. Re-use debris, except top soil where ever possible from the approval of engineers for the construction activities.
- If material is not to be used within a few days, it should be moved to a pre- identified site for storage until needed.
- Debris should not be disposed to water bodies, agricultural lands, marsh lands or any environmentally sensitive areas.
- Pits should be sealed off to prevent the spread of waterborne diseases.
- Once area is cleared of all debris, it is advisable to landscape area.

4. Selection of Best suited technology for MSAN Project

Keeping in consideration the factors like i) water table persist in project districts, ii) community acceptability iii) cost of construction iv) soil structure, v) area of construction and water availability, the following two types of toilet designs are selected:

1. Offset double pit toilet with pour flush – Also recommended in areas where water table is high if raised. Toilet is connected with leaching pits (stone lined) which act as a partial trickling filter and hence the water that escapes is bacteriologically less/not harmful. Once a pit is filled, the second one comes in use and the first is emptied over time.
2. Pit latrine – Only recommended where water is scarce and pour flush technique cannot be utilized and also water table is deep like in desert area.

Annex G: Reconnaissance Survey Methodology and Results

After initial information was collected and reviewed, Reconnaissance Survey (RS) in each district was conducted by ESMF team members to collect primary information for the sub-projects.

RS was focused on collection of information on various environmental and social aspects including but not limiting to physical, biological, hydrological, health and social environment. The survey comprised collection of information on:

- Air quality and noise
- Water & ground water resources;
- Community water sources
- Community issues such as disturbance, health, etc.;
- Archaeological aspect;

Selection of Sample Villages

Due to the limitation of time for conducting the study, in each target district, a minimum of 02 Villages were taken as sample villages to represent the environmental and social conditions. The villages were chosen on the basis of poverty and sanitary conditions.

Findings of Reconnaissance Survey

Ghotki

Village Name: **Changlani**	Union Council: **Beriri**
Socioeconomic Indicators	***Description***
Number of Households	110
Average Household Size	8
Income Level	Low (Rs.5,000 - 9,000 Monthly)
Major Occupations	Agriculture, Rickshaw Drivers and Labors
Major Diseases	Flue, skin diseases, Diarrhea, Hepatitis, Cough, Malaria etc.
Source(s) of Drinking Water	Boring
Environmental Indicators	***Description***
General Land Use	20% of the area is saline, Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: a. Air and Noise Quality b. Surface Water Quality c. Groundwater Quality	(ESMF Team/Locals perspective) a. Good b. Bad c. Fair
Existing Groundwater Table (ft)	60-75

	
Consultation with the villagers of Changlani	Cotton farm
	
Dwelling units	
	
Toilet in a house	Drainge dumped into agricultural water canal

Pictorial Overview of Village Chaglani, district Ghotki.	
	
Surrounding area of village	

	
Toilet in a house	Drainage system but not connected to any water body
	
Toilet of govt school	Govt. school

Village Name: **Haji Allah Rakhio Langha**	Union Council: **Beriri**

Socioeconomic Indicators	***Description***
Number of Households	100
Average Household Size	7
Income Level	Medium (Rs.12,000 Monthly)
Major Occupations	Agriculture, Drivers and Labors
Major Diseases	cough, Tuberculosis, Diabetes, Hepatitis, fever, Malaria
Source(s) of Drinking Water	Boring
Environmental Indicators	***Description***
General Land Use	20% of the area is saline, Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: d. Air and Noise Quality e. Surface Water Quality f. Groundwater Quality	(ESMF Team/Locals perspective) d. Good e. Bad f. Fair
Existing Groundwater Table (ft)	60-70

Pictorial Overview of Village of Haji Allah Rakhio, district Ghotki

Dwelling units

Surrounding area of village

Small pond in the village area

Toilet

Drainage going into canal

Khairpur

Village Name: **Bachal Bhambro**	Union Council: Rasoolabad

Socioeconomic Indicators	***Description***
Number of Households	80
Average Household Size	7
Income Level	Medium (Rs.5,000-10,000 Monthly)
Major Occupations	Farmers
Major Diseases	Typhoid, Malaria, Hepatitis, Diabetes & Blood pressure
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture
Environmentally Sensitive Areas	No
Environmental Components: g. Air and Noise Quality h. Surface Water Quality i. Groundwater Quality	(ESMF Team/Locals perspective) g. Good h. Good i. Good
Existing Groundwater Table (ft)	60-70

Pictorial Overview of Village Bachal Bhambro, district Khairpur


Surrounding area of village


Open defecation

Government school

Hospital

Saline land

Village Name: **Izzat Solangi**	Union Council: **Deh Sohu**

Socioeconomic Indicators	***Description***
Number of Households	150
Average Household Size	6
Income Level	Low (Rs.5,000-10,000 Monthly)
Major Occupations	Farmers
Major Diseases	Typhoid, Malaria, Hepatitis, Diabetes & Blood pressure
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture
Environmentally Sensitive Areas	No
Environmental Components: j. Air and Noise Quality k. Surface Water Quality l. Groundwater Quality	(ESMF Team/Locals perspective) j. Good k. Good l. Good
Existing Groundwater Table (ft)	70

Pictorial Overview of Village Izzat Solangi, district Khairpur.

	
canal	Rain water accumulated on land
	
Charity school	Drainage goimg into fodder farm
	
Dwelling units	

Sukkur

Village Name: **Goth M Bungal Khoso**	Union Council: Goth M Bungal Khoso

Socioeconomic Indicators	***Description***
Number of Households	80
Average Household Size	8
Income Level	Medium (Rs.18,000-20,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Diarrhea & Malaria
Source(s) of Drinking Water	Canals

Environmental Indicators	***Description***
General Land Use	Agriculture
Environmentally Sensitive Areas	No
Environmental Components: m. Air and Noise Quality n. Surface Water Quality	(ESMF Team/Locals perspective) m. Good n. Good

o. Groundwater Quality	o. Good
Existing Groundwater Table (ft)	75

Pictorial Overview of Village Bangal Khoso, district Sukkur.

	
Dwelling units	
	
Surrounding area of village	
	
People practice OD near & use this hand pump	Toilet near mosque not in use

Village Name: **Draihal**	Union Council: Tamachani

Socioeconomic Indicators	***Description***
Number of Households	150
Average Household Size	6
Income Level	Medium (Rs.18,000-20,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Diarrhea, Malaria, Hepatitis, diabetes and skin diseases
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***

General Land Use	Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: p. Air and Noise Quality q. Surface Water Quality r. Groundwater Quality	(ESMF Team/Locals perspective) p. Good q. Good r. Good
Existing Groundwater Table (ft)	-

Pictorial Overview of Village Draihal, district Sukkur.

Rice fields

Water logged area

Drainage system leading to open land

Water accumulated on land

Surroundings of the village

	
Dwelling units	Toilet in a house

Shaheed Benazirabad

Village Name: **Jeevan Mallah**	Union Council: **Deh Fulail**

Socioeconomic Indicators	***Description***
Number of Households	70
Average Household Size	5
Income Level	Medium (Rs.8,000-12,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Hepatitis (B, C), Malaria, Tuberculosis, Diarrhea
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture, Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: s. Air and Noise Quality t. Surface Water Quality u. Groundwater Quality	(ESMF Team/Locals perspective) s. Good t. Fair u. Bad
Existing Groundwater Table (ft)	100-200

toilets

Waste water from toilets going into the farm

Hospital under construction

Surrounding area of village

Cattles

Village Name: **Bahar Jo Pher**	Union Council: **Deh Fulail**

Socioeconomic Indicators	***Description***
Number of Households	80
Average Household Size	6
Income Level	Medium (Rs.8,000-15,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Cancer (very common), Hepatitis, Malaria, Tuberculosis, stomach related diseases, skin diseases & Diabetes
Source(s) of Drinking Water	Canals

Environmental Indicators	***Description***
General Land Use	Agriculture, Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: v. Air and Noise Quality	(ESMF Team/Locals perspective) v. Good

w. Surface Water Quality x. Groundwater Quality	w. Bad x. Bad
Existing Groundwater Table (ft)	60-150

School

Surrounding area of village

Naushahro Feroze

Village Name: **Abdullah Bhambro**	Union Council: Bahlani

Socioeconomic Indicators	***Description***
Number of Households	50
Average Household Size	7
Income Level	Low (Rs.5,000-10,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Blood pressure, Hepatitis, Malaria, stomach related diseases, skin diseases et
Source(s) of Drinking Water	Dugwell

Environmental Indicators	***Description***
General Land Use	Agriculture, Water logged, Flood in case of torrential rains
Environmentally Sensitive Areas	No
Environmental Components: y. Air and Noise Quality z. Surface Water Quality aa. Groundwater Quality	(ESMF Team/Locals perspective) a. Fair b. Fair c. Fair
Existing Groundwater Table (ft)	80-120


Surrounding area of village

Small pond in the village area

Village Name: **Pir Qaim Shah II**	Union Council: **Bahlani**
Socioeconomic Indicators	***Description***
Number of Households	55
Average Household Size	6
Income Level	Low (Rs.6,000-10,000 Monthly)
Major Occupations	Farmers, Cattle grazing
Major Diseases	Cancer (very common), Hepatitis, Malaria, Tuberculosis, stomach related diseases, skin diseases & Diabetes
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture, Water logged, Flood from canals
Environmentally Sensitive Areas	No
Environmental Components: bb. Air and Noise Quality	(ESMF Team/Locals perspective) d. Good

cc. Surface Water Quality dd. Groundwater Quality	e. Fair f. Fair
Existing Groundwater Table (ft)	50-70

Surrounding area of village

Rohri canal

Gates on Mahrabpur Regulator

Dwelling units

Matiari

Village Name: **Bhakar Jamali**	Union Council: **Bhakar Jamali**

Socioeconomic Indicators	***Description***
Number of Households	140
Average Household Size	8
Income Level	Medium (Rs.8,000-15,000 Monthly)
Major Occupations	Farmers, Cattle grazing, Teacher
Major Diseases	Hepatitis, Malaria, diarrhea, flue
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture, Water logged, Flood from canals
Environmentally Sensitive Areas	No
Environmental Components: ee. Air and Noise Quality ff. Surface Water Quality gg. Groundwater Quality	(ESMF Team/Locals perspective) g. Good h. Good i. Good
Existing Groundwater Table (ft)	50

Surrounding

Rohri canal

Surrounding area of village

Government school


Toilets under construction


Electric grid station

Road under construction

Gas pipeline being laid

Village Name: **Shadad Jamali**	Union Council: Bharedino Kaka

Socioeconomic Indicators	***Description***
Number of Households	25
Average Household Size	8

Income Level	Medium (Rs.8,000-12,000 Monthly)
Major Occupations	Farmers
Major Diseases	Blood pressure, Asthma, Hepatitis, Malaria, diarrhea
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture, Flood from canals
Environmentally Sensitive Areas	No
Environmental Components: hh. Air and Noise Quality ii. Surface Water Quality jj. Groundwater Quality	(ESMF Team/Locals perspective) j. Good k. Bad l. Bad
Existing Groundwater Table (ft)	60


Dwelling units


Surrounding area of village

Drainage

Drainage going into farm


Toilet

Hyderabad

Village Name: **Qadir Bux Lashari**	Union Council: **Hatiri**

Socioeconomic Indicators	***Description***
Number of Households	35
Average Household Size	7
Income Level	Low (Rs.6,000-10,000 Monthly)
Major Occupations	Farmers
Major Diseases	Diarrhea, Malaria, diabetes, Blood pressure, skin diseases
Source(s) of Drinking Water	Canals
Environmental Indicators	***Description***
General Land Use	Agriculture, Water logged, saline
Environmentally Sensitive Areas	No
Environmental Components: kk. Air and Noise Quality ll. Surface Water Quality mm. Groundwater Quality	(ESMF Team/Locals perspective) m. Good n. Good o. Good
Existing Groundwater Table (ft)	60-70


Surrounding area of village

	
Toilet. Drainage going in open land	
	
Dwelling unit	Toilet in a govt school

Village Name: **Sahib Khan chandio**	Union Council: **Hatiri**

Socioeconomic Indicators	***Description***
Number of Households	35
Average Household Size	7
Income Level	-
Major Occupations	Farmers
Major Diseases	Hyper tension, diabetes, Asthma
Source(s) of Drinking Water	Dugwell
Environmental Indicators	***Description***
General Land Use	Agriculture, Water logged, saline
Environmentally Sensitive Areas	No
Environmental Components: nn. Air and Noise Quality oo. Surface Water Quality pp. Groundwater Quality	(ESMF Team/Locals perspective) p. Good q. Good r. Good
Existing Groundwater Table (ft)	70

Surrounding area of village

Dwelling unit

Drainage going into a farm

Toilet in a home

Toilet in the govt school

Tando Allah Yar

Village Name: **Alam Lakhmir**	Union Council: **Shah Inayat**

Socioeconomic Indicators	***Description***
Number of Households	55
Average Household Size	8
Income Level	Low (Rs.7,000-9,000 Monthly)
Major Occupations	Farmers
Major Diseases	Diarrhea, Malaria, diabetes, Hepatitis
Source(s) of Drinking Water	Dugwell

Environmental Indicators	Description
General Land Use	Agriculture, Water logged, saline
Environmentally Sensitive Areas	No
Environmental Components: qq. Air and Noise Quality rr. Surface Water Quality ss. Groundwater Quality	(ESMF Team/Locals perspective) s. Good t. Bad u. Good
Existing Groundwater Table (ft)	60-70


Surrounding area of village

Toilet inside a house

Toilet of the govt school

Toilet of another govt school

Dwelling unit

Village Name: **Rahim Bux**	Union Council: **Shah Inayat**

Socioeconomic Indicators	Description
Number of Households	50
Average Household Size	7
Income Level	Low (Rs.9,000-10,000 Monthly)

Major Occupations	Cattle grazing and farming
Major Diseases	Malaria, diabetes, skin diseases
Source(s) of Drinking Water	Dugwell
Environmental Indicators	***Description***
General Land Use	Agriculture, Flood prone
Environmentally Sensitive Areas	No
Environmental Components: tt. Air and Noise Quality uu. Surface Water Quality vv. Groundwater Quality	(ESMF Team/Locals perspective) v. Good w. Good x. Good
Existing Groundwater Table (ft)	60

	
Surrounding area of village	Common toilet outside
	
Toilet drain going into open land	Dwelling units

Malir (Karachi)

Village Name: **Memon Goth**	Union Council: **Gadap**
Socioeconomic Indicators	***Description***
Number of Households	100
Average Household Size	7
Income Level	Medium (Rs.15,000-20,000 Monthly)
Major Occupations	Cattle grazing, Private Jobs, Business
Major Diseases	Malaria, diabetes, skin diseases
Source(s) of Drinking Water	Boring
Environmental Indicators	***Description***
General Land Use	Agriculture

Environmentally Sensitive Areas	No
Environmental Components: ww. Air and Noise Quality xx. Surface Water Quality yy. Groundwater Quality	(ESMF Team/Locals perspective) y. Good z. Bad aa. Good
Existing Groundwater Table (ft)	55

	
Surrounding area of village	Cattle Merchadizing

Karachi Central

Village Name: **Noor Muhammad Goth**	Union Council: **Manghopir**

Socioeconomic Indicators	***Description***
Number of Households	120
Average Household Size	6
Income Level	Medium (Rs.20,000-25,000 Monthly)
Major Occupations	Private Jobs, Business, Teaching
Major Diseases	Malaria, diabetes, skin diseases
Source(s) of Drinking Water	Water board line
Environmental Indicators	***Description***
General Land Use	Peri-Urban, Rocky
Environmentally Sensitive Areas	No
Environmental Components: zz. Air and Noise Quality aaa. Surface Water Quality bbb.Groundwater Quality	(ESMF Team/Locals perspective) bb. Good cc. Bad dd. -
Existing Groundwater Table (ft)	1,000

	
Sewerage and waste on the streets	Surrounding area of village

Karachi West

Village Name: **Yaroo Khan Goth**	Union Council: **New Karachi**

Socioeconomic Indicators	***Description***
Number of Households	150
Average Household Size	7
Income Level	Medium (Rs.20,000-25,000 Monthly)
Major Occupations	Private Jobs, Business, Skilled labor
Major Diseases	diabetes, fever, cholera
Source(s) of Drinking Water	Water board line, boring
Environmental Indicators	***Description***
General Land Use	Urban
Environmentally Sensitive Areas	No
Environmental Components: ccc. Air and Noise Quality ddd. Surface Water Quality eee. Groundwater Quality	(ESMF Team/Locals perspective) ee. fair ff. - gg. fair
Existing Groundwater Table (ft)	200

	
Surrounding area of village	Streets with extensive business activity

Karachi South

Village Name: **Sheerin Jinnah Colony**	Union Council: **Kehkashan**

Socioeconomic Indicators	***Description***
Number of Households	350
Average Household Size	6
Income Level	Medium (Rs.10,000-30,000 Monthly)
Major Occupations	Private Jobs, Business, Skilled labor
Major Diseases	fever, cholera, cold
Source(s) of Drinking Water	Water board line
Environmental Indicators	***Description***
General Land Use	urban
Environmentally Sensitive Areas	No
Environmental Components: fff. Air and Noise Quality ggg. Surface Water Quality hhh. Groundwater Quality	(ESMF Team/Locals perspective) hh. fair ii. - jj. Bad (Sea water)
Existing Groundwater Table (ft)	25

Annex H: List of Ecologically Protected areas in Sindh

Wildlife Sanctuaries

S#	Protected Areas.	District	Area in Hectares
1	Takkar	Khairpur	43,513.334
2	Hudero Lake	Thatta	13,468.416
3	Keenjhar (Kalri) Lake	"	1,320.940
4	Haleji Lake	"	1,704.273
5	Lung Lake	Larkana	19.179
6	Drigh Lake	"	164.268
7	Mahal Kohistan	Dadu	70,577.090
8	Hab Dam	Karachi	27.219.151
9	Ghondhak Dhoro	Jacobabad	30.92
10	Miani Dhand	Hyderabad	56.66
11	Samno Dhand	Hyderabad	22.66
12	Gulsher Dhand	"	24.282
13	Dhounk Block	Shikarpur	2,097.965
14	Lakhat	Shaheed Benazirabad (formerly Nawabshsh)	101.175
15	Kot Dinghano	"	30.252
16	Mohabat Dero	"	16.188
17	Bijoro Chhach	Thatta	121.41
18	Norung	"	242.82
19	Cut Munarki Chhach	"	404.70
20	Sadnani	"	83.772
21	Shah Lanko	"	60.705
22	Hilaya	"	323.76
23	Majiran	"	24.282
24	Gullet Kohri	"	40.47
25	Marho Kotri	"	161.88
26	Munarki	"	12.141
27	Khadi	"	80.94
28	Keti Bander North	"	8,948.322
29	Keti Bander South	"	23,046.06
30	Khat Dhoro	Larkana	10.522
31	Runn of Kutch	Badin & Tharparkar	320463
32	Nara Desert	Sukkur, Khairpur 7 Sanghar	223590
33	Deh Akro - II	Shaheed Benazirabad (formerly Nawabshsh)	20243

Source: Sindh Wildlife Department - GOS

Game Reserves

#	Protected Areas.	District	Area in Hectares
1	Deh Jangisar	Thatta	313.642
2	Deh Khalifa	Thatta	428.982
3	Dosu Forest	Larkana	2,312.212
4	Hala Forest	Hyderabad	953.473
5	Indus River (Dolphin Reserve) From Sukkur to Guddu Barrage	Jacobabad/Ghotki/Shikarpur &Sukkur	44.200
6	Khipro Forest	Sanghar	3,885.254
7	Mando Dero Forest	Sukkur	1,234.335
8	Mirpur Sakro Forest	Thatta	777.024

9	Nara	Khairpur	109,966.39
10	Pai Forest	Shaheed Benazirabad (formerly Nawabshsh)	1,969.270
11	Sahib Samo Forest	Hyderabad	348.473
12	Surjan, Sumbak, Eri & Hothiano Mountains	Dadu	40,631.88
13	Tando Mitho Khan Forest	Sanghar	5,343,294

Source: Sindh Wildlife Department - GOS

Ramsar Sites in Sindh

S#	Name of Ramsar Site	District
1.	Keenjhar (Kalri) Lake	Thatta
2.	Haleji Lake	Thatta
3.	Drigh Lake	Larkana
4.	Indus Dolphin Reserve	Kashmore
5.	Jubho Lagoon	Badin
6.	Nurri Lagoon	Badin
7.	Deh Akro-II Desert Wetland Complex	Nawabshah
8.	Indus Delta	Thatta
9.	Runn Of Kutch	Tharparkar
10.	Hub Dam	Karachi

Source: Ramsar List

Forest Areas

Sindh province, having a population of about 55.24 million, occupies land area of 14.091 million ha. (34.81 million acres). Out of above, an area of 1.125 million ha. (2.782 million acres) is under the control of Sindh Forest Department, which is 8% of the total area of the province. However, out of aforementioned total area, riverine forests and irrigated plantations which are categorized as productive forests cover only 2.29% area, clearly indicating that the province is deficient in forestry resources. The remaining area under the control of Sindh Forest Department (SFD) consists of mangrove forests and rangelands, which are classified as protective forests. The details of both productive and protective categories of forests are given as follows:

Protective categories of Forests of Sindh		
Type	**Area (Million ha.)**	**% of total land area of Sindh**
Riverine Forests	0.241	1.71
Irrigated Plantations	0.082	0.58
Mangroves	0.345	2.45
Rangelands	0.457	3.25
Grand Total	1.125	8.00

Annex I: List of Protected Archeological Sites and Monuments

Hyderabad District

1. Tomb of Ghulam Shah Kalhora, Hyderabad.
2. Boundary Wall of Pucca Fort, Hyderabad.
3. Old office of Mirs, Hyderabad Fort, Hyderabad.
4. Tajar (Treasury) of Mirs, Hyderabad Fort, Hyderabad.
5. Tomb of Ghulam Nabi Khan Kalhora, Hyderabad.
6. Buddhist Stupa, (Guja) a few miles from Tando Muhammad Khan, Hyderabad.
7. Haram of Talpur Mirs, Hyderabad.
8. Enclosure containing Tombs of Talpur Mirs, Hyderabad.
9. Tower (Now used as water tank), Hyderabad Fort, Hyderabad.
10. Two Mosques and a Tomb, Tando Fazal, Hyderabad.
11. Tomb of Sarfaraz Khan Kalhora, Hyderabad.
12. Nasar-ji- Mosque, Mohalla Jhambhas, Nasarpur, Hyderabad.
13. Kiraiji Masjid, Mohalla Misri, Nasarpur, Hyderabad.
14. Mai Khairiji Masjid, Mohalla Memon, Hyderabad.
15. Mosque of Mirs, Hyderabad, ward “E”, Hyderabad.
16. Enclosure containing Tombs of Talpur Mirs, Hyderabad.
17. Shrine of Shah Abdul Latif Bhitai, Bhitshah, Hyderabad.
18. Mukhi Mahal, Fort Incline, Hyderabad.
19. Besent Lodge, near Post Office, Saddar, Hyderabad.
20. Holmsteal Hall, Fort, Hyderabad.
21. Hyderabad Fort, Hyderabad.

Khairpur District

22. Diji ki Takri mound, remains of earliest fortified town, Deh Ghaunro near Kot Diji Fort. Khairpur.
23. Fort at Kot Diji, Kot Diji, Khairpur.
24. Maro Waro Dhoro mound situated on sand hill, Deh Naro Dhoro 2 miles east of Tando Masti Khan, Khairpur.
25. Shrine of Schal Sarmast, Darazah, Khairpur.
26. Faiz Mahal (Adjacent to Sachal Sarmast Khairpur Public Libarary), Mall Road, Khairpur.

Sukkur District

27. Mir Masum’s Minar and tomb, Sukkur.
28. Satyan-jo-than, Rohri, Sukkur.
29. Bakkar Fort entire area including the walls and tombs of Hazrat Sadruddin. Muhammad (occupied by the Army), between Lands down and Sukkur bridges, Sukkur.
30. Mumalji Mari, mound, Taluka Ghotki, Deh Mathelo, Sukkur.
31. Stone Tool Factory area Rohri, Sukkur.
32. Wood carved door an resiential house owne by exacuce Trust Property Board, (wood carved door, length 73 inches, width 55 inches. Panelle arch 27 inches), Takar Bazar, Rohri, Sukkur.

Shaheed Benazirabad District

33. Buddhist Stupa, Village Mir Rukan, Nawabshah.
34. Tomb of Nur Muhammad Kalhora, Deh of Village Nur Muhammad, 17 miles from Daulatpur, Nawabshah.
35. Qubbo Mir Shahadad, Shahpur, Nawabshah.
36. Bhiro Bham Mound, Tepa Chibore, Nawabshah.

Karachi District

37. Wazir Mansion, birthplace of Quaid-e-Azam Muhammad Ali Jinnah, Karachi new Naham Road, Bundar quarters, Kharadar, Karachi.
38. Chaukhandi Tombs, near Landhi on National Highway, Karachi.
39. Lakho Shaikh (Baluch) Graveyard, Kharkhro, Karachi.
40. Khaliq Dina Hall and Library, M.A. Jinnah Road, Karachi.
41. Jam Bijar Fort (or Banbhore), Mirpur Sakro, Karachi.
42. Frere Hall, Karachi.
43. Flag Staff House (Quaid-e- Azam House Museum), Karachi.
44. Mausoleum of the Quaid-e-Azam Muhammad Ali Jinnah, Karachi.
45. Vietoria Mansion, Abdullah Haroon (Victoria) Road, Karachi.
46. JahangirKothari Mansion, Abdullah Haroon (Victoria) Road/Inverarity Road, Karachi.
47. Krishna Mansion, Inverarity Road, Karachi.
48. Lotia & Partners Building, Zaibunnisa (Elphinstone Street/Inverarity Road, Karachi.
49. Excelsior Hotel,Zaibunnisa (Elphinstone) Street, Karachi.
50. Ekanic Building, Zabunnisa (Elphinstone) Street, Karachi.
51. Speechly Building, Zaibunnisa (Elphinstone) Street, Karachi.
52. Service Building, Zaibunnisa (Elphinstone) Street, Karachi.
53. Allah Rakhi Begum Building, Zaibunnisa (Elphinstone) Street, Karachi.
54. Nusserwanjee Building, Zaibunnisa (Elphinstone) Street, Karachi.
55. Hashim Chambers Building, Zaibunnisa (Elphinstone) Street, Karachi.
56. Suleman Umber Building, Zaibunnisa (Elphinstone) Street, Karachi.
57. Victoria Furnishing Mart, Zaibunnisa (Elphinstone) Street/Dundas Street, Karachi.
58. Old Ilaco House, Zaibunnisa (Elphinstone) Street, Karachi.
59. Mohammad Ali Building, Zaibunnisa (Elphinstone) Street, karachi.
60. Fazal Manzil, Parr Street Opp Zaibunnisa (Elphinstone) Street, Karachi.
61. Hasan Ali Building, Zaibunnisa (Elphinstone) Street/Shahrah-e-Iraq (Clarke Street), Karachi.
62. Karim Mansion, Shahrah-e-Iraq (Clarke Street), Karachi.
63. Sir Jahangir Kothari Building, Raja Ghazanfar Ali Road (Somerset Stree) / Shahrah-e-
64. Iraq (Clarke Street), Karachi.
65. Nabi Manzil, Woodburn Street/Stalker Street, Karachi.
66. Rangoonwala Building, Zaibunnisa (Elphinstone) Street/Woodburn Street, Karachi.
67. Muljee Building, Zaibunnisa (Elpinstone) Street, Karachi.
68. Rainbow House Building, Zaibunnisa (Elpinstone) Street/Albert Street, Karachi.
69. Kanji Wasti Building, Albert Street off Zaiunnisa (Elpinstone) Street, Karachi.
70. Emes Building, Zaibunnisa (Elphinstone) Street, Karachi.
71. Abu Building, Zaibunnisa Street, Karachi.
72. Sunderji Hameji Building, Albert Street/Stalker Street, Karachi.

73. Abubakaer Building, Albert Street off Zaibunnisa Street, Karachi.
74. Haji Yunus Building, Lane off Bohra Street, Karachi.
75. Kanji Kara Building, Bohra Street off Raja Ghazanfar Ali Road, (Somerset Street), Karachi.
76. Salamwala Building, Bohra Street off Raja Ghazanfar Ali Road (Somerset Street), Karachi.
77. Gopaldas Building, Raja Ghazanfar Ali Road (Somerset Street)/Albert Street, Karachi.
78. Abdul Aziz Building, Raja Ghazanfar Ali Road (Somerset Street)/Albert Street, Karachi.
79. Haji Abu Trust Building, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
80. Saleh M. Sttar Manzil, Building, Raja Ghazanfar Ali Road (Somerset Street)/Woodburn StreeKarachi.
81. United Bank Building, Raja Ghazanfar Ali Road (Somerset Street,) Karachi.
82. Habib Bank Building, Raja Ghazanfar Ali Road (Somerset Street) Woodburn Street, Karachi.
83. Shirin Karimbai Jivaji Building, Raja Ghazanfar Ali Road (Somerset Street/Woodburn Street, Karachi.
84. Khadija Bai Building, Bohra Street/Furquharson Street, Karachi.
85. Tahirali Asgharali Ghatila Building, Bohra Street/Furquharson Street, Karachi.
86. Mossajee Manzil, Raja Ghazanfar Ali Road (Somerset Street Bohra Street, Karachi.
87. Khyber Hotel, Zaibunnisa (Elphinstone) Street /Preedy Street Karachi.
88. Edulji Dinshaw Dispensary, Preedy Street, Karachi.
89. Mandviwala Building, Preedy Street, Karachi.
90. Rawalpindiwala Buildig, Preedy Street, Karachi.
91. Biramji Building, Preed Street/Dr. Daudpota Road, (Frere Street), Karachi.
92. Empress Market Buildig, Preeding Street, Karachi.
93. Sheikh Fida Ali Building, Dr. Daudpota Road (Frere Street) Bohra Street, Karachi.
94. Faiz-i-Hussaini Building, Dr. Daudpota Road (Frere Street), Karachi.
95. Parsi Dar-e-Meher, Dr. Daudpota Road (Frere Street), Karachi.
96. Gol Wala Building, Dr. Daudpota Road (Frere Street), Karachi.
97. Ismail D. Adam Soomar Building, Dr. Daudpota Road (Frere Street) / Woodburn Street, Karachi.
98. Golgoldenwala Building, Dr. Daudpota Road (Frere Stree), Karachi
99. Aijiwala Building, Sharah-e-Iraq (Clarke Street)/Dr. Daudpota Road (Frere StreetKarachi.
100. Haryanawala Building, Syedna Burhanuddin Road (Mansfield Street) Market Lane, Karachi.
101. Captain House, Sharah-e-Iraq (ClarkeStreet), Karachi.
102. Dossalani Terrace, Syedna Burhanuddin Road (Mansfield Street)/Malvery Street, Karachi.
103. Jama Masjid Qasaban, Karam Ali Talpur Road (Napier Street), Karachi.
104. Adbul Wahid Building, Karam Ali Talpur Road (Napier Street), Karachi.
105. Farid Mansion, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
106. Haji Yunus Building, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
107. Haque Building, Raja Ghazanfar Ali Road (Somerset Street) Sheikhchand Street, Karachi.
108. Katchi Memon Masjid, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
109. Sir Abdullah Haroon Building, Raja Ghazanfar Ali Road (Somerset Street) Karachi.
110. Palia House, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
111. Abdullah Haroon Trust Building, Raja Ghazanfar AliRoad (Somerset Street), Karachi.
112. Khawaja Manzil, Raja Ghazanfar Ali Road (Somerset Street), Karachi.
113. Lali Bai Building, Raja Ghazanfar Ali Road (Somerset Street), Blenkin Street, Karachi.
114. Olympia Building, Raja Ghazanfar Ali Road, (Somerset Street), Karachi.
115. Medina Building, Raja Ghazanfar Ali Road, (Somerset Street) Karachi.
116. Duarte Mansion, Karam Ali Talpur Road (Naier Street)/Inverarity Road, Karachi.

117. Braganza House, Karam Ali Talpur Road (Napier Street), Karachi.
118. Sega Building, Karam Ali Talpur Road (Napier Stree)/Inverarity Road, Karachi.
119. St. Xavier's School, Syedna Burhanudding Road (Mansfield Street), Karachi.
120. Baweja Building, Karam Ali Talpur Road, (Napier Street, Karachi.
121. Merewether Tower, I.I. Chunderigar (Meleod)Road/M.A Jinnah (Bunder) Road, Karachi.
122. Rustomji Building, I.I. Chundrigar (Meleod)Road / M.A Jinnah (Bunder) Road, Karachi.
123. Shikarpuri Cloth Market, M.A. Jinnah (Bunder) Road, Karachi.
124. New Cloth Market, M.A. Jinnah (Bunder) Road/ Slaeh Mohammad (Dunnolly Road, Karachi.
125. Standard Chartered Bank, I.I. Chundrigar (Mcleod) Road, Karachi.
126. State Bank of Pakistan, M.A. Jinnah (Bunder) Road /Talpur Road (wood Street), Karachi.
127. Nisar Bungalows (Police Quarters), Shahrah-e-Liaquat (Frere Road), Karachi.
128. Overseas Chamber of Commerce, Talpur Road (wood Street), Karachi.
129. Standard Insurance House, I.I. Chundrigar (Mcleod) Road, Karachi.
130. Karachi Chamber of Commerce, Aiwan-e-Tijarat (Nicoll) Road/Shahrah-e-Liaquat (Frere Road), Karachi.
131. Rawalpindi Wala Building, Aiwan-e-Tijarat (Nicoll) Road, Karachi.
132. Lotia Chambers, Aiwan-e-Tijrarat 9Nicoll) Road, Karachi.
133. Ferozpurwala Chamber, M.A. Jinnah (Bunder) Road, Karachi.
134. Feroze House, M.A. Jinnah (Bunder) Road/Serai Road, Karachi.
135. Rubab Chambers, Serai Road, Karachi.
136. Lotia Building, Serai Road, Karachi.
137. Rawalpindiwala Building, Serai Road, Karachi.
138. School Building, Serai Road, Karachi.
139. Kulsum Bai Building, Serai Road, Karachi.
140. Hassaini Arcade, Serai Road, Karachi.
141. Muhammadi Mansion, Serai Road, Karachi.
142. Mandi Wala Building M.A. Jinnah (Bunder) Road, Karachi.
143. Dadabhoy Centre, M.A. Jinnah (Bunder) Road, Karachi.
144. Sheikh Eletric Market, M.A. Jinnah (Bunder) Road, Karachi.
145. Salim Centre, M.A. Jinnah (Bunder) Road, Karachi.
146. Mercantile Bank Building, M.A. Jinnah (Bunder) Karachi.
147. Hafiz Chamber, M.A. Jinnah (Bunder) Karachi.
148. Asia Building, M.A. Jinnah (Bunder) Karachi.
149. Kamil Chambers, Altaf Hussain (Napier) Road, Karachi.
150. Sindh Provincial Cooperative Bank, Serai Road, Karachi.
151. Safiabai Sughrabai Buliding,Shahrah-e-Liaquat (Frere Road)/Serai Road), Karachi.
152. Safiabai Sughrabai Building, Shahrah-e-Liaquat (Frere Road), Karachi.
153. Yusufali Albibhai Building,Sharah-e-Liaquat (Frere Road), Karachi.
154. S.M. Science College, Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Road Karachi.
155. Sindh Madrassah Mosque (Sunni), Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Road, Karachi.
156. Sindh Madrassah Building Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Karachi.
157. Sindh Madrassah Mosque (Shia), Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Road, Karachi.
158. Sindh Madrassah Libarary (Originally Principal's Residence), Shahrah-e-Liaquat (FrereRoad)/Aiwan-e-Tijarat (Nicoll) Road, Karachi.

159. Sindh Madrassah Primary School, Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Road, Karachi.
160. Sindh Madrassah Housing (Hospital), Shahrah-e-Liaquat (Frere Road)/Aiwan-e-Tijarat (Nicoll) Road, Karachi.
161. Haji Abdullah Haroon Waqf Building, Hasrat Mohani (Grant) Road, Karachi.
162. Devadas Building, Altaf Husain (Napier) Road, Karachi.
163. Cotton Exchange Building, I.I. Chundrigar (Mcleod) Road, Karachi.
164. Hanifji Building,, Altaf Hussain (Napier) Road, Karachi.
165. Yusuf Ali Building, Altaf Husain (Napier) Road, Karachi.
166. Burhani Building, Shahrah-e-Liaquat (Frer Road)/Altaf Hussain (Napier) Road, Karachi.
167. Alvi Building, Altaf Hussain (Napier) Road)/Shahrah-e-Liaquat (Frere Road), Karachi.
168. Essai Ibrahim Building, M.A. Jinnah (Bunder Road, Karachi.
169. Sheikha Hussain, M.A. Jinnah (Bunder) Road/Nanakwara Road (Campbell Street), Karachi.
170. Tahirbhoy Muhammadali Building, Nanakwara Road (Campbell Street), Karachi.
171. Moris Wala Building, M.A. Jinnah (Bunder) Road, Karachi.
172. Shri Narayan Temple, M.A. Jinnah (Bunder) Road, Karachi.
173. Al-Saeedia Trading Company Building, Sharah-e-Liaquat (Frere Road), Karachi.
174. Adamjee Building, Qutram Road, Karachi.
175. Railway Bungalow # 73, I.I. Chundrigar (Mcleod) Road/Outram Road, Karachi.
176. Dhramshalla Building, Outram Road, Karachi.
177. Cibbon & Mamooji Building, Shahrah-e-Liaquat (Frere Road)/Hassanali Effendi Road, Karachi.
178. Hyderabad Building, Shahrah-e-Liaquat (Frere Road)/Hassanali Effendi Road, Karachi.
179. Jhumra Autos Building, Dr. Zaiudding Ahmed (Kutehery) Road, Karachi.
180. Noor Manzil, Dr. Ziauddin Ahmed (Hutchery) Road, Karachi.
181. Salma Manzil, Mills Street/Faiz M. Fateh Ali Road, Karachi.
182. Lotia Building, Mills Street/Faiz M. Fateh Ali Raod, Karachi.
183. Razia Zakia Mansion, Shahrah-e-Liaquat (Frrere Road) / Jai Ram Ram Road, Karachi.
184. Lakshmi Chand Building, Jai Ram Road, off Outram Road, Karachi.
185. Kamil Mansion, Jai Ram Road, off Outram Road, Karachi.
186. Prince Offset Printmaker' Building Kanji Tulsi Das Street, Karachi.
187. Fine Publishers' Building, Dr. Ziauddin Ahmed (Kutchery) Road, Karachi
188. Faiz-e-Hussaini Building, Dr. Ziauddin Ahmed (Kutchery) Road, Karachi.
189. Menghraj Dwarkadas Building, Outram Road/Narain Road, Karachi.
190. Kanji Building, Bellasis Street/Narain Road, Karachi.
191. Ibrahim Moosabhai Building, Bellasis Street/Narain Road, Karachi.
192. Adamjee Building, Dr. Ziauddin Ahmed (Kutchery) Road, Karachi.
193. Aziz Manzil, Dr. Ziauddin Ahmed (Kutchery) Road, Karachi.
194. Metharam Hostel Building, Dr. Ziauddin Ahmed (Kutchery) Road Karachi.
195. D.J. College (Geology & Math Department) Originally Principal's Bungalow) Dr. Ziauddin
196. Ahmed (Hutchery) Road, Karachi.
197. C.T.O Commound (Buiding # 1), Muhammad Bin Qaim (Burns) Road /I.I. Chundrigar (Mcleod) Road, Karachi.
198. Mazaar of Pir Mangho, Mangho Pir Road, Karachi.
199. St. Patrick's Chueh, Saddar, Karachi.
200. Holy Trinity Church, Fatima Jinnah Road, Karachi.
201. C.M.S. Curch, Nistar Road, Karachi.

202. Collectors' Kuteheri, Club Road, Karachi.
203. Honeymoon Lodge, Korangi Road, Karachi.
204. Zoological Garden, Nishtar Road, Karachi.
205. St. Paul's Church-Keamari, Karachi.
206. St, Paul's Church-Manora, Karachi.
207. Cantonment Sation, Dr. Daudpota Road, Karachi.
208. City Courts, M.A. Jinnah Road, Karachi.
209. St. Andrew's Church, Saddar, Karachi.
210. Parsi Dare Meher, Dr. Daudpota Road, Karachi.
211. Methoddist Church, Sagheer Shaheed Road, Karachi.
212. Edulji Dinshaw Dispensary, Daddar, Karachi.
213. Sindh Club, Adbullah Haroon Road, Karachi.
214. Sindh Maddressah-tul-Islam, Shahrah-e-Liaquat, Karachi.
215. Max Denso Hall, M.A. Jinnah Road, Karachi.
216. Victora Museum, M.R. Kiyani Road Karachi.
217. Jaffer Fadoo Dispensary, Agha Khan Road, Karachi.
218. Karachi Central Jail, Bahadur Yar Jung Road, Karachi.
219. Ghulam Hoosain Khalikdina Hall, M.A. Jinnah Road, Karachi.
220. Karachi Port Trust, M.A. Jinnah Road, Karachi.
221. Clifton Promenade, Clifton, Karachi.
222. St. Anthony's Chapel, Manora, Karachi.
223. Hindu Gymkhana, Sarwar Shaheed Road, Karachi.
224. Sindh High Court, Court Road, Karachi.
225. KMC Head Office, M.A. Jinnah Road, Karachi.
226. Mohatta Palace (Qasr-e-Fatima), Clifton, Karachi.
227. New Sindh Assembly Building, Court Road, Karachi.
228. Old Sinh Assembly (NJV School), M.A. Jinnah Road, Karachi.
229. Katrak Mansion, Addbullah Haroon Road, Karachi.
230. Bristol Hotel, Sunnyside Roadd, Civil Lines, Karachi.
231. Old Cantonment Board Building, Karachi.
232. Barach, near old Cantonment Boar Builing, Karachi.
233. Karachi Port Trust, Head Office Building, Eduljee Ddinshaw Road, Karachi.
234. Harbour Master's House, Manora, Karachi.
235. Deputy Conservator'ss House, Manora, Karachi.
236. Saint Paul Church, Manora, Karachi.
237. Watch Tower, Manora, Karachi.
238. Flag Mast, Manora, Karachi.
239. Karachi Port Trust, Officers Club, Manora, Karachi.
240. Observatory, Manora, Karachi.
241. Water Truff, near Hardding Bridge, Karachi.
242. Hindu Temple, Manora, Karachi.
243. Mules Mansion, Keamari, Karachi.
244. Christ Church, near Jackson Police Station Keamari, Karachi.
245. Hindu Ghat at Native Jetty Bridqe, Karachi.
246. Variawa Chamber 14, Sunnysie Road, Belqrave Terrace Road, Karachi.
247. Variawa Building, I.I. Chundrigar Road, Karachi.

248. Shrine of Adbul Shah Gazi, Clifton, Karachi.

WORLD HERITAGE MONUMENTS ON UNESCO LIST.

1. Mohenjodaro, District Larkana.
2. Makli Hill, Thatta.

Note: There are no gazette archeological/historical sites in District Tando Allahyar, Matiari, Naushero Feroze, Shaheed Benazirabad and Ghotki.

Annex J: Methodology and Feedback of Consultation with Communities

Methodology

Due to the limited time-frame of the study, selected villages in each of the target districts for SSS and A4N programs were targeted for consultation. Based on the project design, a few important aspects were used to identify the target villages:

- Low Poverty-level
- Implementation of previous WASH/Agriculture projects
- Poor Malnutrition Indicators

A pre-designed questionnaire was developed for both the projects that covered the project activities, the implementation mechanism, social acceptability, community readiness and other socio-economic aspects. Focus Group Discussions (FGDs) were used as the primary consultation tool for engaging stakeholders. In each district 1 or 2 FGDs were held with community representatives that were well-informed of local issues and were able to voice their concerns and suggestions. Various community representatives including village elders, farmers, women and youth were part of the consultation sessions. Two field teams supported by local community mobilizers were deployed to conduct the survey in all 14 districts from 02 August to 14 August, 2017 for 14 districts.

A total of 20 FGDs were conducted in 14 Districts. The villages visited in each district, along with the respective coordinates are shown in following table:

Villages Consulted for SSS and A4N Projects				
S. No.	**Districts**	**Villages**	**Project Focus**	**Coordinates**
1.	**Ghotki**	Changlani	SSS and A4N	27° 55' 25.60"N 69° 20' 20.40"E
2.		Haji Allah Rakhio Langha	SSS and A4N	24° 44’ 27.1” N 67° 58’ 00.9” E
3.	**Khairpur**	Bachal Bhambro	SSS and A4N	27° 10' 26.70"N 68° 25' 54.00"E
4.		Izzat Solangi	SSS and A4N	27° 22' 20.01"N 68° 49' 32.80"E
5.	**Sukkur**	Goth M Bungal Khoso	SSS and A4N	27° 45' 57.00"N 65° 48' 06.00"E
6.		Draihal	SSS and A4N	27° 45' 12.40"N 68° 48' 10.40"E
7.	**Shaheeh Benazirabad**	Bahar Jo Pher	SSS and A4N	26° 30' 33.80"N 67° 59' 22.00"E
8.		Jeevan Mallah	SSS and A4N	26 30 29.01 N 67 58 53.02 E
9.	**Naushero Feroze**	Abdullah Bhambro	SSS and A4N	27° 05' 39.00"N 68° 20' 07.00"E
10.		Pir Qaim Shah II	SSS and A4N	27° 05' 34.90"N 68° 21' 50.80"E
11.	**Matiari**	Bhakar Jamali	SSS and A4N	26° 03' 09.90"N 68° 24' 11.20"E
12.		Shadad Jamali	SSS and A4N	26° 03' 14.23"N 68° 23' 58.90"E
13.	**Hyderabad**	Qadir Bux Lashari	SSS and A4N	25° 27' 59.70"N

Villages Consulted for SSS and A4N Projects				
S. No.	**Districts**	**Villages**	**Project Focus**	**Coordinates**
				68° 25' 37.80"E
14.		Sahib Khan chandio	SSS and A4N	25° 27' 57.60"N 68° 25' 42.80"E
15.	**Tando Allahyar**	Alam Lakhmir	SSS and A4N	25° 30' 17.40"N 68° 41' 41.60"E
16.		Rahim Bux	SSS and A4N	25° 30' 44.80"N 68° 41' 15.20"E
17.	**Malir (Karachi)**	Memon Goth	SSS and A4N	24° 55’ 04.10” N 67° 15’ 12.00” E
18.	**Karachi West**	Yaroo Khan Goth	SSS and A4N	25° 0'28.34"N 67° 4'34.62"E
19.		Abdur Rehman Goth	SSS and A4N	24°51'42.68"N 66°50'43.78"E
20.	**Karachi Central**	Noor Muhammad Goth	SSS	24° 59’ 17.3” N 67° 01’ 59.7” E
21.	**Karachi South**	Sheerin Jinnah Colony	SSS	24° 49’ 06.6” N 67° 00’ 22.2” E
22.	**Korangi (Karachi)**	Naik Muhammad Goth	SSS	24° 51’ 03.1” N 67° 10’ 05.2” E

Consultation Feedback

The comments and suggestions received from local community representatives have been detailed in this Annex. Feedback has been separately elucidated for each village. The list of participants and pictorial representation are also illustrated after each summary.

District: **Ghotki**	Union Council: **Beriri**	Date: **20th July 2017**
Name of Village: **Changlani**		Lat/Long: **27° 55' 25.60"N** **69° 20' 20.40"E**
Interviewers: Mr. Abdullah Magsi, Mr. Abdul Rauf & Mr. Anus		

Overview of villagers discussion:

The team members introduced themselves to the villagers of Changlani and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the villagers are related to agriculture while rest are rickshaw drivers, labor etc. Average monthly income is around 5000 to 9000 PKR.

Overall community is Muslim with the male ratio (50%) and female ratio (50%). Sindhi language is spoken in the village.

The villagers are aware of the use of toilets and most houses have toilets. Only 35% of houses do not have toilets due to poverty and unavailability of funds. Toilets in government schools are in very poor condition therefore use of toilets among students is not common.

The villagers are aware of the demerits of open defecation and are willing to support any training & awareness programs in this regard to improve their lifestyle and also the environment.

Local Government is not active in this region and their representatives do not visit village. No construction & development project is under progress. There is no proper drainage system in the village. The waste water from houses is dumped in septic tanks or agriculture farms.

There is no organization of villagers to resolve conflicts. They resolve their conflicts by mutual consensus and decision of the elders of villagers. There is no major conflict among the villagers. If minor dispute occurs such as family conflicts or livestock business, it is resolved by elders through mutual understanding.
There is a primary school in the village.
The common diseases among the villagers are Flue, skin diseases, Diarrhea, Hepatitis, Cough, Malaria etc. Villagers are aware that these diseases are due to poor unhygienic conditions of the village.

Farmers of Village Changlani do not have any proper organization to deal with their agricultural problems and guide them for improvements in crop production. Female members of the village community participate in the agricultural activity with men. Major crops are sugar cane, wheat and cotton. People mostly consume seasonal fruits and vegetables. While consumption of meat is low. The diet pattern is same among all group of villagers i.e. men, women, children and older people.
Farmers showed their willing to participate in training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest.

S.No.	Name of Participants	Occupations
01.	Mir Hasan	Auto rickshaw driver
02.	Amin Ali	Auto rickshaw driver
03.	Salah Uddin	Car driver
04.	Abdul Jabbar	Farmer
05.	Imtiaz	Auto rickshaw driver
06.	Rahib Ali	Farmer
07.	M Akram	Farmer
08.	Faisal Hussain	Student
09.	Subhan Ali	Farmer
10.	Ali Muhammad	Farmer

District: **Ghotki**	Union Council: **Beriri**	Date: **20th July 2017**
Name of Village: **Changlani**		Lat/Long: **27° 55' 25.60"N** **69° 20' 20.40"E**
Interviewers: Ms Zeenat Baloch		

Overview of villagers discussion:

The enumerator introduced herself to the women of village Changlani and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Most of the women of the village are house wife and also work in farms.
Overall community is Muslim with the male ratio (50%) and female ratio (50%). Sindhi language is spoken in the village.
30% villagers practice open defecation while 70% of the population have facility of toilets (Flush toilets). People are unable to construct toilets in their homes due to poverty and unavailability of funds. Villagers wash their hands after using toilets as it protects them from many diseases. There is a primary school in the village. Toilets in government school are in very poor condition.
Women villagers agree that by developing hand washing and toilet facilities in government schools will help sensitizing the villagers and thus improving the environment of the village. The components of SSS program will definitely bring a behavioral change among villagers and help in meeting the goals for ODF village. Women suggested that awareness campaign and assistance in construction of toilets should be included in the SSS components.
There is no development and construction activities going on in the village.
There is no organization of villagers to resolve conflicts. They resolve their conflicts by mutual consensus and decision of the elders of villagers. There is no major conflict among the villagers.

Local Government is not active in this region and do not coordinate with villagers to resolve their issues. There is no proper drainage system in the village. The waste water from houses is dumped in septic tanks or agriculture farms.
They suggest that the Local government should not be involved in the ODF & toilet construction project.
The common diseases among the villagers are Diarrhea, Hepatitis, Malaria, Tuberculosis & Diabetes etc. Villagers are aware that these diseases are due to poor hygienic conditions of the village.
No project regarding the improvement of nutritional status & agriculture potential of the village. Farmers of Village Changlani do not have any proper organization to deal with their agricultural problems and guide them to better crop yield. Family conflicts are the most common conflict in the village. Female members of the village community participate in the agricultural activity with men. Major crops are sugar cane, wheat and cotton. People mostly consume seasonal fruits and vegetables. The diet pattern is same among all group of villagers i.e. men, women, children and older people.

Farmers showed their willing to participate in training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program will be tool for change towards healthy diet. Female should be focused for provision of training regarding improvement in quality of diet.

S.No.	Name of Participants	Occupations
01.	Mai Hazooran	House wife
02.	Mai Irbab	House wife
03.	Mai Sabiran	House wife
04.	Urosa	House wife
05.	Zahida	Farming
06.	Farzana	Farming
07.	Memona	House wife
08.	Mai Hajani	Tailor
09.	Mai Rani	Farming
10.	Mai Sodhi	Farming
11.	Mai Rabul	Farming

District: **Ghotki**	Union Council: **Beriri**	Date: **20th July 2017**
Name of Village: **Haji Allah Rakhio Langha**		Lat/Long: N 27^{O} 55 30.9 E 69^{O} 20 17.6
Interviewer: Ms Zeenat Baloch		

Overview of villagers discussion:

The enumerator introduced herself to the women of village Haji Allah Rakhio Langha and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition (A4N) Program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
All of the women are house wife while some also work in agriculture fields.
90% population practice open defecation and only 10% have facility of toilet. Although the villagers prefer open defecation, but have awareness to wash their hands afterwards.
The villagers are aware of the importance of toilets and agree to support campaign such as SSS to improve their lifestyle and also the environment. However, women suggested that these projects be implemented by private organization or NGO rather than government organization and should be monitored by independent body.
Local Government is not active in this region and their representatives do not visit village. The walk ways are not cemented and needs to be paved. The drainage system of the village is damaged. The waste water from houses is collected in pits or drained in agriculture farms. Rain water gets accumulated to forms ponds which are breading points for fly and mosquitoes.

The villagers have no formal committee to address conflicts or resolve civic problems. Although there is no major conflict among the villagers, if a minor dispute related to family conflicts or livestock business do arise, it is resolved by elders of community.
The common diseases among the villagers are skin diseases, Tuberculosis, Diabetes, Hepatitis, Blood pressure, Malaria etc. Villagers are aware that these diseases are due to poor unhygienic practice of the villagers.

Agriculture for Nutrition

Farmers of Village Haji Allah Rakhio Langha are willing to get sensitized and cognizance regarding modern agriculture practices. This will help them resolve their agriculture issues and get a better yield of their crop. Female members of the village participate in the agricultural activity with men. Major crops are sugar cane, wheat and cotton. Mostly seasonal vegetables and fruits are part of everyday meal. The diet pattern is same among all group of villagers i.e. men, women, children and older people.

District: **Ghotki**	Union Council: **Beriri**	Date: **20th July 2017**
Name of Village: **Haji Allah Rakhio Langha**		Lat/Long: N 27^{O} 55 30.9 E 69^{O} 20 17.6
Interviewer: Mr. Abdullah Magsi, Mr. Anas Khan, Mr. Abdul Rauf		

Overview of villagers discussion:

The enumerators introduced themselves to the participants of village Haji Allah Rakhio Langha and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition (A4N) Program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Most of the villagers are farmer while others are drivers and labor.
85% of men and 60% women practice open defecation and only 30% toilet facility. Poverty and unavailability of funds is the main reason that people do not have toilets in their homes. The villagers are aware to wash their hands afterwards.
The villagers will appreciate the efforts of any organization that help them build toilets at domestic level or at school level and agree to support SSS in this regard to improve their lifestyle and also the environment. However, men suggested that these projects be implemented by private organization or NGO rather than government organization and should be monitored by independent body.
Local Government is quite inactive in this region and their representatives do not visit village. The walk ways are not cemented and needs to be paved. Rain water gets accumulated to forms ponds which becomes breading points for flies and mosquitoes. The drainage system of the village is damaged. The waste water from houses is collected in pits or drained in agriculture farms. The infrastructure of public schools is in extremely poor state.
The villagers have no formal committee to address conflicts or resolve civic problems. Although there is no major conflict among the villagers, if a minor dispute related to family conflicts or livestock business do arise, it is resolved by elders of community.
The common diseases among the villagers are cough, Tuberculosis, Diabetes, Hepatitis, fever, Malaria etc.

Farmers of Village Haji Allah Rakhio Langha are willing to get sensitized and cognizance regarding modern agriculture practices. This will help them resolve their agriculture issues and get a better yield of their crop. Female members of the village participate in the agricultural activity with men. Major crops are sugar cane, wheat and cotton. Mostly seasonal vegetables and fruits are part of everyday meal. The diet pattern is same among all group of villagers i.e. men, women, children and older people.

S.No.	Name of Participants	Occupations
01.	Abdul Hakeem	Farmer
02.	Zulfiqar Ali	Farmer
03.	S. Ali	Farmer
04.	Sikander Ali	Farmer
05.	M Ibrahim	Farmer
06.	Qalander Bux	Driver
07.	M Nawaz	Labou
08.	Nazrullah	Farmer
09.	Mir Hassan	Farmer
10.	Waseem	Social Worker
11.	Hafiz Amanullah	Pesh Imam / Farmer

District: **Khairpur**	Union Council: **Rasoolabad**	Date: **21st July 2017**
Name of Village: **Bachal Bhambro**		Lat/Long: **27° 10' 26.70"N** **68° 25' 54.00"E**
Interviewers: Mr. Abdullah Magsi, Mr. Abdul Rauf & Mr. Anus		

Overview of villagers discussion:

The team members introduced themselves to the villagers of Bachal Bhambro and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the villagers are Farmer while few are labor etc. Average monthly income is around 5000 to 10000 PKR.

Overall community is Muslim.

100% villagers practice open defecation. Villagers wash their hands with water only. Due to poverty and absence of drainage system the villagers are unable to construct toilets.

Villagers are willing to support any project to make their village ODF. But added that the drainage system must also be included in the components of SSS to carry the waste water out of the village.

Local Government is not active in this region and do not play its role for the welfare of the locals. No development project is under progress. The village do not have proper drainage system. The waste water from houses is dumped in septic tanks or agriculture farms. The villagers are against the notion of collaborating local government for the implementation of SSS.

Villagers are not organized in form of any committee to resolve their conflicts. The conflicts are resolved by mutual understanding and decisions of the elders.

The village have basic utilities such as electricity & gas. There is a hospital that operates for 8 hours a day. Boys and girls primary and secondary schools are present village but schools do not have toilets.

Typhoid, Malaria, Hepatitis, Diabetes & Blood pressure are most common diseases among the villagers.

There are no government level projects in progress to resolve agriculture related problems and assist farmers in any aspect.

Major crops are date, rice, & wheat. And these are commonly consumed food. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Female members of the village do not participate in the agricultural activity with men.

Farmers welcome capacity building training regarding agricultural practices and guidelines for selection of healthy and nutritional crop to harvest.

S.No.	Name of Participants	Occupations
01.	Rafique Ahmed	Jobless
02.	Wali Khan	Farmer
03.	Manzoor Ali	Farmer
04.	Nisar Ahmed	Farmer/Student
05.	Abdul Razzaque	Farmer
06.	Ghulam Abbas	Farmer/Student
07.	Abdul Hafeez	Farmer
08.	Imtiaz Ali	Farmer

District: **Khairpur**	Union Council: **Deh Sohu**	Date: **21st July 2017**
Name of Village: **Izzat Solangi**		Lat/Long: **27° 22' 20.01"N** **68° 49' 32.80"E**
Interviewers: Ms Khalida Somroo		

Overview of villagers discussion:

The interviewer introduced herself to the female villagers of Izzat Solangi and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the ladies are housewife. Overall community is Muslim. 80% of the houses are Kucha while only 20% are Pakka.

80% villagers practice open defecation. However, Hand washing practice is common. Due to poverty the villagers are unable to construct toilets.

Ladies of the village welcome any training & awareness programs initiated by government organization or NGO in this regard and to help them build toilets.

Local government is ineffective. It is not contributing in improving the drainage system of this region and do not play its role for the welfare of the locals. No development project is under progress. The waste water from houses is dumped in septic tanks or agriculture farms.

The village do have electricity but gas is not available. Girls and Boys Government schools are present in the village. And also a charity school is located in this village.

Diarrhea & Malaria are most common diseases among the villagers. Villagers are aware that these diseases are prevailing due to unhygienic lifestyle.

There are no projects in progress at any level (government or NGO) to improve the agricultural production and assist farmers in growing healthier crops that is beneficial for health and nutrition. Current agricultural productions such as date & wheat are contributing to healthy diets. Major crops are date, wheat and sugarcane. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Female members of the village do not participate in the agricultural activity with men.

S.No.	Name of Participants	Occupations
01.	Fiza	Housewife
02.	Rasheeda	Housewife
03.	Shaheena	Housewife
04.	Shazia	Housewife
05.	Hameeda	Housewife
06.	Laila	Housewife
07.	Rozina	Housewife
08.	Roina	Student
09.	Latifa	Councilor

District: **Sukkur**	Union Council: **Tamachani**	Date: **21st July 2017**
Name of Village: **Goth M Bungal Khoso**		Lat/Long: **27° 45' 57.00"N** **65° 48' 06.00"E**
Interviewers: Mr. Abdullah Magsi, Mr. Abdul Rauf & Mr. Anus		

Overview of villagers discussion:

The team members introduced themselves to the villagers of M Bungal Khoso and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Farmer is the most common profession while few are govt. employee. Average monthly income is around 18000 to 20000 PKR.
Overall community is Muslim. 90% of the houses are Kucha and 10% are Pakka.
95% villagers practice open defecation. Only 05% of population have toilets (Flush toilet). Hand washing practice is very common among villagers the reason being religion and hygiene. Due to poverty the villagers are unable to construct toilets.
Villagers are willing to support any training & awareness projects in this regard to help them build toilets and improve their lifestyle.
Local Government is not active in this region and do not play its role for the welfare of the locals. No development project is under progress. The village do not have proper drainage system. Rain water remains stagnant on land which becomes breading point for flies and mosquitoes. The waste water from houses is dumped in septic tanks or agriculture farms.
Villagers do not have any committee to resolve their domestic, agriculture related issues and other matters. The conflicts are resolved by mutual understanding of the two proponents.
The village has electricity, but gas and telephone are not available. There is no Health Care Unit/hospital/clinic and school in the vicinity of the village.
Diarrhea, Malaria, Hepatitis, diabetes and skin diseases are most common diseases. Villagers are aware that these diseases are prevailing due to unhygienic environment.
There are no government level projects in progress to improve the agricultural production and assist farmers in this regard.
Current agricultural productions such as sugarcane, rice & wheat are contributing to diets. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Female members of the village participate in the agricultural activity with men.
Farmer seek support to improve the agriculture practice. And also need guidance in selection of crops that are beneficial for health.

S.No.	Name of Participants	Occupations
01.	Mushtaque Ahmed	Govt employee
02.	M. Ishaque	Govt employee
03.	Ghulam Haider	Farmer
04.	Deedar Ali	Farmer
05.	M. Saleem	Farmer
06.	Rizwan Ahmed	Farmer
07.	Khadim Hussain	Farmer
08.	Imdad Ali	Farmer

District: **Sukkur**	Union Council: **Tamachani**	Date: **21st July 2017**
Name of Village: **Draihal**		Lat/Long: **27° 45' 12.40"N** **68° 48' 10.40"E**
Interviewers: Ms Khalida Somroo		

Overview of villagers discussion:

The interviewer introduced herself to the participants of village Draihal and briefed them about the objectives of SAAF SUTHRO SINDH (SSS) program, Agriculture for Nutrition and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the ladies are housewife. Overall community is Muslim. 95% of the houses are Kucha and only 5% are Pakka. Average monthly income is around 15000 PKR.

80% villagers practice open defecation (50% male, 30% female). Hand washing practice is also not very common among male. Poverty is the sole reason the villagers are unable to construct toilets.

Participants showed their consent to welcome any training & awareness programs if initiated by government organization or NGO in this regard and to help them build toilets to make this village an ODF.

Local government is ineffective. It is not contributing for the welfare of the locals. No development project is under progress. The waste water from houses is dumped in septic tanks or agriculture farms. There is no drainage of rain water. Rain water accumulates on land becoming breading ponds for mosquitoes and flies. And also damages land.

The village have electricity but gas is not available. The village do not have Government schools and health care facility.

Diarrhea & Malaria are most common diseases among the villagers. Villagers are aware that these diseases are prevailing due to unhygienic lifestyle.

There are no projects in progress at any level (government or NGO) to improve the agricultural production and assist farmers in growing healthier crops that is beneficial for health and economy. Current agricultural productions such as rice, sugarcane & wheat. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Female members of the village do not participate in the agricultural activity with men.

S.No.	Name of Participants	Occupations
01.	Arbeli	Housewife
02.	Khurshid	Housewife
03.	Tahira	Housewife
04.	Bukhtawar	Housewife
05.	Rubina	Housewife
06.	Seema	Housewife
07.	Sabira	Housewife
08.	Tahira	Housewife

District: **Sh. Benazirabad**	Union Council: **Deh Fulail**	Date: **22nd July 2017**
Name of Village: **Bahar Jo Pher**		Lat/Long: **26° 30' 33.80"N** **67° 59' 22.00"E**

Interviewers:	Mr Abdullah Magsi

Overview of villagers discussion:

The enumerator introduced himself to the women of village Baher Jo Pher and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the women of the village are house wife and also work in farms.

Overall community is Muslim. 80% of the homes are Kucha and rest are Pakka. The village has Electricity, but natural gas and telephone facility is not available.

80% (60% male 20% female) villagers practice open defecation (open pit) while 20% of the population have facility of toilets (Flush toilets). People are unable to construct toilets in their homes due to poverty and lack of awareness. Villagers wash their hands after using toilets as it protects them from many diseases. There is a government school in the village but it is operated by the villagers because government does not show any interest in the school.

Women villagers agree that by developing hand washing and toilet facilities in local schools will help sensitizing the villagers and thus improving the environment of the village. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Women suggested that awareness campaign, assistance in construction of toilets and development of drainage system should be included in the SSS program.

There is no development and construction activities going on in the village by any organization.

Villagers do not have any organization to resolve their conflicts. They resolve their conflicts by mutual consensus and decision of the elders of villagers. Family conflicts commonly arise which are resolved within the community.

Local Government has not taken up any development project in the region and do not coordinate with villagers to ask their problems. SSS should not involve LG for implementation. Proper drainage system does not exist in the village. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.

The common diseases among the villagers are Cancer (very common), Hepatitis, Malaria, Tuberculosis, stomach related diseases, skin diseases & Diabetes etc. Villagers believe that these diseases are due to polluted soil and ground water.

No project ever launched for the improvement of agriculture of the village. Farmers of Village do not have any proper organization to deal with their agricultural problems and get guidance.

S.No.	Name of Participants	Occupations
01.	Zareena	House wife/Farmer
02.	Iman Zadi	House wife/Farmer
03.	Zahida	House wife/Farmer
04.	Haleema	House wife/Farmer
05.	Aamina	House wife/Farmer
06.	Shahida	House wife/Farmer
07.	Rukhsana	House wife/Farmer
08.	Gulaan	House wife/Farmer

District: **Sh. Benazirabad**	Union Council: **Deh Fulail**	Date: **22nd July 2017**
Name of Village: **Jeevan Mallah**		Lat/Long:**26 30 29.01 N 67 58 53.02 E**
Interviewers:	Mr Abdullah Magsi, Mr Abdul Rauf, Mr Anas Khan	

Overview of villagers discussion:

The enumerator introduced himself to the members of village Jeevan Mallah and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Most of the men are farmer.

Overall community is Muslim. 80% of the homes are Kucha and rest are Pakka. The village has Electricity, but natural gas and telephone facility is not available.

80% (60% male 20% female) villagers practice open defecation (open pit) while 20% of the population have facility of toilets (Flush toilets). People are unable to construct toilets in their homes due to poverty and absence of drainage system. Villagers wash their hands after using toilets as it prevents many diseases from spreading.

Government schools are mostly not functional due to lack of interest from government level. Villagers agree that by developing hand washing and toilet facilities in local schools will help raise awareness and thus improving the environment of the village. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village.
There is no development and construction activities going on in the village by any organization and Local government. Villagers are quite pessimist about the launch and implementation of SSS & A4N programs.
Villagers resolve their conflicts by mutual consensus and decision of the elders of villagers. Family conflicts are most common in the community.

Local Government has not taken up any development project in the region and do not coordinate with villagers to ask their problems. SSS should not involve LG for implementation. Proper drainage system does not exist in the village. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.
The common diseases among the villagers are Hepatitis (B, C), Malaria, Tuberculosis, Diarrhea, etc.
No project ever launched for the improvement of agriculture of the village. Farmers of Village do not have any proper organization to deal with their agricultural problems and get guidance. Soil of the area is not very fertile and productions are quite low. Ground water is not fit for use for harvesting. Women participate in the agriculture activity.

Major crops are wheat and rice. The diet pattern is same among all group of villagers i.e. men, women, children and older people.

S.No.	Name of Participants	Occupations
01.	Sadique Lashari	Hotel manager
02.	Suhag	Farmer
03.	Waheed Unar	Farmer
04.	Sardar Ali Bux Mallah	Land lord
05.	Muhammad Tufail	Farmer
06.	Niaz Mallah	Farmer
07.	Ilyas	Farmer

District: **Noushero Feroz**	Union Council: **Bahlani**	Date: **22nd July 2017**
Name of Village: **Abdullah Bhambro**		Lat/Long: **27° 05' 39.00"N** **68° 20' 07.00"E**
Interviewers: Mr Abdullah Magsi, Abdul Rauf, Anas Khan		

Overview of villagers discussion:

The enumerators introduced themselves to the men of village Abdullah Bhambro and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Most of the women of the village are house wife and also work in farms.
Overall community is Muslim. Sindhi language is spoken.

50% (40% male 10% female) villagers practice open defecation (open pit) while 50% of the population have facility of toilets (Flush toilets). People do not construct toilets in their homes due to lack of awareness. Villagers wash their hands after using toilets because it is religious teaching and it protects them from many diseases.

Villagers agree that by developing hand washing and toilet facilities in local schools will help raise awareness of importance of toilets. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Suggested that development of drainage system should be included in the SSS program. Proper drainage system does not exist in the village. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.
UNICEF has conducted survey couple of years earlier regarding the child health.
Villagers have an organization, that is led by the Sardar of the village, to resolve their conflicts. Family conflicts are most common which are resolved by the organization.
Local Government has not launched any development project in the region and do not interact with villagers to resolve their problems. SSS should not involve LG for implementation.
The common diseases among the villagers are Blood pressure, Hepatitis, Malaria, stomach related diseases, skin diseases etc. Villagers believe that these diseases are due to polluted soil and ground water.
No project ever launched for the improvement of agriculture of the village. Farmers of Village do not have any proper agricultural committee to deal with their agriculture related problems and provide guidance. Female members of the village community actively participate in the agricultural activity with men. Major crops are sugar cane, date, vegetables and banana. The diet pattern is same among all group of villagers i.e. men, women, children and older people. People mostly consume the locally grown crops.
Farmers showed enthusiasm to participate in training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program will be helpful for healthy diet.

S.No.	Name of Participants	Occupations
01.	Qamar Uddin Bhambro	Farmer
02.	Hamid Ali	Farmer
03.	Riaz Hussain	Land lord/Farmer
04.	Abid Ali	Farmer
05.	Ahmed Ali	Land lord/Govt. servant
06.	Ghulam Hyder	Farmer
07.	Ghulam Rasool	Farmer

District: **Noushero Feroz**	Union Council: **Bahlani**	Date: **22nd July 2017**
Name of Village: **Pir Qaim Shah II**		Lat/Long: **27° 05' 34.90"N** **68° 21' 50.80"E**
Interviewers: Mr Abdullah Magsi		
Overview of villagers discussion:		

The enumerator introduced himself to the women of village Pir Qaim Shah II and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the women of the village are house wife and also work in farms.
Community is both Muslims & Hindus. 80% of the homes are Kucha and rest are Pakka. Rohri canal & regulator is near the village which is the source of water for the village.
60% (50% male 10% female) villagers practice open defecation while 20% of the population have facility of toilets. People are unable to construct toilets in their homes due to poverty and lack of awareness. Villagers wash their hands after using toilets as it protects them from many diseases.

Women villagers agree that by developing hand washing and toilet facilities in local schools will help sensitizing the villagers and thus improving the environment of the village. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Women suggested that awareness campaign, assistance in construction of toilets and development of drainage system should be included in the SSS program.

No development and construction activities going on in the village by any organization at the moment.
Villagers do not have any organization to resolve their conflicts. They resolve their conflicts by mutual consensus and the decision of the elders of villagers. Family conflicts commonly arise which are resolved within the community.
Local Government is not involved in any development project in the region and do not coordinate with villagers to solve their problems. SSS should not involve LG for implementation. Proper drainage system does not exist in the village. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.
The common diseases among the villagers are Cancer (very common), Hepatitis, Malaria, Tuberculosis, stomach related diseases, skin diseases & Diabetes etc. Villagers believe that these diseases are due to polluted soil and ground water.
Villagers do not have any association to deal with their agriculture related issues. Major crops are Cotton, wheat, animal fodder etc. People commonly consume vegetable and wheat. There is no disproportionate effect on any particular age group of the population. Villagers need and support efforts to improve their crop quality and health benefits of their diet.

District: **Matiyari**	Union Council: **Bharedino Kaka**	Date: **23rd July 2017**
Name of Village: **Bhakar Jamali**		Lat/Long: **26° 03' 09.90"N** **68° 24' 11.20"E**
Interviewers: Mr Abdullah Magsi, Mr Abdul Rauf, Mr Anas Khan		

Overview of villagers discussion:

The enumerators introduced themselves to the members of the gathering and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Most of the women of the village are house wife and also work in farms.
Community is entirely Muslim. 80% of the homes are Kucha and rest are Pakka. Rohri canal is near the village which provides water for agriculture and other uses.

60% villagers practice open defecation (open pit) while 40% of the population have facility of toilets. People cannot construct toilets in their homes due to unavailability of funds & absence of drainage lines. Villagers wash their hands after using toilets because it is religious teaching and it protects them from many diseases.

Villagers need drainage system for sewerage water. Waste water from homes is dumped into agriculture land or remains stagnant in streets. Village require hand washing and toilet awareness. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Suggested that development of drainage system should be included in the SSS program.

Road from highway to the village is being carpeted and new gas lines are being laid. Work is in progress. New toilets in government schools are being built by the school administration.
The common diseases among the villagers are Hepatitis, Malaria, diarrhea, flue etc. However, no particular age group is most effected by any disease.

No project in progress for the improvement of agriculture of the village. No organization exist to resolve agricultural related problems and provide guidance. Female members of the village community participate in the agricultural activity. Major crops are vegetables, wheat and fodder. The diet pattern is same among all group of villagers i.e. men, women, children and older people. People mostly consume the locally grown crops.

Farmers showed willingness to participate in training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program will be helpful for healthy diet.

S.No.	Name of Participants	Occupations
01.	Zamir Hussain	Farmer
02.	Najam Uddin	Student
03.	Ali Nawaz	Trader of fertilizer
04.	Allah Dad	Farmer
05.	Bozdar Khan	Farmer
06.	Bashir Khan	Farmer
07.	Sher Khan	Land lord/Farmer
08.	Ahmed Nawaz	Govt employee
09.	M Younis	Teacher

District: **Matiyari**	Union Council: **Bharedino Kaka**	Date: **23rd July 2017**
Name of Village: **Shadad Jamali**		Lat/Long: **26° 03' 14.23"N** **68° 23' 58.90"E**
Interviewers: Mr Ahmed Nawaz Jamali		

Overview of villagers discussion:

The enumerator introduced himself to the women members of the gathering and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Most of the women of the village are house wife and also work in farms.

Community is Muslim. 60% of the homes are Pakka and 40% are Kucha.

70% of population practice open defecation (open pit) while 30% of the population have facility of toilets. People cannot construct toilets in their homes due to shortage of fund and resources. Only 50% of Villagers wash their hands after using toilets. Awareness about sanitation is not common.

Villagers realize that by developing and promoting hand washing and toilet facilities, health and hygiene level & environment of the village will improve. The components of SSS program cover their sanitation and open defecation issue and it will bring a behavioral change among villagers and help in meeting the goals for ODF village. The domestic and sewage waste water is dumped in septic tanks, agriculture farms or remains stagnant on street providing breeding ponds for mosquitoes.

Villagers do not have any mutual association to resolve their conflicts. family conflicts are common which are resolved by the influential persons of the community.

Local Government has started the project of road pavement and renewal of gas pipelines.

The common diseases among the villagers are Blood pressure, Asthma, Hepatitis, Malaria, diarrhea etc. Villagers believe that these diseases are due to polluted soil and ground water.

No projects for the improvement of agriculture of the village. Farmers of Village do not have any organization among them to resolve agricultural related problems and provide guidance. Female members of the village community participate in the agricultural activity with men. Major crops are Wheat & Lady finger. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Farmers agreed to support training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program will be helpful for healthy diet.

S.No.	Name of Participants	Occupations
01.	Gul Bashar	Housewife/Farmer
02.	Hoor	Housewife
03.	Zuhra	Housewife/Farmer
04.	Dadi	Housewife/Farmer
05.	Zeenat	Housewife/Farmer
06.	Farzana	Housewife
07.	Aisha	Housewife
08.	Shabira	Housewife
09.	Somari	Housewife

District: **Hyderabad**	Union Council: **Hatiri**	Date: **23nd July 2017**
Name of Village: **Qadir Bux Lashari**		Lat/Long: **25° 27' 59.70"N** **68° 25' 37.80"E**
Interviewers: Mr. Abdullah Magsi, Mr. Abdul Rauf, Mr. Anas Khan		

Overview of villagers discussion:

The enumerator introduced themselves to the member of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Women of this village are house wife and also work in farms.
Overall community is Muslim. 30% of the homes are Pakka and 70% are Kucha.

90% villagers practice open defecation while 10% of the population have access to toilets (but males mostly practice open defecation). People cannot construct toilets due to unavailability of resources. Villagers wash their hands after using toilets because it protects them from many diseases. The government school of the village remains closed. Toilets in the govt school are in poor condition and needs renovation.

Villagers said that toilets will be useful in improving the environment of the village only when a proper drainage system is constructed and sewage is taken out in proper sewerage line. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Proper drainage system does not exist in the village.

There is no development and construction activities going on in the village by any organization.
Villagers do not have any association to help them resolve their conflicts. Petty issues within family are common which are resolved by mutual consensus.

Local Government has under taken any development project in the region and do not interact with villagers to resolve their problems. SSS should not involve LG in this project.

The common diseases among the villagers are Diarrhea, Malaria, diabetes, Blood pressure, skin diseases etc.

No project for the improvement of agriculture of the village. Farmers of Village do not have any proper agricultural committee to deal with their agriculture related problems and provide guidance. Female members of the village community actively participate in the agricultural activity with men. Major agriculture produce is cotton, vegetables, banana and rose flower. The diet pattern is same among all group of villagers i.e. men, women, children and older people. People mostly consume the locally grown crops.
Farmers showed interest to participate in training and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program will be helpful for healthy diet.

S.No.	**Name of Participants**	**Occupations**
01.	M Jameel	Govt employee/Farmer
02.	Chakkar Chandio	Farmer
03.	Zaheer Abbas	Farmer
04.	M. Nizam	Farmer
05.	Abdul Jabbar	Farmer
06.	Allah Bux	Farmer
07.	Mashooq Ali	Farmer
08.	Najaf Ali	Farmer
09.	Irfan Ali	Student

District: **Hyderabad**	Union Council: **Hatiri**	Date: **23nd July 2017**
Name of Village: **Sahib Khan chandio**		Lat/Long: **25° 27' 57.60"N** **68° 25' 42.80"E**
Interviewers: Ms Shumaila Memon		

Overview of villagers discussion:

The enumerator introduced herself to the ladies of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.
Women of this village are house wife and also work in farms.
Overall community is Muslim. 90% of the homes are Pakka and 10% are Kucha. Villagers speak Sindhi language.

80% villagers practice open defecation while 20% of the population have access to toilets (but usage is not regular). Females face most problems (such as privacy) due to unavailability of toilets. People cannot construct toilets due to unavailability of resources. Villagers wash their hands after using toilets because it protects them from many diseases. The government school here in this village is not functional.

Villagers agree that by developing hand washing and toilet facilities in local schools will help raise awareness of importance of toilets. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village. Suggested that development of drainage system should be included in the SSS program. Proper drainage system does not exist in the village. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.
There is no development and construction activities going on in the village by any organization.
Villagers do not have any organization, to help them resolve their conflicts. Family conflicts are most common which are resolved by mutual consensus.
Local Government has not initiated any development project in the region and do not interact with villagers to resolve their problems. SSS should not involve LG for implementation.
The common diseases among the villagers are Hyper tension, diabetes, Asthma etc. Females are mostly effected by these diseases. The reason for these diseases is poor nutritional value of the diet.

S.No.	Name of Participants	Occupations
01.	Haseena	Housewife
02.	Shamshad	Housewife
03.	Mrs Jamil	Farmer
04.	Mrs Shafan	Farmer
05.	Mrs Hakim	Farmer
06.	Mrs Badar	Farmer
07.	Muradan	Farmer
08.	Ms Zurreen	Farmer

District: **Tando Allahyar**	Union Council: **Shah Inayat**	Date: **23nd July 2017**
Name of Village: **Alam Lakhmir**		Lat/Long: **25° 30' 17.40"N** **68° 41' 41.60"E**
Interviewers: Mr. Abdullah Magsi, Mr. Abdul Rauf, Mr. Anas Khan		

Overview of villagers discussion:

The enumerator introduced themselves to the member of gathering and informed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of the survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Majority of villagers are Hindu and few are Muslim. Sindhi language is commonly spoken. Canal Naseer provides water for irrigation.

Villagers practice open defecation (open pit) and toilets are not present at all. People unable to construct toilets due to poverty and unavailability of drainage system. Villagers wash their hands after using toilets because it protects them from many diseases. The toilets of the government school are not in condition of using (One of the school is functional due to the efforts of villagers. Another school is not in the condition of being used). (National Rural Support Program (NRSP) has surveyed the school and assured to provide assistance). Toilets in the school are in poor state and are not in use.

Villagers said that toilets will be useful in improving the environment of the village only when a proper drainage system is constructed and sewage is taken out in proper sewerage line. The components of SSS program will bring a behavioral change among villagers and help in meeting the goals for ODF village.

There is no development and construction activities going on in the village by any organization.
Villagers do not have any association to help them resolve their conflicts. Petty issues within family are common which are resolved by mutual consensus.

Local Government is not active in the region and do not interact with villagers to resolve their problems. Villagers are in state of despair.
The common diseases among the villagers are Diarrhea, Malaria, diabetes, Hepatitis etc.

S.No.	Name of Participants	Occupations
01.	Soomar	Farmer
02.	Ramu	Farmer
03.	Jamoo	Farmer
04.	Tharo Mal	Farmer
05.	Maghan Mal	Farmer
06.	Khamiso	Farmer
07.	Qasim	Farmer
08.	Soomro	Farmer
09.	Harichand	Farmer
10.	Umriyo	Farmer
11.	Limokher	Farmer
12.	Maaniyoon	Farmer
13.	Gulji	Farmer
14.	Papoo	Farmer
15.	Sanwan	Farmer
16.	Allan	Farmer
17.	Marjno	Farmer

District: **Tando Allahyar**	Union Council: **Shah Inayat**	Date: **23rd July 2017**
Name of Village: **Rahim Bux**		Lat/Long: **25° 30' 44.80"N** **68° 41' 15.20"E**
Interviewers: Ms Shumaila Memon		

Overview of villagers discussion:

The enumerator introduced herself to the ladies of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked. Women of this village are house wife and also participate in agriculture.
Overall community is Muslim. Population is 300 to 400. Villagers speak Brahvi & Sindhi languages.

95% villagers practice open defecation while 05% of the population have access to toilets (Flush toilets). People cannot construct toilets due to poverty & unavailability of resources. There is no government school in this village.

Villagers agree that by developing hand washing and toilet facilities the environment & hygienic condition in the village will improve. SSS program is a good initiative which will induce behavioral change among villagers and help in achieving the goals for ODF village. The drainage system needs to be developed. The domestic and sewage waste water is dumped in septic tanks or agriculture farms.

No development activities going on in the village by any organization.
Villagers do not have association among their community to resolve their conflicts. Family conflicts mostly arise which are resolved by mutual consensus.

Local Government is not carrying out any development project in the region and do not interact with villagers to resolve their problems. Villagers disagree with the notion of involving LG in the implementation of SSS program.

The common diseases among the villagers are Malaria, diabetes, skin diseases etc.
No project related to agricultural improvement ever initiated in the village. Farmers of village do not have any committee to deal with their agriculture related problems and provide guidance. Female members of the village work in the agricultural fields with men. Major crops are sugar cane, Wheat, vegetables, cotton, onion and banana. The diet pattern is same among all group of villagers i.e. men, women, children and older people. Wheat and vegetable are very common food items.
Farmers showed willingness to get trained and awareness regarding modern agricultural practices and guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program key elements for healthy diet.

S.No.	Name of Participants	Occupations
01.	Zainab	Housewife/farmer
02.	Zahida	Housewife/farmer
03.	Hakeema	Housewife/farmer
04.	Habiba	Housewife/farmer
05.	Perveen	Housewife/farmer
06.	Ayaz	Housewife/farmer
07.	Zeenat	Housewife/farmer
08.	Irfan	Housewife/farmer

District: **Malir (Karachi)**	Union Council: **Gadap**	Date: **14th August 2017**
Name of Village: **Memon Goth**		Lat/Long: **24° 55' 04.10"N** **67° 15' 12.00"E**
Interviewers: Abdur Rauf, Muhammad Haseeb		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Men of this village are mostly merchants and businessmen. Overall community is Muslim. Population is 600-700. Villagers speak Sindhi and Balochi languages.

05% of the villagers practice open defecation while 95% of the population have access to toilets (Flush toilets). They only do open defecation when working in the fields at day.

Villagers said that they all have toilets in their homes as well as in schools.

Several NGOs like HANDS and Sind Education foundation are already working in the area and they developed schools and hospitals. The sanitation condition of the village is very good.

Local government is usually visiting the area and solve people problems.

Villagers have Wadera system to resolve their conflicts. Family conflicts mostly arise which are resolved by mutual consensus.

The common diseases among the villagers are diabetes etc.

Female members of the village are mostly housewives and also socialy working like lady health workers. Major crops are fodder, vegetables, cotton, dates and banana. Wheat and vegetable are very common food items.

Farmers and shepherds showed willingness to get trained and awareness regarding modern agricultural practices and cattle rearing techniques guidelines for selection of healthy and nutritional crop to harvest. Components identified in A4N program key elements for healthy diet.

S.No.	Name of Participants	Occupations
01.	Haji M. Varial	School Guard
02.	Zulfiqar	Shepherd
03.	Mansoor	Cattle Merchant
04.	Faraz Ali	Student
05.	Niaz Ahmed	Fodder Merchant

District: **Karachi West**	Union Council: New Karachi	Date: **14th August 2017**
Name of Village: **Yaroo Khan Goth**		Lat/Long: **25° 0'28.34"N** **67° 4'34.62"E**
Interviewers: Abdur Rauf, Muhammad Haseeb		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Villagers are mostly doing jobs in this village.

Overall community is Muslim. Population is above 1000. Villagers speak Urdu and Sindhi languages.

No one in the village is practicing open defecation and all have access to toilets (piped water and flush toilet).

No local government persons are visited the village and the infrastructure is already deteriorated.

People of the village used to go to Police to settle their conflicts.

The common diseases among the villagers are diabetes, fever, cholera etc.

Female members of the village are mostly housewives.

No agriculture is practices in the village as well as people do not grow food crops or fodder in their houses. Therefore, as per their view, there will be no change occur if A4N component is applied.

S.No.	Name of Participants	Occupations
01.	Asif Raza	Mechanic
02.	Farooq	Private Job
03.	Zaheer	Student
04.	Sajid	Private

District: **Karachi Central**	Union Council: Manghopir	Date: **14th August 2017**
Name of Village: **Noor Muhammad Goth**		Lat/Long: **24° 59’ 17.3” N** **67° 01’ 59.7” E**
Interviewers: Abdur Rauf, Muhammad Haseeb		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Villagers are mostly doing business in the village.

Overall community is Muslim. Population is 800-900. Villagers speak Pashto languages.

15% of the villagers especially children practice open defecation.

No local government persons are visited the village and the infrastructure like sewerage and solid waste management is deteriorated.

Jirga System prevails to settle village conflicts.

The common diseases among the villagers are diabetes, fever, cholera etc.

Female members of the village are mostly housewives.

No agriculture is practices in the village as well as people do not grow food crops or fodder in their houses. Therefore, as per their view, there will be no change occur if A4N component is applied.

S.No.	Name of Participants	Occupations
01.	Ahsaan Gul	Driver
02.	Momin Hasan	Karyana Merchant
03.	Faraz Khan	Truck Driver
04.	Feroze Khan	Business of Marble

District: **Karachi South**	Union Council: Kehkashan	Date: **14th August 2017**
Name of Village: **Sheerin Jinnah Colony**		Lat/Long: **24° 49' 06.6" N** **67° 00' 22.2" E**
Interviewers: Abdur Rauf, Muhammad Haseeb		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Villagers are mostly doing small businesses in the colony and also fishermen.

Overall community is Muslim. Population is above 2000. Villagers mostly speak Pashto and Katchi memon languages.

5% of the villagers especially children practice open defecation.

Local government is usually visiting the area and solve people problems. Also nominated persons of the village do resolves problems of the people and also the conflicts.

Villagers welcome the project and also stated to rebuild the sewerage system in their village. They all have toilets in the village. However, there are no government schools in the village.

The common diseases among the villagers are fever, cholera, cold etc.

Female members of the village are mostly housewives and do the housejob.

No agriculture is practices in the village as well as people do not grow food crops or fodder in their houses. Therefore, as per their view, there will be no change occur if A4N component is applied.

S.No.	Name of Participants	Occupations
01.	Ubaidur Rehman	Semi Government Job
02.	Gul Faraz	Peon in Semi Government company
03.	Umer Gul	Peon in Semi Government company
04.	Javed Ali	Milk Merchant
05.	Gul Salam	Cattle Merchant

District: **Karachi West**	Union Council: Gabo Pat	Date: **05th August 2017**
Name of Village: **Abdur Rehman Village**		Lat/Long: **27° 52’ 04.8” N** **67° 58’ 05.6” E**
Interviewers: Tasneem Bhatti, Syed Ali Ghalib		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program, Agriculture for Nutrition (A4N) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Villagers are mostly fishermen of Hawksbay and working in the power plants nearby.

Overall community is Muslim. Population is above 200. Villagers mostly speak balochi language.

Most of the villagers do practice open defecation into the sea. There are also shortage of toilet facilities in the village.

As the development of power plants in the neighborhood, the people get help, health facilities and infrastructure improvements from the power plant management.

Villagers welcome the project and also stated to rebuild the sewerage system in their village. They all have toilets in the village. However, there are no government schools in the village.

The common diseases among the villagers are fever, cholera, cold etc.

Female members of the village are mostly housewives and also fetch water from dug wells.

No agriculture is practices in the village as well as people do not grow food crops or fodder in their houses. Therefore, as per their view, there will be no change occur if A4N component is applied.

S.No.	Name of Participants	Occupations
01.	Adbul Wahid	Chief of Goth
02.	Haji Qasim Mirbahar	Fisherman
03.	Afzal	Fisherman
04.	Haji Abdul Ghani	Fisherman
05.	Asfand	Fisherman
06.	Ghulam Ali	School Teacher

District: **Korangi (Karachi)**	Union Council: Sharafi Goth	Date: **15th August 2017**
Name of Village: **Naik Muhammad Goth**		Lat/Long: **24° 51’ 03.1” N** **67° 10’ 05.2” E**
Interviewers: Abdur Rauf, Tasneem Bhatti		

Overview of villagers discussion:

The enumerator introduced herself to the men of village and briefed them about the objectives of SINDH SAAF SUTHRO (SSS) program and purpose of survey. At the beginning, a brief data of the participants was gathered. Then the questions of the survey forms were asked.

Villagers are mostly workers in the nearby industries.

Overall community is Muslim. Population is above 1,500. Villagers mostly speak Balochi / Sindhi languages.

5% of the villagers especially children practice open defecation.

Local government is usually visiting the area and solve people problems. Also nominated persons of the village do resolves problems of the people and also the conflicts.

Villagers welcome the project and also stated to rebuild the sewerage system in their village. They all have toilets in the village. However, there are no government schools in the village.

The common diseases among the villagers are fever, cholera, cold etc.

Female members of the village are mostly housewives and do the house job.

No agriculture is practices in the village as well as people do not grow food crops or fodder in their houses. Therefore, as per their view, there will be no change occur if A4N component is applied.

S.No.	Name of Participants	Occupations
01.	Ibrahim	Job in Pak Steel
02.	Safah	Driver
03.	Haji	Driver
04.	Abdul Hameed	Driver
05.	Allah Bux	Unemployed
06.	Khudadad	Driver
07.	M. Saleem Baloch	Head Master / Teacher

Annex K: Socioeconomic Data Tables

Table KA1: Population figures district-wise

Districts	Population (based on 1998 census)			Population (projected for 2013)
	Male	Female	Total	
Ghotki	5 11,363	459,186	970,549	1,570,360
Hyderabad	7 85,634	713,231	1,498,865	2,095,798
Khairpur	8 10,448	736,139	1,546,587	2,309,752
Matiari	2 67,517	247,881	515,398	720,659
Naushahro Feroze	5 68,574	518,997	1,087,571	1,381,988
Shaheed Benazirabad	5 71,834	530,750	1,102,584	1,632,285
Sukkur	479,715	421,758	901,473	1,380,121
Tando Allahyar	2 43,454	224,919	468,373	654,906
Karachi Central Karachi East Karachi West Karachi South Korangi (Karachi) Malir (Karachi)	5,306,106	4,550,212	9,856,318	17,086,794

Source: Development Statistics of Sindh 2014 prepared by the Bureau of Statistics, Government of Sindh

Table KB1: Percentage of poor in Sindh districts

District	Poverty Classification	% Poor
Ghotki	Very Poor	54.07
Hyderabad	Poor	36.62
Khairpur	Very Poor	53.81
Matiari	Extremely Poor	61.45
Naushahro Feroze	Extremely Poor	57.26
Shaheed Benazirabad	Extremely Poor	65.84
Sukkur	Poor	42.62
Tando Allahyar	Extremely Poor	60.64
Karachi Central	Least Poor	11.01
Karachi East	Least Poor	12.01
Karachi West	Vulnerable	18.3
Karachi South	Least Poor	10.89
Korangi (Karachi)	-	-
Malir (Karachi)	Vulnerable	20.81

Source: Poverty survey 2010-11, conducted under Benazir Income Support Program (BISP)

Table KC1: Percent distribution of household population according to type of toilet facility used by the household, by district, Sindh, 2014

District	HHs population with improved sanitation facilities (%)	HH population with unimproved sanitation facilities (%)	Open defecation (no facility, bush, field) (%)
Ghotki	49.8	11.2	39.0
Hyderabad	87.6	5.8	6.6
Khairpur	58.6	6.5	34.9
Matiari	60.2	12.8	27.0
Naushahro Feroze	64.1	9.9	26.0
Shaheed Benazirabad	61.0	13.0	26.0
Sukkur	69.7	8.7	21.6
Tando Allahyar	61.8	86.3	24.5
Karachi Central	99.8	0.2	0.0

Karachi East	99.8	0.2	0.0
Karachi West	99.7	0.0	0.3
Karachi South	99.7	0.3	0.0
Korangi (Karachi)	--	--	--
Malir (Karachi)	96.8	1.9	1.3
Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh			

Table KC2: Percent distribution of household population according to type of improved sanitation facility commonly used by the household, by district, Sindh, 2014

District	Piped sewage system (%)	Septic tank (%)	Soakage pit latrine (%)	Ventilated improved pit latrine (%)	Pit latrine with slab (%)	Compositing toilet (%)
Ghotki	29.5	2.6	12.8	2.5	2.2	0.2
Hyderabad	71.9	0.6	3.6	10.6	0.9	0.0
Khairpur	28.4	11.8	12.5	2.3	3.6	0.0
Matiari	43.7	2.4	4.3	5.2	4.6	0.0
Naushahro Feroze	48.7	4.1	5.6	2.7	0.6	0.0
Shaheed Benazirabad	29.8	12.0	6.5	10.9	1.5	0.0
Sukkur	45.4	13.6	7.4	2.6	0.7	0.0
Tando Allahyar	29.1	0.4	19.6	1.3	10.5	0.9
Karachi Central	99.5	0.3	0.0	0.0	0.0	0.0
Karachi East	99.7	0.0	0.0	0.1	0.0	0.0
Karachi West	97.2	0.1	2.1	0.0	0.4	0.0
Karachi South	99.6	0.0	0.1	0.0	0.1	0.0
Korangi (Karachi)	--	--	--	--	--	--
Malir (Karachi)	90.9	1.7	2.4	0.2	1.3	0.0
Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh						

Table KC3: Percent distribution of household population according to type of unimproved sanitation facility commonly used by the household, by district, Sindh, 2014

District	Flush/Pour flush (%)	Pit latrine without slab/Open pit (%)	Bucket (%)
Ghotki	4.5	4.3	0.0
Hyderabad	2.6	1.1	0.0
Khairpur	4.3	1.3	0.0
Matiari	0.1	0.6	0.0
Naushahro Feroze	1.0	4.9	0.0
Shaheed Benazirabad	0.3	4.3	0.0
Sukkur	6.1	0.6	0.0
Tando Allahyar	7.0	5.4	0.0
Karachi Central	0.0	0.0	0.0
Karachi East	0.0	0.1	0.0
Karachi West	0.0	0.0	0.0
Karachi South	0.0	0.3	0.0
Korangi (Karachi)	--	--	--
Malir (Karachi)	0.2	1.1	0.0
Source: Multiple Indicator Cluster Survey (MICS) Sindh 2014, Bureau of Statistics, Government of Sindh			

Table KC4: Water and sanitation facilities in schools		
District	**No. of Schools with washrooms**	**No. of schools with drinking water facility**
Ghotki	1,007	1,459
Hyderabad	714	553
Khairpur	2,277	2,723
Matiari	699	589
Naushahro Feroze	1,364	1,977
Shaheed Benazirabad	1,583	1,857
Sukkur	831	925
Tando Allahyar	534	432
Karachi Central	509	481
Karachi East	253	235
Karachi West	299	223
Karachi South	458	371
Korangi (Karachi)	458	380
Malir (Karachi)	416	316
Source: Sindh Education Profile 2014-215, Reform Support Unit (RSU), Government of Sindh		

Table KD: Malnutrition Prevalence in Sindh		
Indicator	North Sindh[47] (%)	South Sindh[48] (%)
Global Acute Malnutrition (GAM)	22.9	21.2
Severe Acute Malnutrition (SAM)	6.1	2.9
Chronic Malnutrition	53.9	51.8
Maternal Malnutrition (moderate malnutrition)	11.2	10.1
Maternal Malnutrition (severe malnutrition)	1.9%	0%
Source: Flood-Affected Nutrition Surveys 2010, Department of Health, GoS		

Table KE1: District-wise health profile					
District	**Hospitals**	**Dispensaries**	**Mother Child Health Centers (MCHCs)**	**Basic Health Units (BHUs)**	**Rural Health Centers (RHCs)**
Ghotki	11	36	3	34	3
Hyderabad	35	221	13	18	3
Khairpur	8	94	5	82	11
Matiari	3	67	3	21	4
Naushahro Feroze	3	69	3	45	12
Shaheed Benazirabad	14	167	21	37	9
Sukkur	22	72	6	26	3
Tando Allahyar	7	69	5	14	3
Karachi Central	I65	646	85	37	6
Karachi East					
Karachi West					
Karachi South					
Korangi (Karachi)					
Malir (Karachi)					
Source: Health Profile of Sindh (District Wise) 2015, Bureau of Statistics, Planning and Development, Government of Sindh					

[47] Ghotki, Jacobabad, Kashmore, Khaipur, Larkana, Shahdadkot, Shikarpur and Sukkur districts
[48] Dadu, Hyderabad, Nawabshah, Mitiari, Noushero Feroz and Thatta districts

Table KE2: District-wise medical staff profile			
District	**Population served per doctor**	**Population served per Nurse**	**Population served per Bed**
Ghotki	4302	33792	3078
Hyderabad	1062	6574	588
Khairpur	3747	32493	3594
Matiari	3859	56692	3350
Naushahro Feroze	3744	31909	3251
Shaheed Benazirabad	3267	19488	1182
Sukkur	3430	10143	1112
Tando Allahyar	4085	51538	2018
Karachi Central	2825	6789	1328
Karachi East			
Karachi West			
Karachi South			
Korangi (Karachi)			
Malir (Karachi)			
Source: Health Profile of Sindh (District Wise) 2015, Bureau of Statistics, Planning and Development, Government of Sindh			

Table KF1:District-wise educational profile									
District	**No. of Schools**			**Enrolment**			**Teachers**		
	Functional	**Closed**	**Total**	**Boys**	**Girls**	**Total**	**Male**	**Female**	**Total**
Ghotki	1,784	121	58	132,593	58,322	190,915	4,328	868	5,196
Hyderabad	840	34	2	80,931	74,113	155,044	4,663	4,199	8,862
Khairpur	3,130	214	116	201,327	122,662	323,898	7,944	2,445	10,389
Matiari	776	69	29	55,024	30,465	85,489	2,788	747	3,535
Naushahro Feroze	2,119	139	76	150,229	96,174	246,403	6,172	1,920	8,092
Shaheed Benazirabad	2,259	217	56	146,728	89,513	236,341	5,469	1,800	7,264
Sukkur	1,133	94	-	97,344	63,349	160,693	3969	1,595	5,504
Tando Allahyar	1,005	5	11	51,173	28,837	80,010	1,678	571	2,249
Karachi Central	606	9	-	47,810	58,373	106,183	1,930	5,420	7,350
Karachi East	263	-	4	22,088	30,251	52,339	895	2,535	3,430
Karachi West	363	4	5	24,475	33,348	57,823	1,016	1,520	2,536
Karachi South	476	6	17	34,174	46,153	80,327	1,455	2,971	4,426
Korangi (Karachi)	549	2	-	44,815	59,729	104,544	1,493	4,123	5,616
Malir (Karachi)	580	27	6	31,410	26,220	57,630	1,457	905	2,362
Source: Reform Support Unit (2014-2015), Education and Literacy Department, Government of Sindh									

Table KF2: District-wise literacy rate			
District	**Literacy rate (%)[49]**		
	Male	**Female**	**Total**
Ghotki	67	21	45
Hyderabad	75	66	70
Khairpur	71	33	53

[49] 10 years and above.

Matiari	62	32	48
Naushahro Feroze	77	40	60
Shaheed Benazirabad	70	29	51
Sukkur	71	41	57
Tando Allahyar	63	31	47
Karachi Central	86	77	82
Karachi East			
Karachi West			
Karachi South			
Korangi (Karachi)			
Malir (Karachi)			
Source: Pakistan emergency situation analysis 2014, district profiles, USAID			

Table KG1: The data for this section has been extracted from the Report on Mouza Census 2008 (Sindh Province), published by Pakistan Bureau of Statistics (PBS).

Sources of Employment – Ghotki							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly[50]	3	208	3	-	-	19
	Some[51]	210	57	57	17	120	240
Female	Mostly	-	44	1	-	-	85
	Some	43	58	8	6	57	164
Sources of Employment - Kashmore							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	5	110	-	-	-	5
	Some	99	23	44	7	116	120
Female	Mostly	4	58	1	-	1	15
	Some	55	69	14	5	75	87
Sources of Employment - Hyderabad							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	6	50	-	-	2	9
	Some	58	15	3	7	48	57
Female	Mostly	3	33	-	-	-	22
	Some	16	14	4	3	11	46
Sources of Employment - Khairpur							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	9	160	1	-	40	94
	Some	315	193	118	60	217	247
Female	Mostly	9	67	-	1	37	103
	Some	176	159	13	13	73	209
Sources of Employment - Matiari							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	-	45	-	-	1	41

[50] Population of 50 percent and above.
[51] population between 1 percent and 50 percent

	Some	82	44	18	7	51	53
Female	Mostly	-	16	-	-	6	26
	Some	44	42	6	3	23	56
Sources of Employment - Naushahro Feroze							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	1	99	1	-	2	62
	Some	184	107	85	30	134	138
Female	Mostly	3	55	-	-	-	53
	Some	116	110	12	12	53	125
Sources of Employment - Shaheed Benazirabad							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	3	250	-	-	1	37
	Some	229	29	29	7	173	187
Female	Mostly	-	86	-	1	2	64
	Some	63	95	3	2	32	153
Sources of Employment - Sukkur							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	15	152	1	-	1	22
	Some	160	63	42	14	130	192
Female	Mostly	1	101	-	-	2	52
	Some	56	68	2	2	59	157
Sources of Employment - Tando Allahyar							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	1	40	1	-	-	28
	Some	84	46	17	2	70	57
Female	Mostly	-	8	-	-	1	34
	Some	50	52	-	-	38	43
Sources of Employment - Karachi							
Gender	Quantification	Populated Rural Mouzas Reporting Sources of Employment					
		Service	Agriculture	Trade	Industry	Personal Business	Labor
Male	Mostly	9	10	1	-	-	45
	Some	68	34	24	19	49	24
Female	Mostly	-	4	-	-	-	30
	Some	33	24	8	5	17	45

Annex L: FORMAT FOR VOLUNTARY DONATION OF LAND

(Voluntary Donation of Land on Rs. -----/- Stamp Paper)

1. This deed of voluntary donation is made and executed on …......................... day of …...............……… between Mr. …...S/o W/ Mr. -------------------------------- AND the Government of Punjab through Punjab Irrigation Department to render public service (Rehabilitation /strengthening /construction of new Flood protection embankment (project Title and Location). Herein after called the "Recipient" which term denotes to "for and on behalf of Project Management Unit, Saaf Suthro Sindh (SSS) or Agriculture for Nutrition (A4N), Government of Sindh" on the other part and shall mean and include his successors –in office, nominees and assignees etc.

2. Whereas, the details of the Location of the, land are given below:

Location Details

Land record No	Location /Village
Tehsil/UC	District
Title Holder/ Details	
Name and Father/ Husband's Name CNIC No,	Status: Title Holder
Age: occupation: Residence:	Gender:
Schedule –Land Details/structure	

Land in Question

Area	Location
North Boundary	East Boundary
West Boundary	South Boundary

Note: Detailed Map to the scale is appended.

3. Whereas the Title Holder is presently using/ holds the transferable right of the above mentioned piece of land in the village mentioned above. Whereas the encroacher does not hold any transferable rights of the above mentioned piece of land in the village mentioned above but has been a long standing encroacher, dependent on its usufruct hereditarily.

4. Whereas the Title Holder testifies that the land is free of Tenants, squatters or encroachers, not subject to other claims/ claimants and does not obstruct access to other people's land or livelihoods.

5. Whereas the Title Holder hereby voluntarily surrenders the land/structure without any type of pressure, influence, coercion or payment what so ever directly or indirectly and hereby surrender all his/her subsisting rights in the said land with free will and intention. He/she will transfer the property to the CSO/Project office its ownership and use.

6. Whereas the Recipient shall construct and develop infrastructure facilities under the project SERRS and take all possible precautions to avoid damage to adjacent land/structure/other assets.

7. Whereas both the parties agree that the infrastructure so constructed/developed shall be for public purpose.

8. The land donated does not constitute more than 10% of the entire landholding of the donor/donors.

Signatories

Title holder		Tehsildar	
Name		Name	
NIC No.		Official Seal	
		Transfer registration No.	
Witnesses			
1. UC Nazim	Name		Signature
	CNIC		
2. Village Numberdar	Name		Signature
	CNIC		
3. Directorate Representative	Name		Signature
Director / D. Director	CNIC		

Annex M: World Bank Group's Environment, Health, and Safety Guidelines

Environmental, Health, and Safety General Guidelines

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These **General EHS Guidelines** are designed to be used together with the relevant **Industry Sector EHS Guidelines** which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment[2] in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

The **General EHS Guidelines** are organized as follows:

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] For IFC, such assessment is carried out consistent with Performance Standard 1, and for the World Bank, with Operational Policy 4.01.

General Approach to the Management of EHS Issues at the Facility or Project Level

Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate- and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- Identifying EHS project hazards[3] and associated risks[4] as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.
- Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations presented in this document that are relevant to the project.
- Understanding the likelihood and magnitude of EHS risks, based on:
    - The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
    - The potential consequences to workers, communities, or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources on which they depend.
- Prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.
- Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.
- Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

[3] Defined as "threats to humans and what they value" (Kates, et al., 1985).

[4] Defined as "quantitative measures of hazard consequences, usually expressed as conditional probabilities of experiencing harm" (Kates, et. al., 1985)

1.0 Environmental

1.1 Air Emissions and Ambient Air Quality

Applicability and Approach

This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on the spatial characteristic of the source including point sources, fugitive sources, and mobile sources and, further, by process, such as combustion, materials storage, or other industry sector-specific processes.

Where possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of:

- Energy use efficiency
- Process modification
- Selection of fuels or other materials, the processing of which may result in less polluting emissions
- Application of emissions control techniques

The selected prevention and control techniques may include one or more methods of treatment depending on:

- Regulatory requirements
- Significance of the source
- Location of the emitting facility relative to other sources
- Location of sensitive receptors
- Existing ambient air quality, and potential for degradation of the airshed from a proposed project
- Technical feasibility and cost effectiveness of the available options for prevention, control, and release of emissions

Ambient Air Quality

General Approach

Projects with significant[5,6] sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[9] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[10] (see Table 1.1.1), or other internationally recognized sources[11];
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.[12]

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby[13] structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]

	Averaging Period	Guideline value in μg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

5 Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute a net emissions increase of one or more of the following pollutants within a given airshed: PM10: 50 tons per year (tpy); NOx: 500 tpy; SO2: 500 tpy; or as established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.

6 United States Environmental Protection Agency, Prevention of Significant Deterioration of Air Quality, 40 CFR Ch. 1 Part 52.21. Other references for establishing significant emissions include the European Commission. 2000. "Guidance Document for EPER implementation." http://ec.europa.eu/environment/ippc/eper/index.htm ; and Australian Government. 2004. "National Pollutant Inventory Guide." http://www.npi.gov.au/handbooks/pubs/npiguide.pdf

7 World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

8 Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

9 Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

10 Available at World Health Organization (WHO). http://www.who.int/en

11 For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

12 US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

included in Annex 1.1.1. These approaches include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD OR ADMS). Model selection is dependent on the complexity and geo-morphology of the project site (e.g. mountainous terrain, urban or rural area).

Projects Located in Degraded Airsheds or Ecologically Sensitive Areas

Facilities or projects located within poor quality airsheds[14], and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed.

Specific provisions for minimizing emissions and their impacts in poor air quality or ecologically sensitive airsheds should be established on a project-by-project or industry-specific basis. Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.

Point Sources

Point sources are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere. They are typically located in manufacturing or production plants. Within a given point source, there may be several individual 'emission points' that comprise the point source.[15]

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls, examples of which are provided in Annex 1.1.2. Additional recommendations regarding stack height and emissions from small combustion facilities are provided below.

Stack Height

The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP (see Annex 1.1.3) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For projects where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions,

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13 "Nearby" generally considers an area within a radius of up to 20 times the stack height.

14 An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.

15 Emission points refer to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

including small combustion sources,[16] should also use GIIP in stack design.

Small Combustion Facilities Emissions Guidelines

Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWth) and 50 MWth.

The emissions guidelines in Table 1.1.2 are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilization of more than 30 percent. Plants firing a mixture of fuels should compare emissions performance with these guidelines based on the sum of the relative contribution of each applied fuel[17]. Lower emission values may apply if the proposed facility is located in an ecologically sensitive airshed, or airshed with poor air quality, in order to address potential cumulative impacts from the installation of more than one small combustion plant as part of a distributed generation project.

[16] Small combustion sources are those with a total rated heat input capacity of 50MWth or less.

[17] The contribution of a fuel is the percentage of heat input (LHV) provided by this fuel multiplied by its limit value.

Table 1.1.2 - Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth) – (in mg/Nm³ or as indicated)

Combustion Technology / Fuel	Particulate Matter (PM)	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NOx)	Dry Gas, Excess O_2 Content (%)
Engine				
Gas	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15
Liquid	50 or up to 100 if justified by project specific considerations (e.g. Economic feasibility of using lower ash content fuel, or adding secondary treatment to meet 50, and available environmental capacity of the site)	1.5 percent Sulfur or up to 3.0 percent Sulfur if justified by project specific considerations (e.g. Economic feasibility of using lower S content fuel, or adding secondary treatment to meet levels of using 1.5 percent Sulfur, and available environmental capacity of the site)	If bore size diameter [mm] < 400: 1460 (or up to 1,600 if justified to maintain high energy efficiency.) If bore size diameter [mm] > or = 400: 1,850	15
Turbine				
Natural Gas =3MWth to < 15MWth	N/A	N/A	42 ppm (Electric generation) 100 ppm (Mechanical drive)	15
Natural Gas =15MWth to < 50MWth	N/A	N/A	25 ppm	15
Fuels other than Natural Gas =3MWth to < 15MWth	N/A	0.5 percent Sulfur or lower percent Sulfur (e.g. 0.2 percent Sulfur) if commercially available without significant excess fuel cost	96 ppm (Electric generation) 150 ppm (Mechanical drive)	15
Fuels other than Natural Gas =15MWth to < 50MWth	N/A	0.5% S or lower % S (0.2%S) if commercially available without significant excess fuel cost	74 ppm	15
Boiler				
Gas	N/A	N/A	320	3
Liquid	50 or up to 150 if justified by environmental assessment	2000	460	3
Solid	50 or up to 150 if justified by environmental assessment	2000	650	6

Notes: -N/A/ - no emissions guideline; Higher performance levels than these in the Table should be applicable to facilities located in urban / industrial areas with degraded airsheds or close to ecologically sensitive areas where more stringent emissions controls may be needed.; MWth is heat input on HHV basis; Solid fuels include biomass; Nm^3 is at one atmosphere pressure, 0°C.; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack except for NOx and PM limits for turbines and boilers. Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.

Fugitive Sources

Fugitive source air emissions refer to emissions that are distributed spatially over a wide area and not confined to a specific discharge point. They originate in operations where exhausts are not captured and passed through a stack. Fugitive emissions have the potential for much greater ground-level impacts per unit than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and particulate matter (PM). Other contaminants (NO_x, SO_2 and CO) are mainly associated with combustion processes, as described above. Projects with potentially significant fugitive sources of emissions should establish the need for ambient quality assessment and monitoring practices.

Open burning of solid wastes, whether hazardous or non-hazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.

Volatile Organic Compounds (VOCs)

The most common sources of fugitive VOC emissions are associated with industrial activities that produce, store, and use VOC-containing liquids or gases where the material is under pressure, exposed to a lower vapor pressure, or displaced from an enclosed space. Typical sources include equipment leaks, open vats and mixing tanks, storage tanks, unit operations in wastewater treatment systems, and accidental releases. Equipment leaks include valves, fittings, and elbows which are subject to leaks under pressure. The recommended prevention and control techniques for VOC emissions associated with equipment leaks include:

- Equipment modifications, examples of which are presented in Annex 1.1.4;
- Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period.[18]

For VOC emissions associated with handling of chemicals in open vats and mixing processes, the recommended prevention and control techniques include:

- Substitution of less volatile substances, such as aqueous solvents;
- Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption;
- Collection of vapors through air extractors and subsequent treatment with destructive control devices such as:
  - Catalytic Incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations
  - Thermal Incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700º C to 1,300º C
  - Enclosed Oxidizing Flares: Used to convert VOCs into CO_2 and H_2O by way of direct combustion
- Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.

Particulate Matter (PM)

The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads.

[18] For more information, see Leak Detection and Repair Program (LDAR), at: http://www.ldar.net

Recommended prevention and control of these emissions sources include:

- Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins;
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. Examples of additional control options for unpaved roads include those summarized in Annex 1.1.5.

Ozone Depleting Substances (ODS)

Several chemicals are classified as ozone depleting substances (ODSs) and are scheduled for phase-out under the Montreal Protocol on Substances that Deplete the Ozone Layer.[19] No new systems or processes should be installed using CFCs, halons, 1,1,1-trichloroethane, carbon tetrachloride, methyl bromide or HBFCs. HCFCs should only be considered as interim / bridging alternatives as determined by the host country commitments and regulations.[20]

Mobile Sources – Land-based

Similar to other combustion processes, emissions from vehicles include CO, NO_x, SO_2, PM and VOCs. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following approach should be considered:

- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles[21] (cars and light trucks) within an airshed should consider additional ways to reduce potential impacts including:
  - Replacing older vehicles with newer, more fuel efficient alternatives
  - Converting high-use vehicles to cleaner fuels, where feasible
  - Installing and maintaining emissions control devices, such as catalytic converters
  - Implementing a regular vehicle maintenance and repair program

Greenhouse Gases (GHGs)

Sectors that may have potentially significant emissions of greenhouse gases (GHGs)[22] include energy, transport, heavy industry (e.g. cement production, iron / steel manufacturing, aluminum smelting, petrochemical industries, petroleum refining, fertilizer manufacturing), agriculture, forestry and waste management. GHGs may be generated from direct emissions

[19] Examples include: chlorofluorocarbons (CFCs); halons; 1,1,1-trichloroethane (methyl chloroform); carbon tetrachloride; hydrochlorofluorocarbons (HCFCs); hydrobromofluorocarbons (HBFCs); and methyl bromide. They are currently used in a variety of applications including: domestic, commercial, and process refrigeration (CFCs and HCFCs); domestic, commercial, and motor vehicle air conditioning (CFCs and HCFCs); for manufacturing foam products (CFCs); for solvent cleaning applications (CFCs, HCFCs, methyl chloroform, and carbon tetrachloride); as aerosol propellants (CFCs); in fire protection systems (halons and HBFCs); and as crop fumigants (methyl bromide).

[20] Additional information is available through the Montreal Protocol Secretariat web site available at: http://ozone.unep.org/

[21] The selected fleet size thresholds are assumed to represent potentially significant sources of emissions based on individual vehicles traveling 100,000 km / yr using average emission factors.

[22] The six greenhouse gases that form part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change include carbon dioxide ($C0_2$); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

from facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project.

Recommendations for reduction and control of greenhouse gases include:

- Carbon financing;[23]
- Enhancement of energy efficiency (see section on 'Energy Conservation');
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forms of agriculture and forestry;
- Promotion, development and increased use of renewable forms of energy;
- Carbon capture and storage technologies;[24]
- Limitation and / or reduction of methane emissions through recovery and use in waste management, as well as in the production, transport and distribution of energy (coal, oil, and gas).

Monitoring

Emissions and air quality monitoring programs provide information that can be used to assess the effectiveness of emissions management strategies. A systematic planning process is recommended to ensure that the data collected are adequate for their intended purposes (and to avoid collecting unnecessary data). This process, sometimes referred to as a data quality objectives process, defines the purpose of collecting the data, the decisions to be made based on the data and the consequences of making an incorrect decision, the time and geographic boundaries, and the quality of data needed to make a correct decision.[25] The air quality monitoring program should consider the following elements:

- *Monitoring parameters*: The monitoring parameters selected should reflect the pollutants of concern associated with project processes. For combustion processes, indicator parameters typically include the quality of inputs, such as the sulfur content of fuel.
- *Baseline calculations*: Before a project is developed, baseline air quality monitoring at and in the vicinity of the site should be undertaken to assess background levels of key pollutants, in order to differentiate between existing ambient conditions and project-related impacts.
- *Monitoring type and frequency*: Data on emissions and ambient air quality generated through the monitoring program should be representative of the emissions discharged by the project over time. Examples of time-dependent variations in the manufacturing process include batch process manufacturing and seasonal process variations. Emissions from highly variable processes may need to be sampled more frequently or through composite methods. Emissions monitoring frequency and duration may also range from continuous for some combustion process operating parameters or inputs (e.g. the quality of fuel) to less frequent, monthly, quarterly or yearly stack tests.
- *Monitoring locations*: Ambient air quality monitoring may consists of off-site or fence line monitoring either by the project sponsor, the competent government agency, or by collaboration between both. The location of ambient air

[23] Carbon financing as a carbon emissions reduction strategy may include the host government-endorsed Clean Development Mechanism or Joint Implementation of the United Nations Framework Convention on Climate Change.

[24] Carbon dioxide capture and storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources; transport to a storage location; and long-term isolation from the atmosphere, for example in geological formations, in the ocean, or in mineral carbonates (reaction of CO_2 with metal oxides in silicate minerals to produce stable carbonates). It is the object of intensive research worldwide (Intergovernmental Panel on Climate Change (IPCC), Special Report, Carbon Dioxide Capture and Storage (2006).

[25] See, for example, United States Environmental Protection Agency, Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, EPA/240/B-06/001 February 2006.

quality monitoring stations should be established based on the results of scientific methods and mathematical models to estimate potential impact to the receiving airshed from an emissions source taking into consideration such aspects as the location of potentially affected communities and prevailing wind directions.

- *Sampling and analysis methods*: Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization,[26] the European Committee for Standardization,[27] or the U.S. Environmental Protection Agency.[28] Sampling should be conducted by, or under, the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.

Monitoring of Small Combustion Plants Emissions

- Additional recommended monitoring approaches for **boilers**:

  Boilers with capacities between =3 MWth and < 20 MWth:

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification if no SO_2 control equipment is used.
  - If Annual Stack Emission Testing demonstrates results consistently and significantly better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: None

  Boilers with capacities between =20 MWth and < 50 MWth

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification (if no SO_2 control equipment is used)
  - Emission Monitoring: SO_2. Plants with SO_2 control equipment: Continuous. NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. PM: Continuous monitoring of either PM emissions, opacity, or indicative PM emissions using combustion parameters / visual monitoring.

- Additional recommended monitoring approaches for **turbines**:
  - Annual Stack Emission Testing: NO_x and SO_2 (NO_x only for gaseous fuel-fired turbines).
  - If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters.SO_2: Continuous monitoring if SO_2 control equipment is used.

- Additional recommended monitoring approaches for **engines**:
  - Annual Stack Emission Testing: NO_x ,SO_2 and PM (NO_x only for gaseous fuel-fired diesel engines).

[26] An on-line catalogue of ISO standards relating to the environment, health protection, and safety is available at: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=&ICS3=&scopelist=

[27] An on-line catalogue of European Standards is available at: http://www.cen.eu/catweb/cwen.htm .

[28] The National Environmental Methods Index provides a searchable clearinghouse of U.S. methods and procedures for both regulatory and non-regulatory monitoring purposes for water, sediment, air and tissues, and is available at http://www.nemi.gov/.

- If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. SO_2: Continuous monitoring if SO_2 control equipment is used. PM: Continuous monitoring of either PM emissions or indicative PM emissions using operating parameters.

Annex 1.1.1 – Air Emissions Estimation and Dispersion Modeling Methods

The following is a partial list of documents to aid in the estimation of air emissions from various processes and air dispersion models:

Australian Emission Estimation Technique Manuals
http://www.npi.gov.au/handbooks/

Atmospheric Emission Inventory Guidebook, UN / ECE / EMEP and the European Environment Agency
http://www.aeat.co.uk/netcen/airqual/TFEI/unece.htm

Emission factors and emission estimation methods, US EPA Office of Air Quality Planning & Standards
http://www.epa.gov/ttn/chief

Guidelines on Air Quality Models (Revised), US Environmental Protection Agency (EPA), 2005
http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

Frequently Asked Questions, Air Quality Modeling and Assessment Unit (AQMAU), UK Environment Agency
http://www.environment-agency.gov.uk/subjects/airquality/236092/?version=1&lang=_e

OECD Database on Use and Release of Industrial Chemicals
http://www.olis.oecd.org/ehs/urchem.nsf/

Annex 1.1.2 – Illustrative Point Source Air Emissions Prevention and Control Technologies

Principal Sources and Issues	General Prevention / Process Modification Approach	Control Options	Reduction Efficiency (%)	Gas Condition	Comments
Particulate Matter (PM)					
Main sources are the combustion of fossil fuels and numerous manufacturing processes that collect PM through air extraction and ventilation systems. Volcanoes, ocean spray, forest fires and blowing dust (most prevalent in dry and semiarid climates) contribute to background levels.	Fuel switching (e.g. selection of lower sulfur fuels) or reducing the amount of fine particulates added to a process.	Fabric Filters	99 - 99.7%	Dry gas, temp <400F	Applicability depends on flue gas properties including temperature, chemical properties, abrasion and load. Typical air to cloth ratio range of 2.0 to 3.5 cfm/ft^2 Achievable outlet concentrations of 23 mg/Nm^3
		Electrostatic Precipitator (ESP)	97 – 99%	Varies depending of particle type	Precondition gas to remove large particles. Efficiency dependent on resistivity of particle. Achievable outlet concentration of 23 mg/Nm^3
		Cyclone	74 – 95%	None	Most efficient for large particles. Achievable outlet concentrations of 30 - 40 mg/Nm^3
		Wet Scrubber	93 – 95%	None	Wet sludge may be a disposal problem depending on local infrastructure. Achievable outlet concentrations of 30 - 40 mg/Nm3
Sulfur Dioxide (SO_2)					
Mainly produced by the combustion of fuels such as oil and coal and as a by-product from some chemical production or wastewater treatment processes.	Control system selection is heavily dependent on the inlet concentration. For SO2 concentrations in excess of 10%, the stream is passed through an acid plant not only to lower the SO2 emissions but also to generate high grade sulfur for sale. Levels below 10% are not rich enough for this process and should therefore utilize absorption or 'scrubbing,' where SO2 molecules are captured into a liquid phase or adsorption, where SO2 molecules are captured on the surface of a solid adsorbent.	Fuel Switching	>90%		Alternate fuels may include low sulfur coal, light diesel or natural gas with consequent reduction in particulate emissions related to sulfur in the fuel. Fuel cleaning or beneficiation of fuels prior to combustion is another viable option but may have economic consequences.
		Sorbent Injection	30% - 70%		Calcium or lime is injected into the flue gas and the SO_2 is adsorbed onto the sorbent
		Dry Flue Gas Desulfurization	70%-90%		Can be regenerable or throwaway.
		Wet Flue Gas Desulfurization	>90%		Produces gypsum as a by-product

Annex 1.1.2: Illustrative Point Source Air Emissions Prevention and Control Technologies (continued)

Oxides of Nitrogen (NOx)		Percent Reduction by Fuel Type			Comments
Associated with combustion of fuel. May occur in several forms of nitrogen oxide; namely nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O), which is also a greenhouse gas. The term NOx serves as a composite between NO and NO_2 and emissions are usually reported as NOx. Here the NO is multiplied by the ratio of molecular weights of NO_2 to NO and added to the NO_2 emissions. Means of reducing NOx emissions are based on the modification of operating conditions such as minimizing the resident time at peak temperatures, reducing the peak temperatures by increasing heat transfer rates or minimizing the availability of oxygen.	**Combustion modification** (Illustrative of boilers)	**Coal**	**Oil**	**Gas**	These modifications are capable of reducing NOx emissions by 50 to 95%. The method of combustion control used depends on the type of boiler and the method of firing fuel.
	Low-excess-air firing	10–30	10–30	10–30	
	Staged Combustion	20–50	20–50	20–50	
	Flue Gas Recirculation	N/A	20–50	20–50	
	Water/Steam Injection	N/A	10–50	N/A.	
	Low-NOx Burners	30–40	30–40	30–40	
	Flue Gas Treatment	**Coal**	**Oil**	**Gas**	Flue gas treatment is more effective in reducing NOx emissions than are combustion controls. Techniques can be classified as SCR, SNCR, and adsorption. SCR involves the injection of ammonia as a reducing agent to convert NOx to nitrogen in the presence of a catalyst in a converter upstream of the air heater. Generally, some ammonia slips through and is part of the emissions. SNCR also involves the injection of ammonia or urea based products without the presence of a catalyst.
	Selective Catalytic Reduction (SCR)	60–90	60–90	60–90	
	Selective Non-Catalytic Reduction (SNCR)	N/A	30–70	30–70	

Note: Compiled by IFC based on inputs from technical experts.

Annex 1.1.3 - Good International Industry Practice (GIIP) Stack Height

(Based on United States 40 CFR, part 51.100 (ii)).

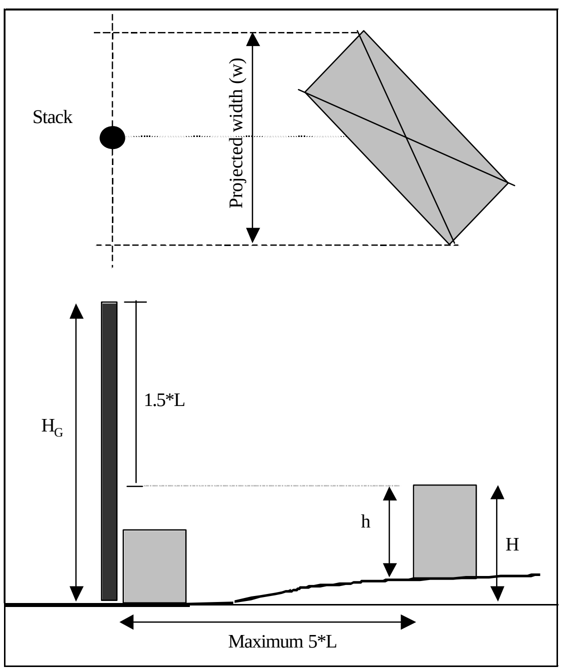
$H_G = H + 1.5L$; where

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures

"Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.



Annex 1.1.4 - Examples of VOC Emissions Controls

Equipment Type	Modification	Approximate Control Efficiency (%)
Pumps	Seal-less design	100[29]
	Closed-vent system	90[30]
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid	100
Compressors	Closed-vent system	90
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the compressed gas	100
Pressure Relief Devices	Closed-vent system	Variable[31]
	Rupture disk assembly	100
Valves	Seal-less design	100
Connectors	Weld together	100
Open-ended Lines	Blind, cap, plug, or second valve	100
Sampling Connections	Closed-loop sampling	100
Note: Examples of technologies are provided for illustrative purposes. The availability and applicability of any particular technology will vary depending on manufacturer specifications.		

29 Seal-less equipment can be a large source of emissions in the event of equipment failure.
30 Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.
31 Control efficiency of closed vent-systems installed on a pressure relief device may be lower than other closed-vent systems.

Annex 1.1.5 - Fugitive PM Emissions Controls

Control Type	Control Efficiency
Chemical Stabilization	0% - 98%
Hygroscopic salts Bitumens/adhesives	60% - 96%
Surfactants	0% - 68%
Wet Suppression – Watering	12% - 98%
Speed Reduction	0% - 80%
Traffic Reduction	Not quantified
Paving (Asphalt / Concrete)	85% - 99%
Covering with Gravel, Slag, or "Road Carpet"	30% - 50%
Vacuum Sweeping	0% - 58%
Water Flushing/Broom Sweeping	0% - 96%

1.2 Energy Conservation

Applicability and Approach

This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors.

Energy management at the facility level should be viewed in the context of overall consumption patterns, including those associated with production processes and supporting utilities, as well as overall impacts associated with emissions from power sources. The following section provides guidance on energy management with a focus on common utility systems often representing technical and financially feasible opportunities for improvement in energy conservation. However, operations should also evaluate energy conservation opportunities arising from manufacturing process modifications.

Energy Management Programs

Energy management programs should include the following elements:

- Identification, and regular measurement and reporting of principal energy flows within a facility at unit process level
- Preparation of mass and energy balance;
- Definition and regular review of energy performance targets, which are adjusted to account for changes in major influencing factors on energy use
- Regular comparison and monitoring of energy flows with performance targets to identify where action should be taken to reduce energy use
- Regular review of targets, which may include comparison with benchmark data, to confirm that targets are set at appropriate levels

Energy Efficiency

For any energy-using system, a systematic analysis of energy efficiency improvements and cost reduction opportunities should include a hierarchical examination of opportunities to**:**

- Demand/Load Side Management by reducing loads on the energy system
- Supply Side Management by:
  - Reduce losses in energy distribution
  - Improve energy conversion efficiency
  - Exploit energy purchasing opportunities
  - Use lower-carbon fuels

Common opportunities in each of these areas are summarized below.[32]

Process Heating

Process heating is vital to many manufacturing processes, including heating for fluids, calcining, drying, heat treating, metal heating, melting, melting agglomeration, curing, and forming[33].

In process heating systems, a system heat and mass balance will show how much of the system's energy input provides true process heating, and quantify fuel used to satisfy energy losses caused by excessive parasitic loads, distribution, or conversion losses. Examination of savings opportunities should be directed by the results of the heat and mass balance, though the following techniques are often valuable and cost-effective.

Heating Load Reduction

- Ensure adequate insulation to reduce heat losses through furnace/oven etc. structure
- Recover heat from hot process or exhaust streams to reduce system loads
- In intermittently-heated systems, consider use of low thermal mass insulation to reduce energy required to heat the system structure to operating temperature
- Control process temperature and other parameters accurately to avoid, for example, overheating or overdrying
- Examine opportunities to use low weight and/or low thermal mass product carriers, such as heated shapers, kiln cars etc.
- Review opportunities to schedule work flow to limit the need for process reheating between stages
- Operate furnaces/ovens at slight positive pressure, and maintain air seals to reduce air in-leakage into the heated system, thereby reducing the energy required to heat unnecessary air to system operating temperature
- Reduce radiant heat losses by sealing structural openings and keep viewing ports closed when not in use
- Where possible, use the system for long runs close to or at operating capacity
- Consider use of high emissivity coatings of high temperature insulation, and consequent reduction in process temperature
- Near net weight and shape heat designs
- Robust Quality assurance on input material
- Robust Scheduled maintenance programs

Heat Distribution Systems

Heat distribution in process heating applications typically takes place through steam, hot water, or thermal fluid systems. Losses can be reduced through the following actions:

- Promptly repair distribution system leaks
- Avoid steam leaks despite a perceived need to get steam through the turbine. Electricity purchase is usually cheaper overall, especially when the cost to treat turbine-quality boiler feed water is included. If the heat-power ratio of the distribution process is less than that of power systems, opportunities should be considered to increase the ratio; for example, by using low-pressure steam to drive absorption cooling systems rather than using electrically-driven vapor-compression systems.
- Regularly verify correct operation of steam traps in steam systems, and ensure that traps are not bypassed. Since

[32] Additional guidance on energy efficiency is available from sources such as Natural Resources Canada (NRCAN http://oee.nrcan.gc.ca/commercial/financial-assistance/new-buildings/mnecb.cfm?attr=20); the European Union (EUROPA. http://europa.eu.int/scadplus/leg/en/s15004.htm), and United States Department of Energy (US DOE, http://www.eere.energy.gov/consumer/industry/process.html).

[33] US DOE. http://www.eere.energy.gov/consumer/industry/process.html

steam traps typically last approximately 5 years, 20% should be replaced or repaired annually

- Insulate distribution system vessels, such as hot wells and de-aerators, in steam systems and thermal fluid or hot water storage tanks
- Insulate all steam, condensate, hot water and thermal fluid distribution pipework, down to and including 1" (25 mm) diameter pipe, in addition to insulating all hot valves and flanges
- In steam systems, return condensate to the boiler house for re-use, since condensate is expensive boiler-quality water and valuable beyond its heat content alone
- Use flash steam recovery systems to reduce losses due to evaporation of high-pressure condensate
- Consider steam expansion through a back-pressure turbine rather than reducing valve stations
- Eliminate distribution system losses by adopting point-of-use heating systems

Energy Conversion System Efficiency Improvements

The following efficiency opportunities should be examined for process furnaces or ovens, and utility systems, such as boilers and fluid heaters:

- Regularly monitor CO, oxygen or CO2 content of flue gases to verify that combustion systems are using the minimum practical excess air volumes
- Consider combustion automation using oxygen-trim controls
- Minimize the number of boilers or heaters used to meet loads. It is typically more efficient to run one boiler at 90% of capacity than two at 45%. Minimize the number of boilers kept at hot–standby
- Use flue dampers to eliminate ventilation losses from hot boilers held at standby
- Maintain clean heat transfer surfaces; in steam boilers, flue gases should be no more than 20 K above steam temperature)
- In steam boiler systems, use economizers to recover heat from flue gases to pre-heat boiler feed water or combustion air
- Consider reverse osmosis or electrodialysis feed water treatment to minimize the requirement for boiler blowdown
- Adopt automatic (continuous) boiler blowdown
- Recover heat from blowdown systems through flash steam recovery or feed-water preheat
- Do not supply excessive quantities of steam to the de-aerator
- With fired heaters, consider opportunities to recover heat to combustion air through the use of recuperative or regenerative burner systems
- For systems operating for extended periods (> 6000 hours/year), cogeneration of electrical power, heat and /or cooling can be cost effective
- Oxy Fuel burners
- Oxygen enrichment/injection
- Use of turbolators in boilers
- Sizing design and use of multiple boilers for different load configurations
- Fuel quality control/fuel blending

Process Cooling

The general methodology outlined above should be applied to process cooling systems. Commonly used and cost-effective measures to improve process cooling efficiency are described below.

Load Reduction

- Ensure adequate insulation to reduce heat gains through cooling system structure and to below-ambient temperature refrigerant pipes and vessels
- Control process temperature accurately to avoid overcooling
- Operate cooling tunnels at slight positive pressure and maintain air seals to reduce air in-leakage into the cooled system, thus reducing the energy required to cool this unnecessary air to system operating temperature
- Examine opportunities to pre-cool using heat recovery to a process stream requiring heating, or by using a higher temperature cooling utility
- In cold and chill stores, minimize heat gains to the cooled space by use of air curtains, entrance vestibules, or rapidly opening/closing doors. Where conveyors carry products into chilled areas, minimize the area of transfer openings, for example, by using strip curtains
- Quantify and minimize "incidental" cooling loads, for example, those due to evaporator fans, other machinery, defrost systems and lighting in cooled spaces, circulation fans in cooling tunnels, or secondary refrigerant pumps (e.g. chilled water, brines, glycols)
- Do not use refrigeration for auxiliary cooling duties, such as compressor cylinder head or oil cooling
- While not a thermal load, ensure there is no gas bypass of the expansion valve since this imposes compressor load while providing little effective cooling
- In the case of air conditioning applications, energy efficiency techniques include:
    - o Placing air intakes and air-conditioning units in cool, shaded locations
    - o Improving building insulation including seals, vents, windows, and doors
    - o Planting trees as thermal shields around buildings
    - o Installing timers and/or thermostats and/or enthalpy-based control systems
    - o Installing ventilation heat recovery systems[34]

Energy Conversion

The efficiency of refrigeration service provision is normally discussed in terms of Coefficient of Performance ("COP"), which is the ratio of cooling duty divided by input power. COP is maximized by effective refrigeration system design and increased refrigerant compression efficiency, as well as minimization of the temperature difference through which the system works and of auxiliary loads (i.e. those in addition to compressor power demand) used to operate the refrigeration system.

System Design

- If process temperatures are above ambient for all, or part, of the year, use of ambient cooling systems, such as provided by cooling towers or dry air coolers, may be appropriate, perhaps supplemented by refrigeration in summer conditions.
- Most refrigeration systems are electric-motor driven vapor compression systems using positive displacement or centrifugal compressors. The remainder of this guideline relates primarily to vapor-compression systems. However, when a cheap or free heat source is available (e.g. waste heat from an engine-driven generator—low-pressure steam

[34] More information on HVAC energy efficiency can be found at the British Columbia Building Corporation (Woolliams, 2002. http://www.greenbuildingsbc.com/new_buildings/pdf_files/greenbuild_strategies_guide.pdf), NRCAN's EnerGuide (http://oee.nrcan.gc.ca/equipment/english/index.cfm?PrintView=N&Text=N) and NRCAN's Energy Star Programs (http://oee.nrcan.gc.ca/energystar/english/consumers/heating.cfm?text=N&printview=N#AC), and the US Energy Star Program (http://www.energystar.gov/index.cfm?c=guidelines.download_guidelines).

that has passed through a back-pressure turbine), absorption refrigeration may be appropriate.

- Exploit high cooling temperature range: precooling by ambient and/or 'high temperature' refrigeration before final cooling can reduce refrigeration capital and running costs. High cooling temperature range also provides an opportunity for countercurrent (cascade) cooling, which reduces refrigerant flow needs.
- Keep 'hot' and 'cold' fluids separate, for example, do not mix water leaving the chiller with water returning from cooling circuits.
- In low-temperature systems where high temperature differences are inevitable, consider two-stage or compound compression, or economized screw compressors, rather than single-stage compression.

Minimizing Temperature Differences

A vapor-compression refrigeration system raises the temperature of the refrigerant from somewhat below the lowest process temperature (the evaporating temperature) to provide process cooling, to a higher temperature (the condensing temperature), somewhat above ambient, to facilitate heat rejection to the air or cooling water systems. Increasing evaporating temperature typically increases compressor cooling capacity without greatly affecting power consumption. Reducing condensing temperature increases evaporator cooling capacity and substantially reduces compressor power consumption.

Elevating Evaporating Temperature

- Select a large evaporator to permit relatively low temperature differences between process and evaporating temperatures. Ensure that energy use of auxiliaries (e.g. evaporator fans) does not outweigh compression savings. In air-cooling applications, a design temperature difference of 6-10 K between leaving air temperature and evaporating temperature is indicative of an appropriately sized evaporator. When cooling liquids, 2K between leaving liquid and evaporating temperatures can be achieved, though a 4K difference is generally indicative of a generously-sized evaporator.
- Keep the evaporator clean. When cooling air, ensure correct defrost operation. In liquid cooling, monitor refrigerant/process temperature differences and compare with design expectations to be alert to heat exchanger contamination by scale or oil.
- Ensure oil is regularly removed from the evaporator, and that oil additions and removals balance.
- Avoid the use of back-pressure valves.
- Adjust expansion valves to minimize suction superheat consistent with avoidance of liquid carry-over to compressors.
- Ensure that an appropriate refrigerant charge volume is present.

Reducing Condensing Temperature

- Consider whether to use air-cooled or evaporation-based cooling (e.g. evaporative or water cooled condensers and cooling towers). Air-cooled evaporators usually have higher condensing temperatures, hence higher compressor energy use, and auxiliary power consumption, especially in low humidity climates. If a wet system is used, ensure adequate treatment to prevent growth of *legionella* bacteria.
- Whichever basic system is chosen, select a relatively large condenser to minimize differences between condensing and the heat sink temperatures. Condensing temperatures with air cooled or evaporative condensers should not be more than 10K above design ambient condition, and a 4K approach in a liquid-cooled condenser is possible.

- Avoid accumulation of non-condensable gases in the condenser system. Consider the installation of refrigerated non-condensable purgers, particularly for systems operating below atmospheric pressure.
- Keep condensers clean and free from scale. Monitor refrigerant/ambient temperature differences and compare with design expectations to be alert to heat exchanger contamination.
- Avoid liquid backup, which restricts heat transfer area in condensers. This can be caused by installation errors such as concentric reducers in horizontal liquid refrigerant pipes, or "up and over" liquid lines leading from condensers.
- In multiple condenser applications, refrigerant liquid lines should be connected via drop-leg traps to the main liquid refrigerant line to ensure that hot gases flow to all condensers.
- Avoid head pressure control to the extent possible. Head pressure control maintains condensing temperature at, or near, design levels. It therefore prevents reduction in compressor power consumption, which accompanies reduced condensing temperature, by restricting condenser capacity (usually by switching off the condenser, or cooling tower fans, or restricting cooling water flow) under conditions of less severe than design load or ambient temperature conditions. Head pressure is often kept higher than necessary to facilitate hot gas defrost or adequate liquid refrigerant circulation. Use of electronic rather than thermostatic expansion valves, and liquid refrigerant pumps can permit effective refrigerant circulation at much reduced condensing temperatures.
- Site condensers and cooling towers with adequate spacing so as to prevent recirculation of hot air into the tower.

Refrigerant Compression Efficiency

- Some refrigerant compressors and chillers are more efficient than others offered for the same duty. Before purchase, identify the operating conditions under which the compressor or chiller is likely to operate for substantial parts of its annual cycle. Check operating efficiency under these conditions, and ask for estimates of annual running cost. Note that refrigeration and HVAC systems rarely run for extended periods at design conditions, which are deliberately extreme. Operational efficiency under the most commonly occurring off-design conditions is likely to be most important.
- Compressors lose efficiency when unloaded. Avoid operation of multiple compressors at part-load conditions. Note that package chillers can gain coefficient of performance (COP) when slightly unloaded, as loss of compressor efficiency can be outweighed by the benefits of reduced condensing and elevated evaporating temperature. However, it is unlikely to be energy efficient to operate a single compressor-chiller at less than 50% of capacity.
- Consider turndown efficiency when specifying chillers. Variable speed control or multiple compressor chillers can be highly efficient at part loads.
- Use of thermal storage systems (e.g., ice storage) can avoid the need for close load-tracking and, hence, can avoid part-loaded compressor operation.

Refrigeration System Auxiliaries

Many refrigeration system auxiliaries (e.g. evaporator fans and chilled water pumps) contribute to refrigeration system load, so reductions in their energy use have a double benefit. General energy saving techniques for pumps and fans, listed in the next section of these guidelines, should be applied to refrigeration auxiliaries.

Additionally, auxiliary use can be reduced by avoidance of part-load operation and in plant selection (e.g. axial fan evaporative condensers generally use less energy than equivalent centrifugal fan towers).

Under extreme off-design conditions, reduction in duty of cooling system fans and pumps can be worthwhile, usually when the lowest possible condensing pressure has been achieved.

Compressed Air Systems

Compressed air is the most commonly found utility service in industry, yet in many compressed air systems, the energy contained in compressed air delivered to the user is often 10% or less of energy used in air compression. Savings are often possible through the following techniques:

Load reduction

- Examine each true user of compressed air to identify the air volume needed and the pressure at which this should be delivered.
- Do not mix high volume low pressure and low volume high pressure loads. Decentralize low volume high-pressure applications or provide dedicated low-pressure utilities, for example, by using fans rather than compressed air.
- Review air use reduction opportunities, for example:
    - Use air amplifier nozzles rather than simple open-pipe compressed air jets
    - Consider whether compressed air is needed at all
    - Where air jets are required intermittently (e.g. to propel product), consider operating the jet via a process-related solenoid valve, which opens only when air is required
    - Use manual or automatically operated valves to isolate air supply to individual machines or zones that are not in continuous use
    - Implement systems for systematic identification and repair of leaks
    - All condensate drain points should be trapped. Do not leave drain valves continuously 'cracked open'
    - Train workers never to direct compressed air against their bodies or clothing to dust or cool themselves down.

Distribution

- Monitor pressure losses in filters and replace as appropriate
- Use adequately sized distribution pipework designed to minimize pressure losses

1.3 Wastewater and Ambient Water Quality

Applicability and Approach

This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, stormwater, and sanitary sewage. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. This guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or stormwater should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

In the context of their overall ESHS management system, facilities should:

- Understand the quality, quantity, frequency and sources of liquid effluents in its installations. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points
- Plan and implement the segregation of liquid effluents principally along industrial, utility, sanitary, and stormwater categories, in order to limit the volume of water requiring specialized treatment. Characteristics of individual streams may also be used for source segregation.
- Identify opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within their facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes).
- Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

- Water use efficiency to reduce the amount of wastewater generation
- Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment
- If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land)

When wastewater treatment is required prior to discharge, the level of treatment should be based on:

- Whether wastewater is being discharged to a sanitary sewer system, or to surface waters
- National and local standards as reflected in permit requirements and sewer system capacity to convey and treat wastewater if discharge is to sanitary sewer
- Assimilative capacity of the receiving water for the load of contaminant being discharged wastewater if discharge is to surface water
- Intended use of the receiving water body (e.g. as a source of drinking water, recreation, irrigation, navigation, or other)
- Presence of sensitive receptors (e.g., endangered species) or habitats
- Good International Industry Practice (GIIP) for the relevant industry sector

General Liquid Effluent Quality

Discharge to Surface Water

Discharges of process wastewater, sanitary wastewater, wastewater from utility operations or stormwater to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality.[35] Receiving water use[36] and assimilative capacity[37], taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines. Projects for which there are no industry-specific guidelines should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1 below;
- Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

Discharge to Sanitary Sewer Systems

Discharges of industrial wastewater, sanitary wastewater, wastewater from utility operations or stormwater into public or private wastewater treatment systems should:

- Meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges.
- Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact

35 An example is the US EPA National Recommended Water Quality Criteria http://www.epa.gov/waterscience/criteria/wqcriteria.html

36 Examples of receiving water uses as may be designated by local authorities include: drinking water (with some level of treatment), recreation, aquaculture, irrigation, general aquatic life, ornamental, and navigation. Examples of health-based guideline values for receiving waters include World Health Organization (WHO) guidelines for recreational use (http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html)

37 The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

characteristics of residuals from wastewater treatment operations.

- Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pretreatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.

Land Application of Treated Effluent

The quality of treated process wastewater, wastewater from utility operations or stormwater discharged on land, including wetlands, should be established based on local regulatory requirements. . Where land is used as part of the treatment system and the ultimate receptor is surface water, water quality guidelines for surface water discharges specific to the industry sector process should apply.[38] Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as part of any wastewater treatment system.

Septic Systems

Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks, Septic systems should only be used for treatment of sanitary sewage, and unsuitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be:

- Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater.
- Well maintained to allow effective operation.
- Installed in areas with sufficient soil percolation for the design wastewater loading rate.
- Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.

Wastewater Management

Wastewater management includes water conservation, wastewater treatment, stormwater management, and wastewater and water quality monitoring.

Industrial Wastewater

Industrial wastewater generated from industrial operations includes process wastewater, wastewater from utility operations,, runoff from process and materials staging areas, and miscellaneous activities including wastewater from laboratories, equipment maintenance shops, etc.. The pollutants in an industrial wastewater may include acids or bases (exhibited as low or high pH), soluble organic chemicals causing depletion of dissolved oxygen, suspended solids, nutrients (phosphorus, nitrogen), heavy metals (e.g. cadmium, chromium, copper, lead, mercury, nickel, zinc), cyanide, toxic organic chemicals, oily materials, and volatile materials. , as well as from thermal characteristics of the discharge (e.g., elevated temperature). Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls.

Process Wastewater – – Examples of treatment approaches typically used in the treatment of industrial wastewater are summarized in Annex 1.3.1. While the choice of treatment

[38] Additional guidance on water quality considerations for land application is available in the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 2: Wastewater Use in Agriculture http://www.who.int/water_sanitation_health/wastewater/gsuweg2/en/index.html

technology is driven by wastewater characteristics, the actual performance of this technology depends largely on the adequacy of its design, equipment selection, as well as operation and maintenance of its installed facilities. Adequate resources are required for proper operation and maintenance of a treatment facility, and performance is strongly dependent on the technical ability and training of its operational staff. One or more treatment technologies may be used to achieve the desired discharge quality and to maintain consistent compliance with regulatory requirements. The design and operation of the selected wastewater treatment technologies should avoid uncontrolled air emissions of volatile chemicals from wastewaters. Residuals from industrial wastewater treatment operations should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Wastewater from Utilities Operations - Utility operations such as cooling towers and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system anti-fouling agents, etc. Recommended water management strategies for utility operations include:

- Adoption of water conservation opportunities for facility cooling systems as provided in the Water Conservation section below;
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations;
- Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local regulatory requirements and manufacturer recommendations;
- Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.

Stormwater Management - Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources. Typically stormwater runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for stormwater treatment, the following principles should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge
- Surface runoff from process areas or potential sources of contamination should be prevented
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should

be reduced (e.g. by using vegetated swales and retention ponds);

- Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;
- When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;
- Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
- Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Sanitary Wastewater

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening etc. may also be discharged to the sanitary wastewater treatment system. Recommended sanitary wastewater management strategies include:

- Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);
- Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems;
- If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1;
- If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required.
- Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]

Notes:
[a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[b] MPN = Most Probable Number

Emissions from Wastewater Treatment Operations

Air emissions from wastewater treatment operations may include hydrogen sulfide, methane, ozone (in the case of ozone disinfection), volatile organic compounds (e.g., chloroform generated from chlorination activities and other volatile organic compounds (VOCs) from industrial wastewater), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bioaerosols. Odors from treatment facilities can also be a nuisance to workers and the surrounding community. Recommendations for the management of emissions are presented in the Air Emissions and Ambient Air Quality section of this document and in the EHS Guidelines for Water and Sanitation.

Residuals from Wastewater Treatment Operations

Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of this document.

Occupational Health and Safety Issues in Wastewater Treatment Operations

Wastewater treatment facility operators may be exposed to physical, chemical, and biological hazards depending on the design of the facilities and the types of wastewater effluents managed. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bioaerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia. Detailed recommendations for the management of occupational health and safety issues are presented in the relevant section of this document. Additional guidance specifically applicable to wastewater treatment systems is provided in the EHS Guidelines for Water and Sanitation.

Monitoring

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

- *Monitoring parameters*: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;
- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent

variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).

- *Monitoring locations*: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.

- *Data quality*: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Annex 1.3.1 - Examples of Industrial Wastewater Treatment Approaches

Pollutant/Parameter	Control Options / Principle	Common End of Pipe Control Technology
pH	Chemical, Equalization	Acid/Base addition, Flow equalization
Oil and Grease / TPH	Phase separation	Dissolved Air Floatation, oil water separator, grease trap
TSS - Settleable	Settling, Size Exclusion	Sedimentation basin, clarifier, centrifuge, screens
TSS - Non-Settleable	Floatation, Filtration - traditional and tangential	Dissolved air floatation, Multimedia filter, sand filter, fabric filter, ultrafiltration, microfiltration
Hi - BOD (> 2 Kg/m³)	Biological - Anaerobic	Suspended growth, attached growth, hybrid
Lo - BOD (< 2 Kg/m³)	Biological - Aerobic, Facultative	Suspended growth, attached growth, hybrid
COD - Non-Biodegradable	Oxidation, Adsorption, Size Exclusion	Chemical oxidation, Thermal oxidation, Activated Carbon, Membranes
Metals - Particulate and Soluble	Coagulation, flocculation, precipitation, size exclusion	Flash mix with settling, filtration - traditional and tangential
Inorganics / Non-metals	Coagulation, flocculation, precipitation, size exclusion, Oxidation, Adsorption	Flash mix with settling, filtration - traditional and tangential, Chemical oxidation, Thermal oxidation, Activated Carbon, Reverse Osmosis, Evaporation
Organics - VOCs and SVOCs	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological : Suspended growth, attached growth, hybrid; Chemical oxidation, Thermal oxidation, Activated Carbon
Emissions – Odors and VOCs	Capture – Active or Passive; Biological; Adsorption, Oxidation	Biological : Attached growth; Chemical oxidation, Thermal oxidation, Activated Carbon
Nutrients	Biological Nutrient Removal, Chemical, Physical, Adsorption	Aerobic/Anoxic biological treatment, chemical hydrolysis and air stripping, chlorination, ion exchange
Color	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological Aerobic, Chemical oxidation, Activated Carbon
Temperature	Evaporative Cooling	Surface Aerators, Flow Equalization
TDS	Concentration, Size Exclusion	Evaporation, crystallization, Reverse Osmosis
Active Ingredients/Emerging Contaminants	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Radionuclides	Adsorption,Size Exclusion, Concentration	Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Pathogens	Disinfection, Sterilization	Chlorine, Ozone, Peroxide, UV, Thermal
Toxicity	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Evaporation, crystallization, Reverse Osmosis

1.4 Water Conservation

Applicability and Approach

Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.

General recommendations include:

- Storm/Rainwater harvesting and use
- Zero discharge design/Use of treated waste water to be included in project design processes
- Use of localized recirculation systems in plant/facility/shops (as opposed to centralized recirculation system), with provision only for makeup water
- Use of dry process technologies e.g. dry quenching
- Process water system pressure management
- Project design to have measures for adequate water collection, spill control and leakage control system

Water Monitoring and Management

The essential elements of a water management program involve:

- Identification, regular measurement, and recording of principal flows within a facility;
- Definition and regular review of performance targets, which are adjusted to account for changes in major factors affecting water use (e.g. industrial production rate);
- Regular comparison of water flows with performance targets to identify where action should be taken to reduce water use.

Water measurement (metering) should emphasize areas of greatest water use. Based on review of metering data, 'unaccounted' use–indicating major leaks at industrial facilities–could be identified.

Process Water Reuse and Recycling

Opportunities for water savings in industrial processes are highly industry-specific. However, the following techniques have all been used successfully, and should be considered in conjunction with the development of the metering system described above.

- *Washing Machines:* Many washing machines use large quantities of hot water. Use can increase as nozzles become enlarged due to repeated cleaning and /or wear. Monitor machine water use, compare with specification, and replace nozzles when water and heat use reaches levels warranting such work.

- *Water reuse:* Common water reuse applications include countercurrent rinsing, for example in multi-stage washing and rinsing processes, or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing, or bottle-washer rinse water for bottle crate washing, or even washing the floor. More sophisticated reuse projects requiring treatment of water before reuse are also sometimes practical.

- *Water jets/sprays:* If processes use water jets or sprays (e.g. to keep conveyors clean or to cool product) review the accuracy of the spray pattern to prevent unnecessary water loss.
- *Flow control optimization:* Industrial processes sometimes require the use of tanks, which are refilled to control losses. It is often possible to reduce the rate of water supply to such tanks, and sometimes to reduce tank levels to reduce spillage. If the process uses water cooling sprays, it may be possible to reduce flow while maintaining cooling performance. Testing can determine the optimum balance.
    - If hoses are used in cleaning, use flow controls to restrict wasteful water flow
    - Consider the use of high pressure, low volume cleaning systems rather than using large volumes of water sprayed from hosepipes
    - Using flow timers and limit switches to control water use
    - Using ‘clean-up’ practices rather than hosing down

Building Facility Operations

Consumption of building and sanitary water is typically less than that used in industrial processes. However, savings can readily be identified, as outlined below:

- Compare daily water use per employee to existing benchmarks taking into consideration the primary use at the facility, whether sanitary or including other activities such as showering or catering
- Regularly maintain plumbing, and identify and repair leaks
- Shut off water to unused areas
- Install self-closing taps, automatic shut-off valves, spray nozzles, pressure reducing valves, and water conserving fixtures (e.g. low flow shower heads, faucets, toilets, urinals; and spring loaded or sensored faucets)
- Operate dishwashers and laundries on full loads, and only when needed
- Install water-saving equipment in lavatories, such as low-flow toilets

Cooling Systems

Water conservation opportunities in cooling systems include:

- Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems
- Limiting condenser or cooling tower blowdown to the minimum required to prevent unacceptable accumulation of dissolved solids
- Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system
- Use of treated waste water for cooling towers
- Reusing/recycling cooling tower blowdown

Heating Systems

Heating systems based on the circulation of low or medium pressure hot water (which do not consume water) should be closed. If they do consume water, regular maintenance should be conducted to check for leaks. However, large quantities of water may be used by steam systems, and this can be reduced by the following measures:

- Repair of steam and condensate leaks, and repair of all failed steam traps
- Return of condensate to the boilerhouse, and use of heat exchangers (with condensate return) rather than direct steam injection where process permits
- Flash steam recovery
- Minimizing boiler blowdown consistent with maintaining acceptably low dissolved solids in boiler water. Use of reverse osmosis boiler feed water treatment substantially reduces the need for boiler blowdown
- Minimizing deaerator heating

1.5 Hazardous Materials Management

Applicability and Approach

These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Guidance on the transport of hazardous materials is covered in Section 3 of this document.

When a hazardous material is no longer usable for its original purpose and is intended for disposal, but still has hazardous properties, it is considered a *hazardous waste* (see Section 1.4).

This guidance is intended to be applied in conjunction with traditional occupational health and safety and emergency preparedness programs which are included in Section 2.0 on Occupational Health and Safety Management, and Section 3.7 on Emergency Preparedness and Response. Guidance on the Transport of Hazardous Materials is provided in Section 3.5.

This section is divided into two main subsections:

General Hazardous Materials Management: Guidance applicable to all projects or facilities that handle or store any quantity of hazardous materials.

Management of Major Hazards: Additional guidance for projects or facilities that store or handle hazardous materials at, or above, threshold quantities[39], and thus require special treatment to prevent accidents such as fire, explosions, leaks or spills, and to prepare and respond to emergencies.

The overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. This objective can be achieved by:

[39] For examples, threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

- Establishing hazardous materials management priorities based on hazard analysis of risky operations identified through Social and Environmental Assessment;
- Where practicable, avoiding or minimizing the use of hazardous materials. For example, non-hazardous materials have been found to substitute asbestos in building materials, PCBs in electrical equipment, persistent organic pollutants (POPs) in pesticides formulations, and ozone depleting substances in refrigeration systems;
- Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion;
- Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard;
- Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.

General Hazardous Materials Management

Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities. Potentially applicable elements of a management program include the following:

Hazard Assessment

The level of risk should be established through an on-going assessment process based on:

- The types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information:
    - Name and description (e.g. composition of a mixture) of the Hazmat
    - Classification (e.g. code, class or division) of the Hazmat
    - Internationally accepted regulatory reporting threshold quantity or national equivalent[40] of the Hazmat
    - Quantity of Hazmat used per month
    - Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)
- Analysis of potential spill and release scenarios using available industry statistics on spills and accidents where available
- Analysis of the potential for uncontrolled reactions such as fire and explosions
- Analysis of potential consequences based on the physical-geographical characteristics of the project site, including aspects such as its distance to settlements, water resources, and other environmentally sensitive areas

Hazard assessment should be performed by specialized professionals using internationally-accepted methodologies such as Hazardous Operations Analysis (HAZOP), Failure Mode and Effects Analysis (FMEA), and Hazard Identification (HAZID).

Management Actions

The management actions to be included in a Hazardous Materials Management Plan should be commensurate with the level of

[40] Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

potential risks associated with the production, handling, storage, and use of hazardous materials.

Release Prevention and Control Planning

Where there is risk of a spill of uncontrolled hazardous materials, facilities should prepare a spill control, prevention, and countermeasure plan as a specific component of their Emergency Preparedness and Response Plan (described in more detail in Section 3.7). The plan should be tailored to the hazards associated with the project, and include:

- Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training
- Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment
- Preparation of written Standard Operating Procedures (SOPs) for filling USTs, ASTs or other containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response
- SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
- Identification of locations of hazardous materials and associated activities on an emergency plan site map
- Documentation of availability of specific personal protective equipment and training needed to respond to an emergency
- Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources
- Description of response activities in the event of a spill, release, or other chemical emergency including:
    - Internal and external notification procedures
    - Specific responsibilities of individuals or groups
    - Decision process for assessing severity of the release, and determining appropriate actions
    - Facility evacuation routes
    - Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill response equipment.

Occupational Health and Safety

The Hazardous Materials Management Plan should address applicable, essential elements of occupational health and safety management as described in Section 2.0 on Occupational Health and Safety, including:

- Job safety analysis to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards[41]
- Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards. Programs should include aspects of hazard identification, safe operating and materials handling procedures, safe work practices, basic emergency procedures, and special hazards unique to their jobs.

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41 Including: Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®), American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org/TLV/; U.S. National Institute for Occupational Health and Safety (NIOSH), http://www.cdc.gov/niosh/npg/; Permissible Exposure Limits (PELs), U.S. Occupational Safety and Health Administration (OSHA), http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992; Indicative Occupational Exposure Limit Values, European Union, http://europe.osha.eu.int/good_practice/risks/ds/oel/; and other similar sources.

Training should incorporate information from Material Safety Data Sheets[42] (MSDSs) for hazardous materials being handled. MSDSs should be readily accessible to employees in their local language.

- Definition and implementation of permitted maintenance activities, such as hot work or confined space entries
- Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities
- Monitoring and record-keeping activities, including audit procedures designed to verify and record the effectiveness of prevention and control of exposure to occupational hazards, and maintaining accident and incident investigation reports on file for a period of at least five years

Process Knowledge and Documentation

The Hazardous Materials Management Plan should be incorporated into, and consistent with, the other elements of the facility ES/OHS MS and include:

- Written process safety parameters (i.e., hazards of the chemical substances, safety equipment specifications, safe operation ranges for temperature, pressure, and other applicable parameters, evaluation of the consequences of deviations, etc.)
- Written operating procedures
- Compliance audit procedures

Preventive Measures

Hazardous Materials Transfer

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment. Recommended practices to prevent hazardous material releases from processes include:

- Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer
- Regular inspection, maintenance and repair of fittings, pipes and hoses
- Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.

Overfill Protection

Overfills of vessels and tanks should be prevented as they are among the most common causes of spills resulting in soil and water contamination, and among the easiest to prevent. Recommended overfill protection measures include:

- Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling operations and the use of filling operators trained in these procedures
- Installation of gauges on tanks to measure volume inside
- Use of dripless hose connections for vehicle tank and fixed connections with storage tanks

[42] MSDSs are produced by the manufacturer, but might not be prepared for chemical intermediates that are not distributed in commerce. In these cases, employers still need to provide workers with equivalent information.

- Provision of automatic fill shutoff valves on storage tanks to prevent overfilling
- Use of a catch basin around the fill pipe to collect spills
- Use of piping connections with automatic overfill protection (float valve)
- Pumping less volume than available capacity into the tank or vessel by ordering less material than its available capacity
- Provision of overfill or over pressure vents that allow controlled release to a capture point

Reaction, Fire, and Explosion Prevention

Reactive, flammable, and explosive materials should also be managed to avoid uncontrolled reactions or conditions resulting in fire or explosion. Recommended prevention practices include:

- Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas, and with containment facilities separating material storage areas
- Provision of material-specific storage for extremely hazardous or reactive materials
- Use of flame arresting devices on vents from flammable storage containers
- Provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials
- Selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility
- Storage of hazardous materials in an area of the facility separated from the main production works. Where proximity is unavoidable, physical separation should be provided using structures designed to prevent fire, explosion, spill, and other emergency situations from affecting facility operations
- Prohibition of all sources of ignition from areas near flammable storage tanks

Control Measures

Secondary Containment (Liquids)

A critical aspect for controlling accidental releases of liquid hazardous materials during storage and transfer is the provision of secondary containment. It is not necessary for secondary containment methods to meet long term material compatibility as with primary storage and piping, but their design and construction should hold released materials effectively until they can be detected and safely recovered. Appropriate secondary containment structures consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material. Secondary containment design should also consider means to prevent contact between incompatible materials in the event of a release.

Other secondary containment measures that should be applied depending on site-specific conditions include:

- Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/stormwater collection system
- Where it is not practical to provide permanent, dedicated containment structures for transfer operations, one or more alternative forms of spill containment should be provided, such as portable drain covers (which can be deployed for the duration of the operations), automatic shut-off valves on storm water basins, or shut off valves in drainage or sewer facilities, combined with oil-water separators

- Storage of drummed hazardous materials with a total volume equal or greater than 1,000 liters in areas with impervious surfaces that are sloped or bermed to contain a minimum of 25 percent of the total storage volume
- Provision of secondary containment for components (tanks, pipes) of the hazardous material storage system, to the extent feasible
- Conducting periodic (e.g. daily or weekly) reconciliation of tank contents, and inspection of visible portions of tanks and piping for leaks;
- Use of double-walled, composite, or specially coated storage and piping systems particularly in the use of underground storage tanks (USTs) and underground piping. If double-walled systems are used, they should provide a means of detecting leaks between the two walls.

Storage Tank and Piping Leak Detection

Leak detection may be used in conjunction with secondary containment, particularly in high-risk locations[43]. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs. Acceptable leak detection methods include:

- Use of automatic pressure loss detectors on pressurized or long distance piping
- Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals
- Considering the use of SCADA[44] if financially feasible

[43] High-risk locations are places where the release of product from the storage system could result in the contamination of drinking water source or those located in water resource protection areas as designated by local authorities.

[44] Supervisory Control and Data Acquisition

Underground Storage Tanks (USTs)[45]

Although there are many environmental and safety advantages of underground storage of hazardous materials, including reduced risk of fire or explosion, and lower vapor losses into the atmosphere, leaks of hazardous materials can go undetected for long periods of time with potential for soil and groundwater contamination. Examples of techniques to manage these risks include:

- Avoiding use of USTs for storage of highly soluble organic materials
- Assessing local soil corrosion potential, and installing and maintaining cathodic protection (or equivalent rust protection) for steel tanks
- For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure
- Monitoring the surface above any tank for indications of soil movement
- Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store
- Testing integrity by volumetric, vacuum, acoustic, tracers, or other means on all tanks at regular intervals
- Considering the monitoring groundwater of quality down gradient of locations where multiple USTs are in use
- Evaluating the risk of existing UST in newly acquired facilities to determine if upgrades are required for USTs that will be continued to be used, including replacement with new systems or permanent closure of abandoned USTs. Ensuring that new USTs are sited away from wells,

[45] Additional details on the management of USTs is provided in the EHS Guidelines for Retail Petroleum Stations.

reservoirs and other source water protection areas and floodplains, and maintained so as to prevent corrosion.

Management of Major Hazards

In addition to the application of the above-referenced guidance on prevention and control of releases of hazardous materials, projects involving production, handling, and storage of hazardous materials *at or above threshold limits*[46] should prepare a Hazardous Materials Risk Management Plan, in the context of its overall ES/OHS MS, containing all of the elements presented below.[47] The objective of this guidance is the prevention and control of catastrophic releases of toxic, reactive, flammable, or explosive chemicals that may result in toxic, fire, or explosion hazards.[48]

Management Actions

- *Management of Change:* These procedures should address:
  - o The technical basis for changes in processes and operations
  - o The impact of changes on health and safety
  - o Modification to operating procedures
  - o Authorization requirements
  - o Employees affected
  - o Training needs
- *Compliance Audit*: A compliance audit is a way to evaluate compliance with the prevention program requirements for each process. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years and should include:
  - o Preparation of a report of the findings
  - o Determination and documentation of the appropriate response to each finding
  - o Documentation that any deficiency has been corrected
- *Incident Investigation:* Incidents can provide valuable information about site hazards and the steps needed to prevent accidental releases. An incident investigation mechanism should include procedures for:
  - o Initiation of the investigation promptly
  - o Summarizing the investigation in a report
  - o Addressing the report findings and recommendations
  - o A review of the report with staff and contractors
- *Employee Participation:* A written plan of action should describe an active employee participation program for the prevention of accidents.
- *Contractors:* There should be a mechanism for contractor control which should include a requirement for them to develop hazard materials management procedures that meet the requirements of the hazardous materials management plan. Their procedures should be consistent with those of the contracting company and the contractor workforce should undergo the same training. Additionally, procedures should require that contractors are:
  - o Provided with safety performance procedures and safety and hazard information
  - o Observe safety practices
  - o Act responsibly
  - o Have access to appropriate training for their employees
  - o Ensure that their employees know process hazards and applicable emergency actions

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[46] Threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 300-399 and 700 to 789).

[47] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Risk Management Manual. Washington, D.C. December 2000.

[48] The approach to the management of major hazards is largely based on an approach to Process Safety Management developed by the American Institute of Chemical Engineers.

- Prepare and submit training records for their employees to the contracting company
- Inform their employees about the hazards presented by their work
- Assess trends of repeated similar incidents
- Develop and implement procedures to manage repeated similar incidents

- *Training*: Project employees should be provided training on Hazmat management. The training program should include:
  - A list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve the objectives (i.e., hands-on workshops, videos, etc.)
  - The means to determine whether the training program is effective
  - Training procedures for new hires and refresher courses for existing employees

Preventive Measures

The purpose of preventive measures is to ensure that safety-related aspects of the process and equipment are considered, limits to be placed on the operations are well known, and accepted standards and codes are adopted, where they apply.

- *Process Safety Information:* Procedures should be prepared for each hazardous materials and include:
  - Compilation of Material Safety Data Sheets (MSDS)
  - Identification of maximum intended inventories and safe upper/lower parameters
  - Documentation of equipment specifications and of codes and standards used to design, build and operate the process

- *Operating Procedures:* SOPs should be prepared for each step of all processes or operations within the project (e.g. initial startup, normal operations, temporary operations, emergency shutdown, emergency operations, normal shutdown, and start-up following a normal or emergency shutdown or major change). These SOPs should include special considerations for Mazmats used in the process or operations (e.g. temperature control to prevent emissions of a volatile hazardous chemical; diversion of gaseous discharges of hazardous pollutants from the process to a temporary storage tank in case of emergency).

Other procedures to be developed include impacts of deviations, steps to avoid deviations, prevention of chemical exposure, exposure control measures, and equipment inspections.

Mechanical Integrity of process equipment, piping and instrumentation: Inspection and maintenance procedures should be developed and documented to ensure mechanical integrity of equipment, piping, and instrumentation and prevent uncontrolled releases of hazardous materials from the project. These procedures should be included as part of the project SOPs. The specific process components of major interest include pressure vessels and storage tanks, piping systems, relief and vent systems and devices, emergency shutdown systems, controls, and pumps. Recommended aspects of the inspection and maintenance program include:

- Developing inspection and maintenance procedures
- Establishing a quality assurance plan for equipment, maintenance materials, and spare parts
- Conducting employee training on the inspection and maintenance procedures
- Conducting equipment, piping, and instrumentation inspections and maintenance
- Identifying and correcting identified deficiencies

- o Evaluating the inspection and maintenance results and, if necessary, updating the inspection and maintenance procedures
- o Reporting the results to management.

- *Hot Work Permit:* Hot work operations – such as brazing, torch-cutting, grinding, soldering, and welding – are associated with potential health, safety, and property hazards resulting from the fumes, gases, sparks, and hot metal and radiant energy produced during hot work. Hot work permit is required for any operation involving open flames or producing heat and/or sparks. The section of SOPs on hot work should include the responsibility for hot work permitting, personal protection equipment (PPE), hot work procedures, personnel training, and recordkeeping.
- *Pre-Start Review:* Procedures should be prepared to carry out pre-start reviews when a modification is significant enough to require a change in safety information under the management of change procedure. The procedures should:
  - o Confirm that the new or modified construction and/or equipment meet design specifications
  - o Ensure that procedures for safety, operation, maintenance, and emergency are adequate
  - o Include a process hazard assessment, and resolve or implement recommendations for new process
  - o Ensure that training for all affected employees is being conducted

Emergency Preparedness and Response

When handling hazardous materials, procedures and practices should be developed allowing for quick and efficient responses to accidents that could result in human injury or damage to the environment. An Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS MS, should be prepared to cover the following:[49]

- *Planning Coordination:* Procedures should be prepared for:
  - o Informing the public and emergency response agencies
  - o Documenting first aid and emergency medical treatment
  - o Taking emergency response actions
  - o Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes
- *Emergency Equipment:* Procedures should be prepared for using, inspecting, testing, and maintaining the emergency response equipment.
- *Training:* Employees and contractors should be trained on emergency response procedures.

Community Involvement and Awareness

When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies. This should include mechanisms for sharing the results of hazard and risk assessment studies in a timely, understandable and culturally sensitive manner with potentially affected communities that provides a means for public feedback. Community involvement activities should include:

- Availability of general information to the potentially affected community on the nature and extent of project operations, and the prevention and control measures in place to ensure no effects to human health

[49] For a comprehensive treatment of the development of emergency response plans in conjunction with communities refer to the Awareness and Preparedness for Emergencies at Local Level (APELL) Guidelines available at: http://www.uneptie.org/pc/apell/publications/handbooks.html

- The potential for off-site effects to human health or the environment following an accident at planned or existing hazardous installations
- Specific and timely information on appropriate behavior and safety measures to be adopted in the event of an accident including practice drills in locations with higher risks
- Access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans.

1.6 Waste Management

Applicability and Approach

These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It is not intended to apply to projects or facilities where the primary business is the collection, transportation, treatment, or disposal of wastes. Specific guidance for these types of facilities is presented in the Environmental Health and Safety (EHS) Guidelines for Waste Management Facilities.

A *waste* is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste); and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

Sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

Facilities that generate and store wastes should practice the following:

- Establishing waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences
- Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- Avoiding or minimizing the generation waste materials, as far as practicable
- Where waste generation cannot be avoided but has been minimized, recovering and reusing waste

- Where waste can not be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner

General Waste Management

The following guidance applies to the management of non-hazardous and hazardous waste. Additional guidance specifically applicable to hazardous wastes is presented below. Waste management should be addressed through a Waste management system that addresses issues linked to waste minimization, generation, transport, disposal, and monitoring.

Waste Management Planning

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. Effective planning and implementation of waste management strategies should include:

- Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner
- Definition of opportunities for source reduction, as well as reuse and recycling
- Definition of procedures and operational controls for on-site storage
- Definition of options / procedures / operational controls for treatment and final disposal

Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes
- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls[50]
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials
- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed

[50] Examples of waste prevention strategies include the concept of Lean Manufacturing found at http://www.epa.gov/epaoswer/hazwaste/minimize/lean.htm

Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange)
- Establishing recycling objectives and formal tracking of waste generation and recycling rates
- Providing training and incentives to employees in order to meet objectives

Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.

Hazardous Waste Management

Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste can not be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle
- Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- Ensuring compliance with applicable local and international regulations[51]

Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources in area location where:

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[51] International requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)

- Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatibles or physical separation such as walls or containment curbs
- Store in closed containers away from direct sunlight, wind and rain
- Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location
- Provide adequate ventilation where volatile wastes are stored.

Hazardous waste storage activities should also be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes:

- Provision of readily available information on chemical compatibility to employees, including labeling each container to identify its contents
- Limiting access to hazardous waste storage areas to employees who have received proper training
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan
- Conducting periodic inspections of waste storage areas and documenting the findings
- Preparing and implementing spill response and emergency plans to address their accidental release (additional information on Emergency Plans in provided in Section 3 of this document)
- Avoiding underground storage tanks and underground piping of hazardous waste

Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, consistent with the guidance provided in Section 3.4 on the Transport of Hazardous Materials.

Treatment and Disposal

In addition to the recommendations for treatment and disposal applicable to general wastes, the following issues specific to hazardous wastes should be considered:

Commercial or Government Waste Contractors

In the absence of qualified commercial or government-owned waste vendors (taking into consideration proximity and transportation requirements), facilities generating waste should consider using:

- Have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment
- Have all required permits, certifications, and approvals, of applicable government authorities

- Have been secured through the use of formal procurement agreements

In the absence of qualified commercial or government-owned waste disposal operators (taking into consideration proximity and transportation requirements), project sponsors should consider using:

- Installing on-site waste treatment or recycling processes
- As a final option, constructing facilities that will provide for the environmental sound long-term storage of wastes on-site (as described elsewhere in the General EHS Guidelines) or at an alternative appropriate location up until external commercial options become available

Small Quantities of Hazardous Waste

Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities. Examples of these types of wastes include: spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts. These wastes should be managed following the guidance provided in the above sections.

Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste should include:

- Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:
    - Inspection of vessels for leaks, drips or other indications of loss
    - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors
    - Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied)
    - Checking the operability of emergency systems
    - Documenting results of testing for integrity, emissions, or monitoring stations (air, soil vapor, or groundwater)
    - Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage
- Regular audits of waste segregation and collection practices
- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments
- Characterizing waste at the beginning of generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes
- Keeping manifests or other records that document the amount of waste generated and its destination
- Periodic auditing of third party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location

- Regular monitoring of groundwater quality in cases of Hazardous Waste on site storage and/or pretreatment and disposal
- Monitoring records for hazardous waste collected, stored, or shipped should include:
  - Name and identification number of the material(s) composing the hazardous waste
  - Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
  - Quantity (e.g., kilograms or liters, number of containers)
  - Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported and date received, record of the originator, the receiver and the transporter
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste
  - Location of each hazardous waste within the facility, and the quantity at each location

1.7 Noise

Applicability

This section addresses impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety.

Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception.[52] The preferred method for controlling noise from stationary sources is to implement noise control measures at source.[53] Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
- Installing vibration isolation for mechanical equipment
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Siting permanent facilities away from community areas if possible
- Taking advantage of the natural topography as a noise buffer during facility design
- Reducing project traffic routing through community areas wherever possible
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

52 A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds.

53 At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of *"Insertion Loss Performance"* for silencers and mufflers, and *"Transmission Loss Performance"* for acoustic enclosures and upgraded building construction.

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Monitoring

Noise monitoring[56] may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

[54] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.
[55] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

[56] Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.

1.8 Contaminated Land

Applicability and Approach

This section provides a summary of management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. Releases of these materials may be the result of historic or current site activities, including, but not limited to, accidents during their handling and storage, or due to their poor management or disposal.

Land is considered contaminated when it contains hazardous materials or oil concentrations above background or naturally occurring levels.

Contaminated lands may involve surficial soils or subsurface soils that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources include volatile substances, soil vapor may also become a transport and exposure medium, and create potential for contaminant infiltration of indoor air spaces of buildings.

Contaminated land is a concern because of:

- The potential risks to human health and ecology (e.g. risk of cancer or other human health effects, loss of ecology);
- The liability that it may pose to the polluter/business owners (e.g., cost of remediation, damage of business reputation and/or business-community relations) or affected parties (e.g. workers at the site, nearby property owners).

Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts.

Contaminated lands should be managed to avoid the risk to human health and ecological receptors. The preferred strategy for land decontamination is to reduce the level of contamination at the site while preventing the human exposure to contamination.

To determine whether risk management actions are warranted, the following assessment approach should be applied to establish whether the three risk factors of 'Contaminants', 'Receptors', and 'Exposure Pathways' co-exist, or are likely to co-exist, at the project site under current or possible future land use:

- *Contaminant(s)*: Presence of hazardous materials, waste, or oil in any environmental media at potentially hazardous concentrations
- *Receptor(s)*: Actual or likely contact of humans, wildlife, plants, and other living organisms with the contaminants of concern
- *Exposure pathway(s)*: A combination of the route of migration of the contaminant from its point of release (e.g., leaching into potable groundwater) and exposure routes

(e.g., ingestion, transdermal absorption), which would allow receptor(s) to come into actual contact with contaminants

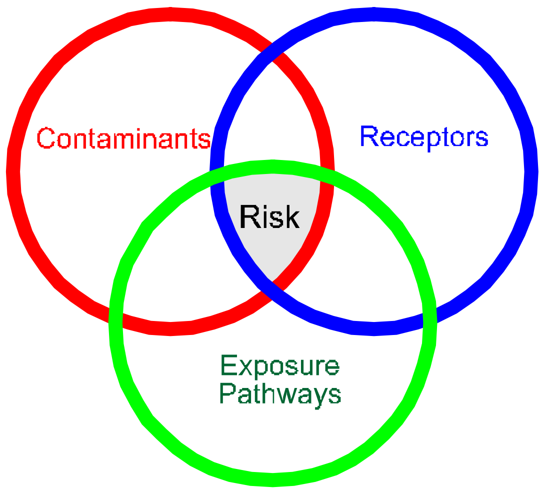

FIGURE 1.8.1: Inter-Relationship of Contaminant Risk Factors

When the three risk factors are considered to be present (in spite of limited data) under current or foreseeable future conditions, the following steps should be followed (as described in the remaining parts of this section):

1) Risk screening;
2) Interim risk management;
3) Detailed quantitative risk assessment; and
4) Permanent risk reduction measures.

Risk Screening

This step is also known as "problem formulation" for environmental risk assessment. Where there is potential evidence of contamination at a site, the following steps are recommended:

- Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information;
- Sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant[57,58];
- Evaluation of the analytical results against the local and national contaminated sites regulations. In the absence of such regulations or environmental standards, other sources of risk-based standards or guidelines should be consulted to obtain comprehensive criteria for screening soil concentrations of pollutants.[59]
- Verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question

The outcome of risk-screening may reveal that there is no overlap between the three risk-factors as the contaminant levels identified are below those considered to pose a risk to human health or the environment. Alternatively, interim or permanent

57 BC MOE. http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance

58 Massachusetts Department of Environment. http://www.mass.gov/dep/cleanup

59 These may include the USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm. These RBCs are considered acceptable for specific land use and contaminant exposure scenarios as they have been developed by governments using risk assessment techniques for use as general targets in the site remediation. Separate PRGs have been developed or adopted for soil, sediment or groundwater, and often a distinction is made between land uses (as noted earlier) because of the need for more stringent guidelines for residential and agricultural versus commercial/industrial landuse. The RBC Tables contains Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for about 400 chemicals. These toxicity factors have been combined with "standard" exposure scenarios to calculate RBCs--chemical concentrations corresponding to fixed levels of risk (i.e., a Hazard Quotient (HQ) of 1, or lifetime cancer risk of 1E-6, whichever occurs at a lower concentration) in water, air, fish tissue, and soil for individual chemical substances. The primary use of RBCs is for chemical screening during baseline risk assessment (see EPA Regional Guidance EPA/903/R-93-001, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening"). Additional useful soil quality guidelines can also be obtained from Lijzen et al. 2001.

risk reduction measures may need to be taken with, or without, more detailed risk assessment activities, as described below.

Interim Risk Management

Interim risk management actions should be implemented at any phase of the project life cycle if the presence of land contamination poses an "imminent hazard", i.e., representing an immediate risk to human health and the environment if contamination were allowed to continue, even a short period of time. Examples of situations considered to involve imminent hazards include, but are not restricted to:

- Presence of an explosive atmosphere caused by contaminated land
- Accessible and excessive contamination for which short-term exposure and potency of contaminants could result in acute toxicity, irreversible long term effects, sensitization, or accumulation of persistent biocumulative and toxic substances
- Concentrations of pollutants at concentrations above the Risk Based Concentrations (RBCs[60]) or drinking water standards in potable water at the point of abstraction

Appropriate risk reduction should be implemented as soon as practicable to remove the condition posing the imminent hazard.

Detailed Risk Assessment

As an alternative to complying with numerical standards or preliminary remediation goals, and depending on local regulatory requirements, a detailed site-specific, environmental risk assessment may be used to develop strategies that yield acceptable health risks, while achieving low level contamination on-site. An assessment of contaminant risks needs to be considered in the context of current and future land use, and development scenarios (e.g., residential, commercial, industrial, and urban parkland or wilderness use).

A detailed quantitative risk assessment builds on risk screening (problem formulation). It involves first, a detailed site investigation to identify the scope of contamination.[61] Site investigation programs should apply quality assurance/quality control (QA/QC) measures to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). The site investigation in turn should be used to develop a *conceptual site model* of how and where contaminants exist, how they are transported, and where routes of exposure occur to organisms and humans. The risk factors and conceptual site model provide a framework for assessing contaminant risks.

Human or ecological risk assessments facilitate risk management decisions at contaminated sites. Specific risk assessment objectives include:

- Identifying relevant human and ecological receptors (e.g., children, adults, fish, wildlife)
- Determining if contaminants are present at levels that pose potential human health and/or ecological concerns (e.g., levels above applicable regulatory criteria based on health or environmental risk considerations)
- Determining how human or ecological receptors are exposed to the contaminants (e.g., ingestions of soil, dermal contact, inhalation of dust)

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60 For example, USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm.

61 Examples include processes defined by the American Society of Testing and Materials (ASTM) Phase II ESA Process; the British Columbia Ministry of Environment Canada (BC MOE) http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance); and the Massachusetts Department of Environment http://www.mass.gov/dep/cleanup.

- Identifying the types of adverse effects that might result from exposure to the contaminants (e.g., effect on target organ, cancer, impaired growth or reproduction) in the absence of regulatory standards
- Quantifying the magnitude of health risks to human and ecological receptors based on a quantitative analysis of contaminant exposure and toxicity (e.g. calculate lifetime cancer risk or ratios of estimated exposure rates compared to safe exposure rates)
- Determining how current and proposed future land use influence the predicted risks (e.g. change of land use from industrial to residential with more sensitive receptors such as children)
- Quantifying the potential environmental and/or human health risks from off-site contaminant migration (e.g., consider if leaching and groundwater transport, or surface water transport results in exposure at adjacent lands/receptors)
- Determining if the risk is likely to remain stable, increase, or decrease with time in the absence of any remediation (e.g., consider if the contaminant is reasonably degradable and likely to remain in place, or be transported to other media)[62]

Addressing these objectives provides a basis to develop and implement risk reduction measures (e.g., clean-up, on-site controls) at the site. If such a need exists, the following additional objectives become relevant:

- Determining where, and in what conceptual manner, risk reduction measures should be implemented
- Identifying the preferred technologies (including engineering controls) needed to implement the conceptual risk reduction measures
- Developing a monitoring plan to ascertain whether risk reduction measures are effective
- Considering the need and appropriateness for institutional controls (e.g. deed restriction, land use restrictions) as part of a comprehensive approach

Permanent Risk Reduction Measures

The *risk factors* and *conceptual site model* within the contaminant risk approach described also provide a basis to manage and mitigate environmental contaminant health risks. The underlying principle is to reduce, eliminate, or control any or all of the three risk factors illustrated in Figure 1.8.1. A short list of examples of risk mitigation strategies is provided below, although actual strategies should be developed based on site-specific conditions, and the practicality of prevailing factors and site constraints. Regardless of the management options selected, the action plan should include, whenever possible, *contaminant source reduction* (i.e., net improvement of the site) as part of the overall strategy towards managing health risks at contaminated sites, as this alone provides for improved environmental quality.

Figure 1.8.2 presents a schematic of the inter-relationship of risk factors and example strategies to mitigate contaminant health risk by modifying the conditions of one or more risk factors to ultimately reduce contaminant exposure to the receptor. The selected approach should take into consideration the technical and financial feasibility (e.g. operability of a selected technology given the local availability of technical expertise and equipment and its associated costs).

Example risk mitigation strategies for contaminant source and exposure concentrations include:

[62] An example of a simplified quantitative risk assessment method is the ASTM E1739-95(2002) Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites and the ASTM E2081-00(2004)e1 Standard Guide for Risk-Based Corrective Action (at chemical release sites).

- Soil, sediment, and sludge:
    - In situ biological treatment (aerobic or anaerobic)
    - In situ physical/chemical treatment (e.g., soil vapor extraction with off-gas treatment, chemical oxidation)
    - In situ thermal treatment (e.g., steam injection, 6-phase heating)
    - Ex situ biological treatment (e.g., excavation and composting)
    - Ex situ physical/chemical treatment (e.g., excavation and stabilization)
    - Ex situ thermal treatment (e.g., excavation and thermal desorption or incineration)
    - Containment (e.g. landfill)
    - Natural attenuation
    - Other treatment processes
- Groundwater, surface water, and leachate:
    - In situ biological treatment (aerobic and/or aerobic)
    - In situ physical/chemical treatment (e.g., air sparging, zero-valent iron permeable reactive barrier)
    - Ex situ biological, physical, and or chemical treatment (i.e., groundwater extraction and treatment)
    - Containment (e.g., slurry wall or sheet pile barrier)
    - Natural attenuation
    - Other treatment processes
- Soil vapor intrusion:
    - Soil vapor extraction to reduce VOC contaminant source in soil
    - Installation of a sub-slab depressurization system to prevent migration of soil vapor into the building
    - Creating a positive pressure condition in buildings
    - Installation (during building construction) of an impermeable barrier below the building and/or an alternative flow pathway for soil vapor beneath building foundations (e.g., porous media and ventilation to shunt vapors away from building)

Example risk mitigation strategies for receptors include:

- Limiting or preventing access to contaminant by receptors (actions targeted at the receptor may include signage with instructions, fencing, or site security)
- Imposing health advisory or prohibiting certain practices leading to exposure such as fishing, crab trapping, shellfish collection
- Educating receptors (people) to modify behavior in order to reduce exposure (e.g., improved work practices, and use of protective clothing and equipment)

Example risk mitigation strategies for exposure pathways include:

- Providing an alternative water supply to replace, for example, a contaminated groundwater supply well
- Capping contaminated soil with at least 1m of clean soil to prevent human contact, as well as plant root or small mammal penetration into contaminated soils
- Paving over contaminated soil as an interim measure to negate the pathway of direct contact or dust generation and inhalation
- Using an interception trench and pump, and treat technologies to prevent contaminated groundwater from discharging into fish streams

The above-reference containment measures should also be considered for immediate implementation in situations where source reduction measures are expected to take time.

Occupational Health and Safety Considerations

Investigation and remediation of contaminated lands requires that workers be mindful of the occupational exposures that could arise from working in close contact with contaminated soil or other environmental media (e.g., groundwater, wastewater, sediments, and soil vapor). Occupational health and safety precautions should be exercised to minimize exposure, as described in Section 2 on Occupational Health and Safety. In addition, workers on contaminated sites should receive special health and safety training specific to contaminated site investigation and remediation activities.[63]

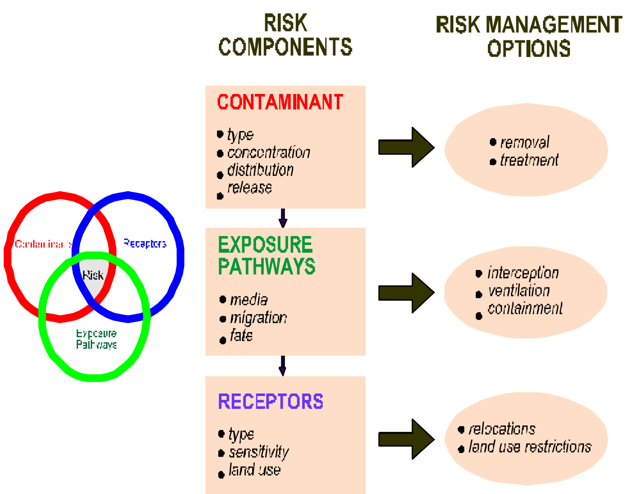

FIGURE 1.8.2: Inter-Relationship of Risk Factors and Management Options

[63] For example, US Occupational Safety and Health Agency (OSHA) regulations found at 40 CFR 1910.120. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

2.0 Occupational Health and Safety

Applicability and Approach

Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction and decommissioning activities. Companies should hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

Preventive and protective measures should be introduced according to the following order of priority:

- *Eliminating the hazard* by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc;
- *Controlling the hazard* at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc;
- *Minimizing the hazard* through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- *Providing appropriate personal protective equipment (PPE)* in conjunction with training, use, and maintenance of the PPE.

The application of prevention and control measures to occupational hazards should be based on comprehensive job safety or job hazard analyses. The results of these analyses should be prioritized as part of an action plan based on the likelihood and severity of the consequence of exposure to the identified hazards. An example of a qualitative risk ranking or analysis matrix to help identify priorities is described in Table 2.1.1.

Table 2.1.1. Risk Ranking Table to Classify Worker Scenarios Based on Likelihood and Consequence

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catas-trophic 5
A. Almost certain	L	M	E	E	E
B. Likely	L	M	H	E	E
C. Moderate	L	M	H	E	E
D. Unlikely	L	L	M	H	E
E. Rare	L	L	M	H	H

Legend

E: extreme risk; immediate action required

H: high risk; senior management attention needed

M: moderate risk; management responsibility should be specified

L: low risk; manage by routine procedures

2.1 General Facility Design and Operation

Integrity of Workplace Structures

Permanent and recurrent places of work should be designed and equipped to protect OHS:

- Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds.
- Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions.
- Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls.
- Floors should be level, even, and non-skid.
- Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections.

Severe Weather and Facility Shutdown

- Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate.
- Standard Operating Procedures (SOPs) should be developed for project or process shut-down, including an evacuation plan. Drills to practice the procedure and plan should also be undertaken annually.

Workspace and Exit

- The space provided for each worker, and in total, should be adequate for safe execution of all activities, including transport and interim storage of materials and products.
- Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum two exits from any work area.

- Facilities also should be designed and built taking into account the needs of disabled persons.

Fire Precautions

The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable to industrial settings. Other essential measures include:

- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present.
- Provision of manual firefighting equipment that is easily accessible and simple to use
- Fire and emergency alarm systems that are both audible and visible

The IFC Life and Fire Safety Guideline should apply to buildings accessible to the public (See Section 3.3).

Lavatories and Showers

- Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work in the facility and allowances made for segregated facilities, or for indicating whether the toilet facility is "In Use" or "Vacant". Toilet facilities should also be provided with adequate supplies of hot and cold running water, soap, and hand drying devices.
- Where workers may be exposed to substances poisonous by ingestion and skin contamination may occur, facilities for showering and changing into and out of street and work clothes should be provided.

Potable Water Supply

- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards

Clean Eating Area

- Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances

Lighting

- Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers' safety and health, and enable safe equipment operation. Supplemental 'task lighting' may be required where specific visual acuity requirements should be met.
- Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.

Safe Access

- Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access
- Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access
- Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.

- Openings should be sealed by gates or removable chains
- Covers should, if feasible, be installed to protect against falling items
- Measures to prevent unauthorized access to dangerous areas should be in place

First Aid

- The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work
- Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response
- Where the scale of work or the type of activity being carried out so requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids
- Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

Air Supply

- Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process-related emissions. Air distribution systems should be designed so as not to expose workers to draughts
- Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning.
- Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms. Heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. *Legionnella pneumophilia*) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.

Work Environment Temperature

- The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.

2.2 Communication and Training

OHS Training

- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

Visitor Orientation

- If visitors to the site can gain access to areas where hazardous conditions or substances may be present, a visitor orientation and control program should be established to ensure visitors do not enter hazard areas unescorted.

New Task Employee and Contractor Training

- The employer should ensure that workers and contractors, prior to commencement of new assignments, have received adequate training and information enabling them to understand work hazards and to protect their health from hazardous ambient factors that may be present. The training should adequately cover:

- Knowledge of materials, equipment, and tools
- Known hazards in the operations and how they are controlled
- Potential risks to health
- Precautions to prevent exposure
- Hygiene requirements
- Wearing and use of protective equipment and clothing
- Appropriate response to operation extremes, incidents and accidents

Basic OHS Training

- A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training should generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
- Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Training would include the risks of becoming infected with blood–borne pathogens through contact with bodily fluids and tissue.
- Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

Area Signage

- Hazardous areas (electrical rooms, compressor rooms, etc), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.
- Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate.

Labeling of Equipment

- All vessels that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, should be labeled as to the contents and hazard, or appropriately color coded.
- Similarly, piping systems that contain hazardous substances should be labeled with the direction of flow and contents of the pipe, or color coded whenever the pipe passing through a wall or floor is interrupted by a valve or junction device.

Communicate Hazard Codes

- Copies of the hazard coding system should be posted outside the facility at emergency entrance doors and fire emergency connection systems where they are likely to come to the attention of emergency services personnel.
- Information regarding the types of hazardous materials stored, handled or used at the facility, including typical maximum inventories and storage locations, should be shared proactively with emergency services and security personnel to expedite emergency response when needed.
- Representatives of local emergency and security services should be invited to participate in periodic (annual) orientation tours and site inspections to ensure familiarity with potential hazards present.

2.3 Physical Hazards

Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or work activity. Single exposure to physical hazards may result in a wide range of injuries, from minor and medical aid only, to disabling, catastrophic, and/or fatal. Multiple exposures over prolonged periods can result in disabling injuries of comparable significance and consequence.

Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations. Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.[64]
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms

Noise

Noise limits for different working environments are provided in Table 2.3.1.

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.[65]
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible
- Periodic medical hearing checks should be performed on workers exposed to high noise levels

Vibration

Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and

[64] For example: CSA Z432.04 Safe Guarding of Machinery, CSA Z434 Robot Safety, ISO 11161 Safety of Machinery – Integrated Manufacturing Systems or ISO 14121 Safety of Machinery – Principals of Risk Management or equivalent ANSI standard.

[65] The American Conference of Governmental Industrial Hygienists (ACGIH), 2006

action values, (i.e. the level of exposure at which remediation should be initiated) are provided by the ACGIH[66]. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

Table 2.3.1. Noise Limits for Various Working Environments

Location /activity	Equivalent level $LA_{eq},8h$	Maximum $LA_{max},fast$
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
Open offices, control rooms, service counters or similar	45-50 dB(A)	-
Individual offices (no disturbing noise)	40-45 dB(A)	-
Classrooms, lecture halls	35-40 dB(A)	-
Hospitals	30-35 dB(A)	40 dB(A)

- Marking all energized electrical devices and lines with warning signs
- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools
- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits
- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas
- Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited (see also Section 3 on Planning, Siting, and Design);
- Establishing "No Approach" zones around or under high voltage power lines in conformance with Table 2.3.2
- Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

66 ACGIH, 2005

Table 2.3.2. No Approach Zones for High Voltage Power Lines

Nominal phase-to-phase voltage rating	Minimum distance
750 or more volts, but no more than 150,000 volts	3 meters
More than 150,000 volts, but no more than 250,000 volts	4.5 meters
More than 250,000 volts	6 meters

Eye Hazards

Solid particles from a wide variety of industrial operations, and / or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO (see also Section 2.3 on Rotating and Moving Equipment and 2.7 on Personal Protective Equipment).
- Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.
- Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding / Hot Work

Welding creates an extremely bright and intense light that may seriously injur a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include:

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.
- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits
- Ensuring drivers undergo medical surveillance
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate

Working Environment Temperature

Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or death. Use of personal protective equipment (PPE) to protect against other occupational hazards can accentuate and aggravate heat-related illnesses. Extreme temperatures in permanent work environments should be avoided through implementation of engineering controls and ventilation. Where this is not possible, such as during short-term outdoor work, temperature-related stress management procedures should be implemented which include:

- Monitoring weather forecasts for outdoor work to provide advance warning of extreme weather and scheduling work accordingly
- Adjustment of work and rest periods according to temperature stress management procedures provided by ACGIH[67], depending on the temperature and workloads
- Providing temporary shelters to protect against the elements during working activities or for use as rest areas
- Use of protective clothing
- Providing easy access to adequate hydration such as drinking water or electrolyte drinks, and avoiding consumption of alcoholic beverages

Ergonomics, Repetitive Motion, Manual Handling

Injuries due to ergonomic factors, such as repetitive motion, over-exertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include:

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds
- Selecting and designing tools that reduce force requirements and holding times, and improve postures
- Providing user adjustable work stations
- Incorporating rest and stretch breaks into work processes, and conducting job rotation
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions
- Taking into consideration additional special conditions such as left handed persons

Working at Heights

Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

67 ACGIH, 2005

- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area
- Proper use of ladders and scaffolds by trained employees
- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines
- Appropriate training in use, serviceability, and integrity of the necessary PPE
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall

Illumination

Work area light intensity should be adequate for the general purpose of the location and type of activity, and should be supplemented with dedicated work station illumination, as needed. The minimum limits for illumination intensity for a range of locations/activities appear in Table 2.3.3.

Table 2.3.3. Minimum Limits For Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, color inspection, fine sorting etc.)	1,000 – 3,000 lux

Controls should include:

- Use of energy efficient light sources with minimum heat emission
- Undertaking measures to eliminate glare / reflections and flickering of lights
- Taking precautions to minimize and control optical radiation including direct sunlight. Exposure to high intensity UV and IR radiation and high intensity visible light should also be controlled
- Controlling laser hazards in accordance with equipment specifications, certifications, and recognized safety standards. The lowest feasible class Laser should be applied to minimize risks.

2.4 Chemical Hazards

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed. Chemical hazards can most effectively be prevented through a hierarchical approach that includes:

- Replacement of the hazardous substance with a less hazardous substitute
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits
- Keeping the number of employees exposed, or likely to become exposed, to a minimum

- Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Any means of written communication should be in an easily understood language and be readily available to exposed workers and first-aid personnel
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE

Air Quality

Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include:

- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended by the ACGIH[68] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after-week), without sustaining adverse health effects.
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
    - Direct piping of liquid and gaseous materials
    - Minimized handling of dry powdered materials;
    - Enclosed operations
    - Local exhaust ventilation at emission / release points
    - Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
    - Indoor secure storage, and sealed containers rather than loose storage
- Where ambient air contains several materials that have similar effects on the same body organs (additive effects), taking into account combined exposures using calculations recommended by the ACGIH[69]
- Where work shifts extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH[70]

Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
    - Remote from entry and exit points into buildings
    - Away from facility ventilation intakes or vents
    - Have natural or passive floor and ceiling level ventilation and explosion venting
    - Use spark-proof fixtures
    - Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems

68 ACGIH, 2005

69 ACGIH, 2005.

70 ACGIH, 2005.

- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

Corrosive, oxidizing, and reactive chemicals

Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals:

- Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills
- Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc).
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water

Asbestos Containing Materials (ACM)

The use of asbestos containing materials (ACM) should be avoided in new buildings or as a new material in remodeling or renovation activities. Existing facilities with ACM should develop an asbestos management plan which clearly identifies the locations where the ACM is present, its condition (e.g. whether it is in friable form with the potential to release fibers), procedures for monitoring its condition, procedures to access the locations where ACM is present to avoid damage, and training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan should be made available to all persons involved in operations and maintenance activities. Repair or removal and disposal of existing ACM in buildings should only be performed by specially trained personnel[71] following host country requirements, or in their absence, internationally recognized procedures.[72]

2.5 Biological Hazards

Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

- If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents can not be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

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[71] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html)

[72] Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products.

- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum.
- The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

Biological agents should be classified into four groups[73]:

- ***Group 1:*** Biological agents unlikely to cause human disease, and consequently only require controls similar to those required for hazardous or reactive chemical substances;
- ***Group 2:*** Biological agents that can cause human disease and are thereby likely to require additional controls, but are unlikely to spread to the community;
- ***Group 3***: Biological agents that can cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community, for which there usually is effective prophylaxis or treatment available and are thereby likely to require extensive additional controls;
- ***Group 4:*** Biological agents that can cause severe human disease, are a serious hazard to workers, and present a high risk of spreading to the community, for which there is usually no effective prophylaxis or treatment available and are thereby likely to require very extensive additional controls.

The employer should at all times encourage and enforce the highest level of hygiene and personal protection, especially for activities employing biological agents of Groups 3 and 4 above. Work involving agents in Groups 3 and 4 should be restricted only to those persons who have received specific verifiable training in working with and controlling such materials.

Areas used for the handling of Groups 3 and 4 biological agents should be designed to enable their full segregation and isolation in emergency circumstances, include independent ventilation systems, and be subject to SOPs requiring routine disinfection and sterilization of the work surfaces.

HVAC systems serving areas handling Groups 3 and 4 biological agents should be equipped with High Efficiency Particulate Air (HEPA) filtration systems. Equipment should readily enable their disinfection and sterilization, and maintained and operated so as to prevent growth and spreading of disease agents, amplification of the biological agents, or breeding of vectors e.g. mosquitoes and flies of public health concern.

[73] World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004).

2.6 Radiological Hazards

Radiation exposure can lead to potential discomfort, injury or serious illness to workers. Prevention and control strategies include:

- Places of work involving occupational and/or natural exposure to ionizing radiation should be established and operated in accordance with recognized international safety standards and guidelines.[74] The acceptable effective dose limits appear Table 2.6.1.
- Exposure to non-ionizing radiation (including static magnetic fields; sub-radio frequency magnetic fields; static electric fields; radio frequency and microwave radiation; light and near-infrared radiation; and ultraviolet radiation) should be controlled to internationally recommended limits[75].

Table 2.6.1. Acceptable Effective Dose Limits for Workplace Radiological Hazards

Exposure	Workers (min.19 years of age)	Apprentices and students (16-18 years of age)
Five consecutive year average – effective dose	20 mSv/year	
Single year exposure – effective dose	50 mSv/year	6 mSv/year
Equivalent dose to the lens of the eye	150 mSv/year	50 mSv/year
Equivalent dose to the extremities (hands, feet) or the skin	500 mSv/year	150 mSv/year

- In the case of both ionizing and non-ionizing radiation, the preferred method for controlling exposure is shielding and limiting the radiation source. Personal protective equipment is supplemental only or for emergency use. Personal protective equipment for near-infrared, visible and ultraviolet range radiation can include appropriate sun block creams, with or without appropriate screening clothing.

2.7 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. Table 2.7.1 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- Active use of PPE if alternative technologies, work plans or procedures cannot eliminate, or sufficiently reduce, a hazard or exposure
- Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual
- Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees

[74] International Basic Safety Standard for protection against Ionizing Radiation and for the Safety of Radiation Sources and its three interrelated Safety Guides.

IAEA. http://www-ns.iaea.org/standards/documents/default.asp?sub=160

[75] For example ACGIH (2005) and International Commission for Non-Ionizing Radiation (ICNIRP).

- Selection of PPE should be based on the hazard and risk ranking described earlier in this section, and selected according to criteria on performance and testing established by recognized organizations[76].

Table 2.7.1. Summary of Recommended Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

2.8 Special Hazard Environments

Special hazard environments are work situations where all of the previously described hazards may exist under unique or especially hazardous circumstances. Accordingly, extra precautions or rigor in application of precautions is required.

Confined Space

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space. A “permit-required” confined space is one that also contains physical or atmospheric hazards that could trap or engulf the person.[77]

Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space. Recommended management approaches include:

- Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.
- Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.

[76] Examples include the American National Standards Institute (ANSI), http://www.ansi.org/; National Institute for Occupational Safety and Health[76] (NIOSH), http://www.cdc.gov/niosh/homepage.html; Canadian Standards Association[76] (CSA), http://www.csa.ca/Default.asp?language=english; Mine Safety and Health Administration[76] (MSHA), http://www.msha.gov.

[77] US OSHA CFR 1910.146

- Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards should be consulted for design specifications;
- Prior to entry into a permit-required confined space:
  - Process or feed lines into the space should be disconnected or drained, and blanked and locked-out.
  - Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
  - The atmosphere within the confined space should be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
  - If the atmospheric conditions are not met, the confined space should be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions should include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

Lone and Isolated Workers

A lone and isolated worker is a worker out of verbal and line of sight communication with a supervisor, other workers, or other persons capable of providing aid and assistance, for continuous periods exceeding one hour. The worker is therefore at increased risk should an accident or injury occur.

- Where workers may be required to perform work under lone or isolated circumstances, Standard Operating Procedures (SOPs) should be developed and implemented to ensure all PPE and safety measures are in place before the worker starts work. SOPs should establish, at a minimum, verbal contact with the worker at least once every hour, and ensure the worker has a capability for summoning emergency aid.
- If the worker is potentially exposed to highly toxic or corrosive chemicals, emergency eye-wash and shower facilities should be equipped with audible and visible alarms to summon aid whenever the eye-wash or shower is activated by the worker and without intervention by the worker.

2.9 Monitoring

Occupational health and safety monitoring programs should verify the effectiveness of prevention and control strategies. The selected indicators should be representative of the most significant occupational, health, and safety hazards, and the implementation of prevention and control strategies. The occupational health and safety monitoring program should include:

- *Safety inspection, testing and calibration:* This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.
- *Surveillance of the working environment:* Employers should document compliance using an appropriate combination of

portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

- *Surveillance of workers health:* When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.
- *Training:* Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

Accidents and Diseases monitoring

- The employer should establish procedures and systems for reporting and recording:
  - Occupational accidents and diseases
  - Dangerous occurrences and incidents

  These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health.
- The systems and the employer should further enable and encourage workers to report to management all:
  - Occupational injuries and near misses
  - Suspected cases of occupational disease
  - Dangerous occurrences and incidents
- All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should:
  - Establish what happened
  - Determine the cause of what happened
  - Identify measures necessary to prevent a recurrence
- Occupational accidents and diseases should, at a minimum, be classified according to Table 2.10.1. Distinction is made between fatal and non-fatal injuries. The two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work. The total work hours during the specified reporting period should be reported to the appropriate regulatory agency.

Table 2.9.1. Occupational Accident Reporting

a. Fatalities (number)	**b. Non-fatal injuries** (number) [78]	**c. Total time lost** non-fatal injuries (days)
a.1 Immediate	**b.1** Less than one day	
a.2 Within a month	**b.2** Up to 3 days	**c.1** Category b.2
a.3 Within a year	**b.3** More than 3 days	**c.2** Category b.3

[78] The day on which an incident occurs is not included in b.2 and b.3.

3.0 Community Health and Safety

This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a project life cycle and can have an impact beyond the life of the project.

3.1 Water Quality and Availability

Groundwater and surface water represent essential sources of drinking and irrigation water in developing countries, particularly in rural areas where piped water supply may be limited or unavailable and where available resources are collected by the consumer with little or no treatment. Project activities involving wastewater discharges, water extraction, diversion or impoundment should prevent adverse impacts to the quality and availability of groundwater and surface water resources.

Water Quality

Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality. Air emissions, wastewater effluents, oil and hazardous materials, and wastes should be managed according to the guidance provided in the respective sections of the General EHS Guidelines with the objective of protecting soil and water resources.

Where the project includes the delivery of water to the community or to users of facility infrastructure (such as hotel hosts and hospital patients), where water may be used for drinking, cooking, washing, and bathing, water quality should comply with national acceptability standards or in their absence the current edition of with WHO Drinking Water Guidelines. Water quality for more sensitive well-being-related demands such as water used in health care facilities or food production may require more stringent, industry-specific guidelines or standards, as applicable. Any dependency factors associated with the deliver of water to the local community should be planned for and managed to ensure the sustainability of the water supply by involving the community in its management to minimize the dependency in the long-term.

Water Availability

The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area.

Project activities should not compromise the availability of water for personal hygiene needs and should take account of potential future increases in demand. The overall target should be the availability of 100 liters per person per day although lower levels may be used to meet basic health requirements.[79] Water volume requirements for well-being-related demands such as water use in health care facilities may need to be higher.

3.2 Structural Safety of Project Infrastructure

Hazards posed to the public while accessing project facilities may include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires
- Injuries suffered as a consequence of falls or contact with heavy equipment
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials

Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily. The following issues should be considered and incorporated as appropriate into the planning, siting, and design phases of a project:

- Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions
- Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, slope stability, wind loading, and other dynamic loads
- Application of locally regulated or internationally recognized building codes[80] to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response
- Engineers and architects responsible for designing and constructing facilities, building, plants and other structures should certify the applicability and appropriateness of the structural criteria employed.

International codes, such as those compiled by the International Code Council (ICC)[81], are intended to regulate the design, construction, and maintenance of a built environment and contain detailed guidance on all aspects of building safety, encompassing methodology, best practices, and documenting compliance. Depending on the nature of a project, guidance provided in the ICC or comparable codes should be followed, as appropriate, with respect to:

- Existing structures
- Soils and foundations
- Site grading
- Structural design
- Specific requirements based on intended use and occupancy
- Accessibility and means of egress
- Types of construction
- Roof design and construction
- Fire-resistant construction
- Flood-resistant construction

[79] World Health Organization (WHO) defines 100 liters/capita/day as the amount required to meet all consumption and hygiene needs. Additional information on lower service levels and potential impacts on health are described in "Domestic Water Quantity, Service Level and Health" 2003. http://www.who.int/water_sanitation_health/diseases/wsh0302/en/index.html

[80] ILO-OSH, 2001. http://www.ilo.org/public/english/protection/safework/cops/english/download/e000013.pdf

[81] ICC, 2006.

- Construction materials
- Interior environment
- Mechanical, plumbing and electrical systems
- Elevators and conveying systems
- Fire safety systems
- Safeguards during construction
- Encroachments into public right-of-way

Although major design changes may not be feasible during the operation phase of a project, hazard analysis can be undertaken to identify opportunities to reduce the consequences of a failure or accident. Illustrative management actions, applicable to hazardous materials storage and use, include:

- Reducing inventories of hazardous materials through inventory management and process changes to greatly reduce or eliminate the potential off-site consequences of a release
- Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release
- Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration
- Reducing the probability that releases will occur through improved site operations and control, and through improvements in maintenance and inspection
- Reducing off-site impacts of releases through measures intended to contain explosions and fires, alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public

3.3 Life and Fire Safety (L&FS)

Applicability and Approach

All new buildings accessible to the public should be designed, constructed, and operated in full compliance with local building codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard. The Life Safety Code[82], which provides extensive documentation on life and fire safety provisions, is one example of an internationally accepted standard and may be used to document compliance with the Life and Fire Safety objectives outlined in these guidelines. With regard to these objectives:

- Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives.
- Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices.
- Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations.

These guidelines apply to buildings that are accessible to the public. Examples of such buildings include:

- Health and education facilities
- Hotels, convention centers, and leisure facilities
- Retail and commercial facilities
- Airports, other public transport terminals, transfer facilities

Specific Requirements for New Buildings

The nature and extent of life and fire safety systems required will depend on the building type, structure, construction, occupancy, and exposures. Sponsors should prepare a Life and Fire Safety Master Plan identifying major fire risks, applicable codes, standards and regulations, and mitigation measures. The Master

[82] US NFPA. http://www.nfpa.org/catalog/product.asp?category%5Fname=&pid=10106&target%5Fpid=10106&src%5Fpid=&link%5Ftype=search

Plan should be prepared by a suitably qualified professional, and adequately cover, but not be limited to, the issues addressed briefly in the following points. The suitably qualified professional selected to prepare the Master Plan is responsible for a detailed treatment of the following illustrative, and all other required, issues.

Fire Prevention

Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development. These issues include:

- Fuel load and control of combustibles
- Ignition sources
- Interior finish flame spread characteristics
- Interior finish smoke production characteristics
- Human acts, and housekeeping and maintenance

Means of Egress

Means of Egress includes all design measures that facilitate a safe evacuation by residents and/or occupants in case of fire or other emergency, such as:

- Clear, unimpeded escape routes
- Accessibility to the impaired/handicapped
- Marking and signing
- Emergency lighting

Detection and Alarm Systems

These systems encompass all measures, including communication and public address systems needed to detect a fire and alert:

- Building staff
- Emergency response teams
- Occupants
- Civil defense

Compartmentation

Compartmentation involves all measures to prevent or slow the spread of fire and smoke, including:

- Separations
- Fire walls
- Floors
- Doors
- Dampers
- Smoke control systems

Fire Suppression and Control

Fire suppression and control includes all automatic and manual fire protection installations, such as:

- Automatic sprinkler systems
- Manual portable extinguishers
- Fire hose reels

Emergency Response Plan

An Emergency Response Plan is a set of scenario–based procedures to assist staff and emergency response teams during real life emergency and training exercises. This chapter of the Fire and Life Safety Master Plan should include an assessment of local fire prevention and suppression capabilities.

Operation and Maintenance

Operation and Maintenance involves preparing schedules for mandatory regular maintenance and testing of life and fire safety features to ensure that mechanical, electrical, and civil structures and systems are at all times in conformance with life and fire safety design criteria and required operational readiness.

L&FS Master Plan Review and Approval

- A suitably qualified professional prepares and submits a Life and Fire Safety (L&FS) Master Plan, including preliminary drawings and specifications, and certifies that the design meets the requirements of these L&FS guidelines. The findings and recommendations of the review are then used to establish the conditions of a Corrective Action Plan and a time frame for implementing the changes.

- The suitably qualified professional conducts a review as part of the project completion test at the time of life and fire safety systems testing and commissioning, and certifies that construction of these systems has been carried out in accordance with the accepted design. The findings and recommendations of the review are used as the basis for establishing project completion or to establish the conditions of a Pre-Completion Corrective Action Plan and a time frame for implementing the changes.

Specific Requirements for Existing Buildings

- All life and fire safety guideline requirements for new buildings apply to existing buildings programmed for renovation. A suitably qualified professional conducts a complete life and fire safety review of existing buildings slated for renovation. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.
- If it becomes apparent that life and fire safety conditions are deficient in an existing building that is not part of the project or that has not been programmed for renovation, a life and fire safety review of the building may be conducted by a suitably qualified professional. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.

Other Hazards

- Facilities, buildings, plants, and structures should be situated to minimize potential risks from forces of nature (e.g. earthquakes, tsunamis, floods, windstorms, and fires from surrounding areas).
- All such structures should be designed in accordance with the criteria mandated by situation-, climatic-, and geology-specific location risks (e.g. seismic activity, wind loading, and other dynamic loads).
- Structural engineers and architects responsible for facilities, buildings, plants and structures should certify the applicability and appropriateness of the design criteria employed.
- National or regional building regulations typically contain fire safety codes and standards[83] or these standards are found in separate Fire Codes.[84,85] Generally, such codes and regulations incorporate further compliance requirements with respect to methodology, practice, testing, and other codes and standards[86]. Such nationally referenced material constitutes the acceptable fire life safety code.

3.4 Traffic Safety

Traffic accidents have become one of the most significant causes of injuries and fatalities among members of the public worldwide. Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents[87]. Road safety initiatives proportional to the scope and nature of project activities should include:

[83] For example, Australia, Canada, South Africa, United Kingdom

[84] Réglementation Incendie [des ERP]

[85] USA NFPA, 2006.

[86] Prepared by National Institutes and Authorities such as American Society for Testing and Materials (ASTM), British Standards (BS), German Institute of Standardization (DIN), and French Standards (NF)

[87] Additional information on vulnerable users of public roads in developing countries is provided by Peden et al., 2004.

- Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:
  - Emphasizing safety aspects among drivers
  - Improving driving skills and requiring licensing of drivers
  - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
  - Avoiding dangerous routes and times of day to reduce the risk of accidents
  - Use of speed control devices (governors) on trucks, and remote monitoring of driver actions
- Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

- Minimizing pedestrian interaction with construction vehicles
- Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns)[88]
- Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents
- Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic
- Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions

3.5 Transport of Hazardous Materials

General Hazardous Materials Transport

- Projects should have procedures in place that ensure compliance with local laws and international requirements applicable to the transport of hazardous materials, including:
  - IATA requirements[89] for air transport
  - IMDG Code[90] sea transport
  - UN Model Regulations[91] of other international standards as well as local requirements for land transport
  - Host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, if applicable to the project activities
- The procedures for transportation of hazardous materials (Hazmats) should include:
  - Proper labeling of containers, including the identify and quantity of the contents, hazards, and shipper contact information
  - Providing a shipping document (e.g. shipping manifest) that describes the contents of the load and its associated hazards in addition to the labeling of the containers. The shipping document should establish a chain-of-custody using multiple signed copies to show that the waste was properly shipped, transported and received by the recycling or treatment/disposal facility

[88] Additional sources of information for implementation of road safety measures is available at WHO, 1989, Ross et al., 1991, Tsunokawa and Hoban, 1997, and OECD, 1999

[89] IATA, 2005. www.iata.org

[90] IMO. www.imo.org/safety

[91] United Nations. Transport of Dangerous Goods - Model Regulations. 14th Revised Edition. Geneva 2005. http://www.unece.org/trans/danger/publi/unrec/rev14/14files_e.html

- Ensuring that the volume, nature, integrity and protection of packaging and containers used for transport are appropriate for the type and quantity of hazardous material and modes of transport involved
- Ensuring adequate transport vehicle specifications
- Training employees involved in the transportation of hazardous materials regarding proper shipping procedures and emergency procedures
- Using labeling and placarding (external signs on transport vehicles), as required
- Providing the necessary means for emergency response on call 24 hours/day

Major Transportation Hazards

Guidance related to major transportation hazards should be implemented in addition to measures presented in the preceding section for preventing or minimizing the consequences of catastrophic releases of hazardous materials, which may result in toxic, fire, explosion, or other hazards during transportation.

In addition to these aforementioned procedures, projects which transport hazardous materials *at or above the threshold quantities*[92] should prepare a Hazardous Materials Transportation Plan containing all of the elements presented below[93].

Hazard Assessment

The hazard assessment should identify the potential hazard involved in the transportation of hazardous materials by reviewing:

- The hazard characteristics of the substances identified during the screening stage
- The history of accidents, both by the company and its contractors, involving hazardous materials transportation
- The existing criteria for the safe transportation of hazardous materials, including environmental management systems used by the company and its contractors

This review should cover the management actions, preventive measures and emergency response procedures described below. The hazard assessment helps to determine what additional measures may be required to complete the plan.

Management Actions

- *Management of Change:* These procedures should address:
  - The technical basis for changes in hazardous materials offered for transportation, routes and/or procedures
  - The potential impact of changes on health and safety
  - Modification required to operating procedures
  - Authorization requirements
  - Employees affected
  - Training needs
- *Compliance Audit:* A compliance audit evaluates compliance with prevention requirements for each transportation route or for each hazardous material, as appropriate. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years. The audit program should include:
  - Preparation of a report of the findings
  - Determination and documentation of the appropriate response to each finding
  - Documentation that any deficiency has been corrected.
- *Incident Investigation:* Incidents can provide valuable information about transportation hazards and the steps needed to prevent accidental releases. The implementation of incident investigation procedures should ensure that:
  - Investigations are initiated promptly
  - Summaries of investigations are included in a report
  - Report findings and recommendations are addressed

92 Threshold quantities for the transport of hazardous materials are found in the UN – Transport of Dangerous Goods – Model Regulations cited above.

93 For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Transportation Manual. Washington, D.C. December 2000.

- Reports are reviewed with staff and contractors

- *Employee Participation:* There should be a written plan of action regarding the implementation of active employee participation in the prevention of accidents.

- *Contractors:* The plan should include procedures to ensure that:
  - The contractor is provided with safety performance procedures and safety and hazard information
  - Contractors observe safety practices
  - Verify that the contractor acts responsibly

  The plan should also include additional procedures to ensure the contractors will:
  - Ensure appropriate training for their employees
  - Ensure their employees know process hazards and applicable emergency actions
  - Prepare and submit training records
  - Inform employees about the hazards presented by their work

- *Training:* Good training programs on operating procedures will provide the employees with the necessary information to understand how to operate safely and why safe operations are needed. The training program should include:
  - The list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve objectives (i.e. hands-on workshops, videos, etc.)
  - Means to determine the effectiveness of the training program
  - Training procedures for new hires and refresher programs

Preventive Measures

The plan should include procedures to implement preventive measures specific to each hazardous material offered for transportation, including:

- Classification and segregation of hazardous materials in warehouses and transport units
- Packaging and packaging testing
- Marking and labeling of packages containing hazardous materials
- Handling and securing packages containing hazardous materials in transport units
- Marking and placarding of transport units
- Documentation (e.g. bills of lading)
- Application of special provisions, as appropriate

Emergency Preparedness and Response

It is important to develop procedures and practices for the handling of hazardous materials that allow for quick and efficient responses to accidents that may result in injury or environmental damage. The sponsor should prepare an Emergency Preparedness and Response Plan that should cover:

- *Planning Coordination:* This should include procedures for:
  - Informing the public and emergency response agencies
  - Documenting first aid and emergency medical treatment
  - Taking emergency response actions
  - Reviewing and updating the emergency response plan to reflect changes and ensuring that the employees are informed of such changes

- *Emergency Equipment:* The plan should include procedures for using, inspecting, testing, and maintaining emergency response equipment.

- *Training:* Employees should be trained in any relevant procedures

3.6 Disease Prevention

Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

Recommended interventions at the project level include[94]:

- Providing surveillance and active screening and treatment of workers
- Preventing illness among workers in local communities by:
    - Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use
    - Training health workers in disease treatment
    - Conducting immunization programs for workers in local communities to improve health and guard against infection
    - Providing health services
- Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers
- Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization

Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. Project sponsors, in close collaboration with community health authorities, can implement an integrated control strategy for mosquito and other arthropod-borne diseases that might involve:

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements
- Elimination of unusable impounded water
- Increase in water velocity in natural and artificial channels
- Considering the application of residual insecticide to dormitory walls
- Implementation of integrated vector control programs
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites
- Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs
- Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread
- Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects
- Educating project personnel and area residents on risks, prevention, and available treatment
- Monitoring communities during high-risk seasons to detect and treat cases

94 Additional sources of information on disease prevention include IFC, 2006; UNDP, 2000, 2003; Walley et al., 2000; Kindhauser, 2003; Heymann, 2004.

- Distributing appropriate education materials
- Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

3.7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows below.

Communication Systems

Worker notification and communication

Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include:

- Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations
- Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company should implement communication measures to alert the community, such as:

- Audible alarms, such as fire bells or sirens
- Fan out telephone call lists
- Vehicle mounted speakers
- Communicating details of the nature of the emergency
- Communicating protection options (evacuation, quarantine)
- Providing advise on selecting an appropriate protection option

Media and Agency Relations

Emergency information should be communicated to the media through:

- A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies
- Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed

Emergency Resources

Finance and Emergency Funds

- A mechanism should be provided for funding emergency activities.

Fire Services

- The company should consider the level of local fire fighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, fire fighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.

Medical Services

- The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.

Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency include:

- Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency
- Providing personnel who can readily call up resources, as required
- Tracking and managing the costs associated with emergency resources
- Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies
- Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site

Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers.

- Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.

Contact List

- The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.

Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should:

- Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency
- Develop a training plan to address needs, particularly for fire fighting, spill response, and evacuation

- Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated
- Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:
    - o Desk top exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed
    - o Response exercises, typically involving drills that allow for testing of equipment and logistics
- o Debrief upon completion of a training exercise to assess what worked well and what aspects require improvement
- o Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) should be replaced
- o Record training activities and the outcomes of the training

Business Continuity and Contingency

Measures to address business continuity and contingency include:

- Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.
- Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.
- Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

4.0 Construction and Decommissioning

Applicability and Approach

This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. Cross referencing is made to various other sections of the General EHS Guidelines.

4.1 Environment{ TC "4.1 Environment" \f C \l "2" }

Noise and Vibration

During construction and decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. Some recommended noise reduction and control strategies to consider in areas close to community areas include:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance
- Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.
- Avoiding or minimizing project transportation through community areas

Soil Erosion

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters. Recommended soil erosion and water system management approaches include:

Sediment mobilization and transport

- Reducing or preventing erosion by:
  - o Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical
  - o Contouring and minimizing length and steepness of slopes
  - o Mulching to stabilize exposed areas
  - o Re-vegetating areas promptly
  - o Designing channels and ditches for post-construction flows
  - o Lining steep channel and slopes (e.g. use jute matting)
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.

Clean runoff management

- Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release

Road design

- Limiting access road gradients to reduce runoff-induced erosion
- Providing adequate road drainage based on road width, surface material, compaction, and maintenance

Disturbance to water bodies

- Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings
- Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.)
- For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water
- Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling

Structural (slope) stability

- Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented
- Providing adequate drainage systems to minimize and control infiltration

Air Quality

Construction and decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. A secondary source of emissions may include exhaust from diesel engines of earth moving equipment, as well as from open burning of solid waste on-site. Techniques to consider for the reduction and control of air emissions from construction and decommissioning sites include:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)
- Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- Selectively removing potential hazardous air pollutants, such as asbestos, from existing infrastructure prior to demolition
- Managing emissions from mobile sources according to Section 1.1
- Avoiding open burning of solid (refer to solid waste management guidance in Section 1.6)

Solid Waste

Non-hazardous solid waste generated at construction and decommissioning sites includes excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills. Other non-hazardous solid wastes include office, kitchen, and dormitory wastes when these types of operations are part of construction project activities. *Hazardous solid waste* includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill cleanup materials from oil and fuel spills. Techniques for preventing and controlling non-hazardous and hazardous construction site solid waste include those already discussed in Section 1.6.

Hazardous Materials

Construction and decommissioning activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. These materials may also be encountered during decommissioning activities in building components or industrial process equipment. Techniques for prevention, minimization, and control of these impacts include:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,
- Using impervious surfaces for refueling areas and other fluid transfer areas
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills
- Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
- Assessing the contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment, asbestos-containing building materials) and process equipment and removing them prior to initiation of decommissioning activities, and managing their treatment and disposal according to Sections 1.5 and 1.6 on Hazardous Materials and Hazardous Waste Management, respectively
- Assessing the presence of hazardous substances in or on building materials (e.g., polychlorinated biphenyls, asbestos-containing flooring or insulation) and decontaminating or properly managing contaminated building materials

Wastewater Discharges

Construction and decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all construction sites. Sanitary wastewater in construction and other sites should be managed as described in Section 1.3.

Contaminated Land

Land contamination may be encountered in sites under construction or decommissioning due to known or unknown historical releases of hazardous materials or oil, or due to the presence of abandoned infrastructure formerly used to store or handle these materials, including underground storage tanks. Actions necessary to manage the risk from contaminated land will depend on factors such as the level and location of contamination, the type and risks of the contaminated media, and the intended land use. However, a basic management strategy should include:

- Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning
- Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities
- Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land in Section 1.6
- Preparation of a management plan to manage obsolete, abandoned, hazardous materials or oil consistent with the approach to hazardous waste management described in Section 1.6.

Successful implementation of any management strategy may require identification and cooperation with whoever is responsible and liable for the contamination.

4.2 Occupational Health and Safety{ TC "4.2 Occupational Health and Safety" \f C \l "2" }

Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction and decommissioning sites. Recommendations for their prevention and control include:

- Training of workers in lifting and materials handling techniques in construction and decommissioning projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary
- Planning work site layout to minimize the need for manual transfer of heavy loads
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks

Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction and decommissioning sites. Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths
- Cleaning up excessive waste debris and liquid spills regularly
- Locating electrical cords and ropes in common areas and marked corridors
- Use of slip retardant footwear

Work in Heights

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction or decommissioning sites. If fall hazards exist, a fall protection plan should be in place which includes one or more of the following aspects, depending on the nature of the fall hazard[95]:

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as

95 Additional information on identification of fall hazards and design of protection systems can be found in the United States Occupational Health and Safety Administration's (US OSHA) web site: http://www.osha.gov/SLTC/fallprotection/index.html

securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces

Struck By Objects

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities. Techniques for the prevention and control of these hazards include:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged
- Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. Techniques for the prevention and control of these impacts include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

Dust

- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- PPE, such as dusk masks, should be used where dust levels are excessive

Confined Spaces and Excavations

Examples of confined spaces that may be present in construction or demolition sites include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress is limited. In addition to the guidance provided in Section 2.8 the occupational hazards associated with confined spaces and excavations in construction and decommissioning sites should be prevented according to the following recommendations:

- Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning
- Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders
- Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated

Other Site Hazards

Construction and decommissioning sites may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms, which should be prevented through the implementation of project-specific plans and other applicable management practices, including:

- Use of specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land as a first step in decommissioning activities to allow for safe excavation, construction, dismantling or demolition
- Use of specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to dismantling or demolition including, for example, insulation or structural elements containing asbestos and Polychlorinated Biphenyls (PCBs), electrical components containing mercury[96]
- Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection

4.3 Community Health and Safety{ TC "4.3 Community Health and Safety" \f C \l "2" }

General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning. Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, buildings that are vacant or under construction, or excavations and structures which may pose falling and entrapment hazards. Risk management strategies may include:

- Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community
- Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials

Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to project personnel and residents of local communities. Recommendations for the prevention and control of communicable and vector-borne diseases also applicable to

[96] Additional information on the management and removal of asbestos containing building materials can be found in ASTM Standard E2356 and E1368

construction phase activities are provided in Section 3.6 (Disease Prevention).

Traffic Safety

Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. The incidence of road accidents involving project vehicles during construction should be minimized through a combination of education and awareness-raising, and the adoption of procedures described in Section 3.4 (Traffic Safety).

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