Environmental Evaluations of a Horticulture Demonstration Farm in Lesotho
(A World Bank Funded Study)

DRAFT REPORT

Submitted To:
Ministry of Trade & Industry,
Cooperatives and Marketing
The Government of Lesotho

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Data and information for the study was collected through site visits and interviews with: relevant ministries, consulting firms, NGOs and other stakeholders as well as literature and Internet research. To the extent feasible, meetings were held with Alpha Estates Management and DENMAR industries, the private South African firms participating in the project. However, at the time of field study, the government of Lesotho had not signed the contractual agreement with either of the firms, limiting their availability. Most of information sources have been properly acknowledged. In general official data was found to be inadequate and/or incomplete and, overall, the textile industry was non-cooperative. The document mirrors the results of the consultation process, the data review and represents analysis by the consultant.

The Consultant would like to thank all the people who helped in this study for their constructive input. In particular, I am grateful to Mr. Chaba Mokuku, Ministry of Tourism, Environment and Culture (MTEC), Bruce Hamilton of Alpha Estates Management for their cooperation and valuable input. However, my special thanks go to TICM for funding this study under the World Bank’s Private Sector Competitive Project (PSCP) loan.
ABBREVIATIONS AND ACRONYMNS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AEM</td>
<td>Alpha Estates Management</td>
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<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>Ft</td>
<td>Foot</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
</tr>
<tr>
<td>Km</td>
<td>Kilometers</td>
</tr>
<tr>
<td>LASA</td>
<td>Lesotho Agricultural Sector Analysis Project</td>
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<tr>
<td>LHDA</td>
<td>Lesotho Highlands Development Authority</td>
</tr>
<tr>
<td>LHWP</td>
<td>Lesotho Highlands Water Project</td>
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<td>LPRC</td>
<td>Land Policy Review Commission</td>
</tr>
<tr>
<td>M</td>
<td>Meters</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeters</td>
</tr>
<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MTEC</td>
<td>Ministry of Tourism, Environment and Culture.</td>
</tr>
<tr>
<td>MTICM</td>
<td>Ministry of Trade &amp; Industry, Cooperatives and Marketing</td>
</tr>
<tr>
<td>NO₂</td>
<td>Nitrite</td>
</tr>
<tr>
<td>NO₃</td>
<td>Nitrates</td>
</tr>
<tr>
<td>OP</td>
<td>Operational Policy (of the World Bank)</td>
</tr>
<tr>
<td>pH</td>
<td>Measure acidify of a solution in term of H ions</td>
</tr>
<tr>
<td>PSCP</td>
<td>Private Sector Competitive Project</td>
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<tr>
<td>ppm</td>
<td>Parts per Million</td>
</tr>
<tr>
<td>USEPA</td>
<td>U.S. Environmental Protection Agency</td>
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<td>WB</td>
<td>World Bank</td>
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EXECUTIVE SUMMARY

Under the World Bank’s Private Sector Competitive Project (PSCP), the Lesotho government is setting up horticulture demonstration farms, apples and cherries in the Leribe district, and Brussels sprouts, butternut, potatoes, white cabbage, carrots and other vegetables in the Berea district. Two South African firms, DENMAR for fruit trees, and Alpha Estates Management for vegetables will assist the project by bringing technical, management, and market expertise, including access to their marketing networks. Successful replication and scalability of the demonstration project will help attract private technical, management and financial partnerships with South African growers/processors, helping alleviate rural poverty.

In Lesotho, commercial agriculture, including fruit production, faces numerous hurdles. Included are: degraded land, primarily due to soil erosion, and poor management, droughts, unpredictable and with increasing frequency, difficult topography, small size of holdings, and overall lack of technical and management resources. Lack of funds seems to be a perennial problem, and according to FAO, historically, in Lesotho, donor funded projects have been prone to failure. It is therefore very important that the current project develops sound interventions to minimize impact of prevailing technical and management constraints to assure its sound footing and long-term sustainability. Included are unresolved issues such as the lack of contractual agreements with the two South African partners, and with the areas farmers who are leasing lands. All such issues need immediate attention.

Additionally, it is important that the project establishes a sound management entity and mechanisms that, with periodic reviews, should operate beyond the project period. Implementation of capacity building activities such as through education, training and awareness rising would help maintain momentum, strengthen the project and its potential replication. Payments offered to farmers should be sufficient to compensate for their opportunity costs. A continuing stakeholders’ participation to assure their buy-in will significantly contribute to project’s long-term success and sustainability. It is also suggested that for both farms, a well-qualified individual is appointed to provide technical and management oversight. The proposed individual will act as the single point of contact responding to all the stakeholders, and made fully accountable for the project’s performance. Also, a small advisory committee comprising of members from key stakeholder should be set up to provide an advisory including trouble-shooting role.

The government must also address structural constraints in the enabling environment which limit adoption and scaling-up of sustainable land management best practices. In addition to land insecurity, these may include: (i) providing appropriate institutional networks, (ii) creating a clearinghouse (to provide technical support such as on knowledge management, and (iii) set up demonstration farms on key Best Management Practices (BMP’s) such as for soil erosion. Such measures will help boost agriculture productivity by introducing modern soil and water conservation techniques. During the fieldwork, it became apparent that Lesotho woefully lacks data and information resources, even at the technical and management levels, technical capacity and knowledge are weak. The proposed interventions are one step in this direction.

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1 Apple trees generally take three years to establish; a contract with farmers should be at least for a five-year period.
The potential use of agrochemicals, in particular pesticides, under the prevailing poor management and weak regulatory environment, is fraught with serious environmental including human health dangers. Pesticides are toxic substances, used to kill or control harmful or undesirable organisms. Potential project-specific risks include: lack of storage facilities, resulting in improper storage, poor labeling, human health risks such as due to inhalation and poor farmer knowledge, training and awareness of dangers. Furthermore, the government must educate farmers and other community members on the serious human health dangers of using empty pesticide containers for storing water and other consumables. Use of Integrated Pest Management, where feasible, should be encouraged.

Likewise, use of fertilizers, in particular nitrogenous, under poor field management, entails potentially serious issues of soil and water contamination, primarily through leaching and runoff, careful attention must be paid to nitrogenous forms, quantities for use. Use of agricultural best management practices should be encouraged through their use, field demonstration, and farmers training. In general, agrochemicals pollution is widely attributed to over application carried out as part of a management strategy to achieve maximum yield, or value. This is particularly true in the Western world, and there are important lessons to be learnt from such an approach.

The implementation of proposed intervention, and similar others, is urgently needed. In addition, there is a serious need to develop and/or update specific legislations on pesticide importation, use, and safe handling. Since issues include health and safety, food and environmental protection, agricultural production, and economic affairs are involved an inter-disciplinary and a multi-agency approach will be needed. Involving stakeholders in various activities will contribute to long-term sustainability of the project. Export of fruits and vegetables to EU requires meeting “EUREPGAP Fruit and Vegetables”\(^\text{2}\), standards, potentially possible to meet including with the use of above strategies.

\(^{2}\) See: http://www.eurepgap.org/fruit/Languages/English/index.html, and others.
Introduction

Landlocked Lesotho—completely surrounded by its much larger neighbor, South Africa—is a small mountainous country, with an area of about 30,600 km$^2$. Lesotho has few exploitable resources, strictly limited agricultural potential—only 9-10% of the country is arable; two thirds of this land is found in the lowlands and foothill regions. The country’s economy is based on exports of water and (excess electricity, when available) to South Africa, some manufacturing—in particular textiles and leather goods, agriculture, livestock, and to some extent the earnings—currently declining—of its laborers employed in South Africa. Its people have developed a strong culture of wage employment. According to the International Labor Organization (ILO), approximately half of the country’s population lives below poverty levels.

Despite the fact that over 85% of the country’s year 2005 population of 2,022,331, in one way or the other, is dependent upon agriculture and livestock, arable land continues to decline due to soil erosion and rapid encroachment of towns, villages and roads. Lesotho is a persistent net food importer. For instance, during the last five years, up to 65 percent of Lesotho’s annual maize requirements and 80 percent of its annual wheat requirements were met through imports. The scope for increasing food production through higher productivity is also extremely limited due to technical and climatic reasons. Given the country’s topography, accessibility to many rural locales at best is difficult.

Subsistence farming based on mixed farming of crops and livestock is the most common form of farming on small landholding. There are no farms in Lesotho but rather fields whose average sizes range from 3-4 ha or less. Lately, however, some (small-scale) commercial farming has gathered some momentum. The commercial farmers lease land from these small holders on seasonal/annual or long-term basis. Individual households grow fruit trees such as apples; most fruits however are imported from South Africa. Lesotho’s soils are generally of poor quality, and given poor agronomic and management practices, yields of the main staple crops—maize, sorghum and wheat—are declining. The non-arable mountain areas are also rapidly deteriorating because of overgrazing and erosion. The land in Lesotho is the property of the nation in the custody of the king and is allocated free to any adult male. However, this situation is under current review.

Lesotho faces land degradation and environmental crisis of massive proportions. This crisis has four major dimensions:

- Declining self-sufficiency in food;

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3 The eastern two thirds of Lesotho are dominated by the Drakensberg mountain range, with elevations of more than 11,000 ft (3,353 m). The extensive rocky areas attract a lot of hiking lovers who can enjoy the natural rock formations caused by soil erosion. The rest of the country is a narrow, rocky tableland.

4 As of July 2006; See: http://worldfacts.us/Lesotho.htm

5 Adapted from: S.D. Turner, CARE, April 2003
- Rapid erosion, estimated to total 40 million tones of soil annually. At this rate all topsoil is projected to be lost by the year 2040;
- Acute shortage of wood fuels, significantly continuing deforestation; and
- Expanding populations, current growth annual rate of 2.6% is considered high, and under current trends, Lesotho’s population will pass 3.1 million – the maximum that can be fed from Lesotho’s lands with high inputs, and assuming no erosion – by the year 2013-2015 AD.

Given the above situation, the existence of the rural population is precarious at the best of times. It has been made even more vulnerable by the increasing frequency of dry spells and spread of HIV/AIDS. Government sees irrigation as a key avenue for increasing agricultural production and household food security. A successfully implemented approach would enable farmers to intensify and diversify their crop production base. Crops identified for diversification include vegetables and fruits such as paprika, asparagus and apples. Some international donors are providing technical and funding assistance to mitigate soil erosion, develop water resources and improve livelihoods. However, according to FAO\(^6\), externally funded development projects in the past, at best, had very poor outcomes for various reasons.

1. **The Current Project: Horticulture Demonstration Farm**

Under the World Bank supported Private Sector Competitive Project (PSCP), the Government of Lesotho (GOL) is proposing to develop two simultaneously implemented pilot farm projects. In the first pilot, Alpha Estates Management (AEM), a South African farm, will partner with the Basotho farmers to grow vegetables—carrots, butternut, potatoes, Brussels sprout, and other crops. The second pilot will focus on the production of apples and cherries, where Denmar Estates, another South African firm\(^7\), will partner with the farmers to grow crops for the local, South African, and the European Union (EU) markets. Each of the South African firms has extensive experience related to the activity, including EU network for food export. The demonstration results will help scale up the activity, helping improve rural livelihoods.

Over the long term, the project’s objective is to add more value to horticultural products grown in Lesotho, particularly vegetables, and fruit crops such as apples and cherries. Production will be linked to markets in South Africa, and the EU (UK) through (i) improving quality, volume and delivery capability of Basotho farmers; (ii) transitioning away from smallholder farming into group or block farming methods; and (iii) production of organic products to help tap into high premium (overseas) niche markets.

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\(^6\) SEE: http://www.fao.org/docrep/007/ae365e/ae365e00.htm

\(^7\) The role of the South African partners is to bring their technical, management and market expertise, including access to its marketing network, to help establish a scalable research plot in Lesotho. It is also envisaged that the preparatory phase of the project will also explore possible relationships with the Deciduous Fruit Producers’ Trust (DFPT) and other grower’s associations. Taking into consideration that Lesotho currently does not have a processing and packing facility, it is anticipated that the proposed program would embark on establishing relationships with organizations like DFPT to tap into their network of private sector interest to attract technical, management and financial partnerships with South African growersprocessors.
The proposed demonstration farms will be established in Lesotho’s two districts: A vegetable farm in the Berea district, and a horticulture farm in the Leribe district. In the Berea district, a 10-Hectare site is proposed. The site is situated about 30 kilometers north east of Maseru, approachable via Teyateyaneng from Maseru. The Leribe district site, approximately 15 hectares, is divided between two unequal separate land parcels in Qoqolosing and Mahobong villages. The Leribe site lies within less than 2-hour drive from Maseru. Each of the site’s lack a fence, considered necessary to prevent unwanted animal grazing. At the time of this study, the required land under each of the projects was being contracted from area farmers. The project areas covers lowlands and foothills (altitudes from about 1,300 m to 2,000 m above sea level) of Leribe, and Berea districts, and includes more than half of Lesotho’s potentially arable land. Leribe is considered to be rich in soils and also, has exceptional concentration of trees, shrubs, thatching grass, and grazing and medicinal plants. These natural resources along with arable land are critical to area’s economy and livelihood.
Description of the Project Area

Relevant features of the project area and Lesotho are synopsized below.

2. Topography

The project area’s topography (and also Lesotho’s) has a direct bearing on agriculture and its productivity. As a country, Lesotho is divided into four physiographic regions. Figure 2-1. *Four Physiographic Regions of Lesotho* shows key details. As can be seen from the figure, the Lowlands form a narrow strip along the western boarder with South Africa at approximately 1,500 to 1,800m above sea level. Over 80 percent of the productive arable land and the highest population densities are found in this region. The foothills range in elevation from 1,800 to 2,000 meters above sea level along the lower

3. Climate

The climate of the project region can be classified as continental and temperate, with four distinct seasons: spring, summer, autumn and winter. The summers often have high temperatures and precipitation due to the position of the Inter-tropical Conversion Zone (ITCZ) i.e. being south of the equator. In winter, the presence of high-pressure results in clear skies, dry air, and warm temperature during

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the day, becoming cold after sunset. The spatial and temporal distribution of rainfall in each growing season is highly variable, and its value for crop production is further degraded by various factors. These include heavy storms that limit infiltration and increase runoff and erosion, and hail that damages or destroys crops. Unseasonal frosts can damage crops anywhere in the country, they are a particular hazard in the mountains, where the growing season is short, and frost can occur in mid summer. Heavy snowfalls in the mountains often limits grazing, sometimes leading to widespread livestock mortality. However, it is the variable character of the rainfall regime, and the destructive nature of some precipitation events, that are more significant for livelihoods than the long-term average rainfall figures, which of themselves are adequate for a variety of dry land crops.

The highlands areas experience severe winters, with ground frost in few areas up to 200 days a year. The winter’s severity along with the area’s topography, limit the scope of crop production and its diversity. The mountainous regions receive snow during the unusually cold winters. In Lesotho January is normally the hottest month of the year with average temperatures in excess of 30º C being recorded in the lowlands. The coldest period is between June and July with an average of 8ºC. Temperatures in excess of 35ºC have been recorded particularly during droughts. For example, 39.4ºC was recorded in Maseru in January 1973. Low temperatures in the highlands are indicative of the effect of altitude on temperature e.g. a rare lowest of – 20.4º C was recorded in the highlands in 1967.

As the table shows, the temperature in Lesotho varies from place to place according to altitude and decreases with increasing elevation. The country exhibits marked seasonality, where even the lowlands fluctuate around 30 to 50º C. The country can be divided into four ecological regions. Table 2-1. Key Climatic Figure for the four Ecological Regions provides some relevant figures. On the whole, Lesotho’s climatic conditions are optimal for the annual cultivation of most temperate zone crops, including maize, sorghum, wheat, beans, peas, vegetables and fruits.

<table>
<thead>
<tr>
<th>Description</th>
<th>Lowland</th>
<th>Senqu River Valley</th>
<th>Foothills</th>
<th>Mountains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual rainfall (mm)</td>
<td>600 - 900</td>
<td>450 - 600</td>
<td>900 – 1,000</td>
<td>1,000 – 1,300</td>
</tr>
<tr>
<td>Temperature (ºC)</td>
<td>-11 - 38</td>
<td>-5 - 36</td>
<td>-8 - 30</td>
<td>-8 - 30</td>
</tr>
<tr>
<td>Average Temperature (ºC)</td>
<td>17</td>
<td>16</td>
<td>14</td>
<td>13</td>
</tr>
</tbody>
</table>

4. Rainfall

Water is crucial for crop growth and rainfall is an important source of water. In Lesotho, precipitation is characterized by fluctuating trends, with high variability from year to year. The reliability of rainfall (and distribution of water) is a serious constraint on agricultural production. Rainfall, the bulk of which, as much as 85% of the total, falls between October and April—but there is normally no month that has less than 12 mm—
varies from about 700 mm to 1,000 mm depending on location. Rainfall is also (highly) variable both between years and locations. Droughts are common. Key characteristics related to rainfall in Lesotho are:

- The seasonal distribution of precipitation varies considerably and thus the danger of rain falling at the wrong time, or falling too hard, or not falling at all when it is needed, is always present even if total rainfall has been adequate;
- Extreme weather conditions occur periodically; droughts are said to occur three years out of every ten, heavy frosts are frequent and heavy unseasonable rains also occur from time to time; and
- Not just the geographical distribution of precipitation, but also the fact that water does not always collect in places where it is immediately accessible for agriculture constitutes a problem; this makes it necessary to build, for example, conveyance infrastructures.

However, as the river discharge statistics show, most of the rainfall is lost in the form of run-off. Taken as a whole, rainfall in Lesotho is at a level that is adequate to sustain healthy agricultural activity; however, the erratic nature of its distribution, unpredictable droughts and poor management are major constraints for food production.

5. Soils

Most of the program area’s soils are derived from sandstone or shale. Soils, with both management and inherent fertility problems, influence the productivity of both arable land and rangelands are common. In both the project areas, maize dominates cropping. However, yields (per hectare) are low due to poor soil fertility and poor management, leading to a declining trend over the years. Some sorghum is also grown and beans—grown by some farmers, are usually intercropped with maize. Small amounts of potatoes and wheat are cultivated as cash crops. As across Lesotho, soil erosion and land degradation is also a major concern in the project area. Even to a casual observer, many areas in each of the project districts, look eroded and worn out. Gullies scar the landscape, and in many places the surface of the soils is crusted and hard.

Lesotho soils are mostly of alluvial, colluvial or eolian of either sedimentary or basaltic origin. Those derived from sedimentary rocks are more common in the lowlands and those from basalt and dolerite are predominant in the mountains. However, mixtures and variations occur throughout the country. Most soils in the flatter and gently sloping areas tend to be moderately deep to deep, and well drained, whilst those of the mountain slopes tend to be more shallow and stony. The principal arable soils of the lowlands and foothills are yellowish red to yellowish brown loams with sandy loam topsoil. They are moderately fertile and slightly acidic, and are prone to wind and water erosion.
In general, Lesotho soils, classified as *Oxisols*
9, are characterized by soil erosion, low pH,
and extreme deficiency of Phosphorus, physical problems such as difficult land
-topography, and the impacts of the environmentally degrading soil degradation
10. Soil
degradation is a two-stage process. Initially, organic matter-rich surface horizons are
removed leading to diminished nutrient supplying capabilities, water holding capacity,
biodiversity, and aggregation. In the more deeply eroded phases, such as in many areas of
Lesotho, soil water storage capacity is a limiting factor due to shallow soil depth.

Soil conservation touches many rural households since it provides major employment:
Over grazing, and bad farming practices have significantly contributed to soil
deterioration, and the traditional agricultural system lacks many soil-conserving
elements—broadcast of grains, dispersed rotational grazing, grassland surrounded
agricultural fields.

6. Water Resources

Technically, Lesotho is a water-abundant country, due largely to high precipitation in the
northeast where the main rivers rise. This abundance inspired the Lesotho Highlands
Water Project, which is now exporting water to South Africa. An FAO study estimates
surface water resources at 4.73 km$^3$/year—far in excess of the country’s requirements,
and the groundwater resources estimated at 0.5 km$^3$/year. Aquifer yields are low, usually
less than 1 liter/second.11

In the context of the farming, water resources can be viewed from three perspectives: the
precipitation that feeds crops; groundwater that supplies domestic needs from springs,
and reticulated water supplies; and rivers that feed some larger reticulation schemes and
provide the potential for irrigation. Taking the water balance into account, the overall
water output for Lesotho is estimated at 159.53 m$^3$ per second12. Ironically, in spite of the
abundance of water, from the people’s perspective, the domestic dimension of water
resources is still a constraining feature of their livelihood context; the population has
cited scarce, undependable, and unclean water as significant problems, according to the
studies done by Water and Sewage Authority (WASA) and others in Lesotho.

The overall potential for irrigation in Lesotho is generally considered to be modest,
because of topography and soil distribution relative to the position of suitable rivers.
However, micro-irrigation and water conservation techniques at the scale of the
individual field or homestead garden offer good potential. The government is also

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9 *Oxisols* are very highly weathered soils that are found primarily in the intertropical regions of the world. These soils contain few
weatherable minerals and are often rich in Fe and Al oxide minerals. Most of these soils are characterized by extremely low native
fertility, resulting from very low nutrient reserves, and high phosphorus retention by oxide minerals, and low cation exchange capacity
(CEC). Most nutrients in Oxisol ecosystems are contained in the standing vegetation and decomposing plant material. Despite low
fertility, Oxisols can be quite productive with inputs of lime and fertilizers.

10 A 1979 study argued, “ten of the 25 soil series described for Lesotho are classified as highly erodible, but most of the gully erosion
(dongas) actually occurs in the duplex or clay pan soils. Also, much of [the crop land] is so highly eroded that it should be returned to
permanent cover with only very limited grazing permitted. See Turner, 2003 op cit


And All Annexes Reports For Lesotho Government.. Maseru, Lesotho: Ministry of Natural Resources.
proposing major interventions to improve irrigation technologies for improving agriculture production.

7. **Biodiversity and Forest Resources**

The project areas, Leribe and Berea districts, each—Leribe more than Berea—has large areas of shrub lands, in particular rangelands, and a very modest area of plantation forests (mostly based on *Eucalyptus* and *Pinus*). In a few almost inaccessible areas, very small patches of Afrotomontane Forest are preserved. However, many forest areas have been cleared for agricultural use, the problem of soil erosion has been exacerbated. Furthermore, degradation in various forms is a dominant landscape feature, more in Berea, and relatively less in the Leribe district.

Lesotho, as a country, however has a high degree of botanical diversity. As many as 2,000 species of plants have been recorded in Lesotho, including such as the unique Peridophytes as lycophyte with secondary growth Isoetes welwitschii and two species of Ophioglossum, O. vulgatum and O. polyphyllum. Among the flowering plants these are: Euphorbia clavarioides, Euphorbia pulvinata (known only from Quthing area), Aloe polyphylla (endemic to Lesotho), Guthreia capensis (endemic to Lesotho), Dais cotonifolia (known from Berea district only), Aponogeton ranunculiflourus, Salix mucronata (indigenous willow), Leucosidea sericea (important species), Helichrysum palustre (endemic to Lesotho), and Helichrysum quthlambanum (only in Butha-Buthe district).

Some groups like algae and fungi have not received adequate attention. In addition, there are other plant species of concern, which are not physically protected even though they are protected by law. Lack of law enforcement and low fines has led to declining populations of these (and other important) species. *Aloe Polyphylla*, spiral aloe is an endemic plant that is also facing extinction. The exploiters are selling it to tourists and the public.

The country is full of mountains, and mountains are known centers for endemism. For example, with the altitudes ranging from 2,300 and 3,400 m, Drakensberg forms an important center for endemism as well as speciation. The Drakensbergs are thought to be some of the oldest mountains in the world and are in the center of a continent rather than at continental edges. The Mountains are an international 'hot-spot' of plant biodiversity, not only of vascular plants (over 2200 species in an area of about 40,000 km², but also of bryophytes.

The government's policy towards biodiversity is very emphatic in protecting wild genetic resources although the means of implementation are very limited because of the communal use of land resource in the country. The high risk of losing valuable

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13 The Drakensberg Mountains (28°30’ – 31°20’S, 27°00’ – 29°40’E) form a 300-km border between the landlocked mountain kingdom of Lesotho (formerly Basutoland; = Mountain Kingdom) and South Africa. The area was called Drakensberg ('Dragon Mountain') by the early Dutch settlers (Voortrekkers) because of its resemblance to the ridges of a dragon's back. The steep ridges of its dragon-like back are formed by headwater erosion of rivers that separate the Highveld Plateau from the coastal lowlands of southern Africa.
indigenous plant resources due to forest clearance, collecting of firewood and medicinal plants is a serious problem in Lesotho. Furthermore, there is rapid replacement of traditional varieties by the high yielding hybrid varieties. Cropland races and threatened plant Species should be the priority for future collecting missions in Lesotho.

8. Land Use Management Practices

Lesotho government’s policy calls for an integrated approach to planning and management of land. The overall objective is to formulate a land conservation policy to facilitate the allocation of land to promote transition to a sustainable and integrated management of land resources. Key guiding principles include: (i) Matching soil types with development activities, (ii) Land use plans should, *inter alia*, be based on land types, and (iii) Ownership of land to ensure that the farmers will manage it in a sustainable manner. In addition, the government is committed to developing sector master plans for all major social and economic sectors to enhance integrated and sustainable utilization of land resources.

In the project districts, overall land management however is considered highly inadequate, which is also a common trend across Lesotho. For example, in cultivation practices, there is little use of conservation tillage, crop rotation, or other soil conservation and cultivation practices that can help maintain soil productivity also minimize environmental damage from loss of vegetative cover, increased runoff, soil erosion and siltation. Judicious use of chemicals, both fertilizers and pesticides, expedient for economic reasons does not exist. This can help minimize or prevent eutrophication, groundwater contamination, nitrate accumulation, and evolution of pesticide resistance in non-target species that can result from excessive or indiscriminating applications. Furthermore, land management is also adversely influenced due to poor land tenure policies. These policies include: married status, acceptance of overall authority to the King of Lesotho, residency requirements, ability to cultivate the land for retaining it, unlimited grazing rights into any available grazing area etc. These requirements currently are under review.
AGRONOMIC, INSTITUTIONAL, AND ENVIRONMENTAL ISSUES

The project proposes to establish demonstration farms for growing: (i) apple and cherry trees in the Leribe district, and (ii) a vegetable farm in Berea district. Currently, in the project area, the most important economic activity is agriculture, with livestock the major component. However, as stated earlier, the climatic conditions and physiography impose serious varying degrees of constraints on crop farming.

9. Tillage Practices for the Horticulture Farm

Tillage practices for each of the proposed farms will vary significantly. Adequate and proper form of tillage is important since tillage as such is a major factor in the loss of soil carbon (the major component of soil organic matter), which leads to decreased productivity. It is therefore important to assess the soil types, topography, method of planting, and other factors to develop soil conserving, cost-effective tillage practices. For instance, conservation tillage systems and cover crops offer the potential to ameliorate many of the environmental concerns associated with agricultural practices, while improving soil productivity and economic profitability.

Soil preparation and soil testing before planting are important elements of productivity. To ensure long-term productivity of apples and cherries, the perennial crops proposed for the demonstration farm, it is important to prepare the soils through tillage and adding organic matter well in advance of planting. Prior to planting, through soil testing, nutrient levels and pH levels should be noted for adequacy. Lime can be added to raise the soil pH levels where it is below 5.5. Since phosphorus, potassium and lime do not move readily through the soil, pre-plant applications are generally the most effective. The same is true of micronutrient boron, needed for health apple and cherry growth. Agrochemicals containing these (and other nutrients) should be effectively worked into the soils. Furthermore, the target pH before establishing a new orchard is 6.5 on sandy soils and 6.0 on clay soils. Use of dolomitic lime (high in magnesium) on soils low in magnesium is recommended. Rates of application vary with soil type and initial pH.

In addition, care must also be exercised to minimize erosion due to trees or vegetable plantation. Erosion rates are generally high during crop establishment, and decrease during the growing season as surface coverage increases. In furrow and bed systems commonly used for vegetables, initial erosion is due to raindrop detachment of soil from the beds. Some of the detached soil accumulates into the compacted furrows. However, rapid soil loss occurs in overland flow down the furrows during heavy rainstorms. All such aspects need to be carefully understood in the context of each demonstration farm area. An analysis of soil texture, soil structure, topography, rainfall, and others in the context of cultivation practices would be useful. Analysis of suspended sediments and the

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\(14\) An operational definition of conservation tillage used by the Natural Resources Conservation Service of the US Department of Agriculture states that conservation tillage is “any tillage system that leaves greater than 30 percent residue remaining on the soil surface after planting”
original soil should be included. It is important to note that the finest particles, usually the most enriched, are also likely to be transported furthest, and to ultimately reach reservoirs and other surface-water bodies. These particles also carry most of the nutrient pollution potential and proper tillage practices can help reduce this potential.

10. Irrigation for the Farm

For irrigation, the Berea farm will draw water from the Caledon River, flowing along its northwestern borders, and use a center pivot system, currently installed on the farm. Such a system however is considered uneconomical where soil types vary, a case in this site. A pumping station already exists at the farm. It is being made operational according to Alpha Estates Management, the project’s partner. At the Leribe site, the water will come primarily from boreholes and the existing irrigation system. Sound irrigation systems and practices are essential for good crop production at each of the sites. The system at Berea needs a careful review.

Also, the type of irrigation method used has implications on water usage, and in some cases crop production. For instance, surface irrigation has unavoidable water wastage that can lead to water logging or salinity, as well as encouraging agrochemicals applied on the surface to be carried with the drainage water. Sprinkler irrigation, when well managed, and drip irrigation use only the water the vegetables (and other crops) need, and also minimize the drainage problems.

In addition, good quality irrigation water is essential to ensure high yield, produce of good quality, minimal damage to the soil structure, and low risk of contamination to groundwater resources and low risk of damage to irrigation equipment. For example, use of iron rich waters, with concentration above 0.2 mg/l will result in spots on leaves. This occurs as a result of iron being in contact with air it precipitates; the same precipitates on leaves will result in spots. Foliar damage can be seen as white carbonaceous deposits resulting from evaporation of irrigation waters or discoloration of leaves and or defoliation. The result is decreased visual quality of crops and their eventual market value.

Poor irrigation water quality also poses increased risk of damage to irrigation equipment, impacting the equipment’s sustainability. Such damage can be in the form of clogging of drips, encrustation of pipe and or scouring of irrigation pipes. A number of factors can contribute towards irrigation equipment damage: pH and presence of suspended solids in irrigation water. In addition, according to US Department of Agriculture, presence of suspended solids at a concentration above 50 mg/l will cause clogging of drip irrigation systems, and 0.2 mg/l of iron will causes clogging on trickle or drip irrigation systems. In addition, oxidation of Manganese-to-Manganese Oxide can cause clogging to irrigation equipment at concentration above 0.2 mg/l. It is therefore important intermittently test the irrigation water quality.

Furthermore, yield decreases can occur as a result of exposure of crops to unfavorable water quality while irrigating. Suspended solids concentrations above 50 mg/l, salt
sensitivity, and high solids content will reduce crop yield. Yield decreases can occur as a result of exposure of crops to unfavorable water quality while irrigating. Suspended solids concentrations above 50 mg/l, Salt sensitivity, and high solids content will reduce crop yield. The government as a means of ensuring food security is currently exploring a number of irrigation initiatives across Lesotho.

11. Application of Fertilizer\textsuperscript{15} and Pesticides\textsuperscript{16} for the Farm

Fertilizer can be applied in the form of solids, semisolids, slurry suspensions, pure liquids, aqueous solutions, or gases can be added to the soil, or applied directly to crop or tree foliage, to supply elements needed for plant nutrition. Most commercial fertilizers, in addition to nitrogen (N), phosphorus (P) and potash (K), the essential elements, also contain micronutrients such as boron, cobalt, magnesium, and others. Organic fertilizers come from organic materials of vegetable and animal origin, which contain certain macro, secondary, or micronutrients that can be utilized by plants after application to agricultural soils.

Nutrient levels in the topsoil considered adequate for apple orchard establishment are\textsuperscript{17} 12-20 ppm phosphorus, 120-150 ppm potassium, 100-250 ppm magnesium, and 1000-5000 ppm calcium. On coarse-textured, infertile soils, the use of a starter solution at planting time (e.g., 10-52-10 or 20-20-20 of NPK respectively) may give the trees a needed boost. High nitrogen levels can result in excessive growth and incomplete tree hardening. Because of the complexity of nitrogen interactions with quality and production, the best guide for nitrogen rates is leaf analysis. There are several forms of nitrogen available, but ammonium nitrate (34-0-0) or calcium ammonium nitrate (27-0-0) is the most economical form of nitrogen to use. Where blended fertilizers are used, ammonium nitrate as the N source has generally given higher crop productivity.

While benefits of fertilizers (and pesticides) are well known, such benefits do not come without cost; one such cost is environmental pollution. Given this situation, water resources in the vegetable production areas have a high risk of contamination due to high application rate of fertilizers and pesticides, in particular for vegetables. It is important to apply sound technologies and management options to minimize the contamination of water resources by agrochemicals. An example is the use of conservation tillage, an appropriate technology, both for Leribe and Berea districts.

Given their toxic effects, pesticides use involves environmental and health issues. Their use, including importation, must therefore be regulated. Pesticides use should involve a need-based approach and where feasible, Integrated Pest Management (IPM). Thus, the quantity (and quality) of pesticides used must be controlled. Some countries including Malaysia, South Africa and Sri Lanka have proposed review of the definition of threshold values for pest or pathogen damage as a means of reducing the frequency of pesticide

\footnotesize 15 Natural or artificial substance containing the chemical elements that improve growth and productiveness of plants can be applied to enhance the natural fertility of the soil or replace the chemical elements taken from the soil by previous
\footnotesize 16 Refers to herbicides, insecticides, and fungicides
\footnotesize 17 These levels, based on soil analysis and other site-specific data need to be calculated for each site. This information was not available for the project districts. (Based on discussions with the Leribe’s District Agriculture Officer, August 23, 06)
application. Improving application technique can also help. For example, in South Africa improved application techniques for cotton helped improve (application) efficiency, and when coupled with the use of threshold values, quantities of insecticide (for cotton) needed were reduced by 30 per cent.

Horticulture Farm Nutrient Needs and Quantities of Fertilizer

Several factors influence the amount of nutrients, NPK required per hectare. Included are: the type of fruit (in this case, apples or cherries) or vegetables grown, the soil type, plant density, climatic factors, and others. For the proposed farm, in absence of lack of data and information including with the two South African partners, this information cannot be provided at this time. Nevertheless, recommending fertilizer levels or using the recommended rates, it is important that the environmental side-effects of nitrogen application, in particular the leaching of nitrate, should be explicitly taken into account in the any systems. Ideally, recommendations should provide farmers with accurate tools to obtain high crop yields of good quality with the minimum burden on the environment.

Given the environmental implications, any over-fertilization, particularly of nitrogen, is detrimental. For instance, in the US, leaching nitrogen losses in cabbage farms have been reported about eight per cent of the nitrogen applied. One rule-of-thumb is to reduce nitrogen rate by half if proposed orchard is cultivated without sod between tree rows. Another similar (rough) rule for many locations is not to exceed 200 kg of actual nitrogen/hectare/year regardless of the number of trees/hectare. The exact amount of nitrogen to apply is a function of soil nitrogen level, cultivar, rootstock, soil moisture, etc. The best way to determine nitrogen requirements is by taking leaf analysis regularly. One U.S. study found low residual levels of nitrogen, on the average, 20-75 kg N ha\(^{18}\) for Brussels sprouts and cabbage, after recommended dozes were applied. Such levels are usually high, up to 200 kg/ha where vegetables such as spinach that are harvested before maturity.

It is important to note that the quantity of nitrogen fertilizer to be applied is primarily a function of the difference between the mineral nitrogen content of the soil plus the amount likely to be released during the growing season from organic sources, and the nitrogen required by the plant. Before applying fertilizers, it is important to measure or estimate these two main sources of mineral nitrogen in the soil: the nitrogen already available at the beginning of the season (called soil mineral nitrogen), and the nitrogen released by mineralization throughout the season. For vegetable farms, the quantity of nitrogen can be estimated by: (previous) experience and observations, by performing calculations, or better by directly measuring the quantities involved by means of soil and plant analyses.

Phosphorus, the other major nutrient is (often) not required in large amounts by apple and cherry trees, the two crops for the proposed demonstration farm at Leribe. Based on anecdotal evidence, and with few exceptions, the level of phosphorus in Leribe soils

seems adequate at present; a soil test should be done. However, subsequent to a couple of years after seedling plantation, if cover crops are planted between trees, Phosphorus does have a place for its maintenance. A soil test is the best way to determine if there is a need to apply this nutrient. In the absence of a soil test, a complete fertilizer (100 kg/ha 10-20-20) could be broadcast and incorporated before seeding a cover crop in an orchard. Phosphorus should also be applied before planting an orchard when it can be thoroughly incorporated in the soil if a soil test indicates a need. Phosphorus soil test values between 12-20 ppm are considered adequate for tree fruit establishment and production. It is important to note that in acidic soils, Phosphorus gets fixed and its availability may be limited.

Potassium is important for fruit color, winter hardiness, and tree growth and disease resistance. An excess amount of potassium however can lead to deficiency of magnesium (Mg), so take care when deciding upon potassium rates. Potassium soil test values between 120-150 ppm are considered adequate when planting tree fruits. muriate of potash (0-0-60) is the most common form of potassium. If leaf analysis data is not available, use approximate rates as noted in the table below. Apply no more than 3 kg of K2O (5 kg muriate of potash) per mature standard apple tree in a year, regardless of how severe the deficiency. When the tree canopy has covered the space available, potassium fertilizer requirements will level out and will not increase indefinitely with tree age. Again leaf analysis is the most reliable guide.

It is important to note that micronutrients deficiency is not shown by many soils. Among the micronutrients, magnesium should be of particular concern. Its deficiency can be native to the soil or can occur when high rates of potassium are applied. Magnesium deficiency can lead to premature drop of fruit at the harvest. Leaf analysis is the best way to evaluate magnesium deficiency. Magnesium sulfate (Epsom salts) or liquid formulations including chelates are recommended for foliar application. This situation, given the lack of data and available information, could not be verified for Berea and Leribe soils.

Likewise, calcium deficiency is associated with fruit problems with apples. Calcium has been shown to advance fruit maturity. Based on the soil and leaf analysis, its deficiency should be mitigated through use of calcium chloride or calcium nitrate. Other formulations available include chelates. In alkaline soils or sandy knolls, boron deficiency often shows up. Apples are the most sensitive fruit crop to boron deficiency. Symptoms include internal breakdown of highly colored fruit that drops prematurely. Leaf tests should be done to check boron deficiency. Foliar sprays of soluble boron fertilizer can be applied in pre-determined dozes to correct deficiency. The deficiency of Zinc, another important micronutrient of relevance, in apples, shows as short internodes, small narrow leaves, *interveinal chlorosis* with shoot and branch dieback in advanced stages. In managing nutrient deficiency, words of caution: (i) Nutrient sprays should not be concentrated, and (ii) spraying when temperatures are above 25°C may injure fruit.
Environmental Fate of Fertilizer Nitrogen

Nitrogen fertilizers contain nitrogen in one of the three forms: ammonium, nitrate or urea, the most common form, worldwide. However, regardless of the type of fertilizer used, the same type of benefit, nitrates, is available to vegetables and crops. Nitrates are extremely soluble in water, which means the irrigation (or rain) water passing through the soil may carry nitrates with it. Ammonium, which is not soluble in water, is converted to nitrates by microorganisms, and therefore also contributes to nitrates over the long-term. Where yields need to be maximized such as for cash crops\textsuperscript{19}, vegetables included, intensive cultivation including through use of fertilizer is recommended. This offers the potential to lead to a to wide scale nitrate contamination of ground and surface waters.

A number of processes are involved in the N cycle of agricultural systems. These include: assimilation, mineralization/immobilization, nitrification, de-nitrification, ammonia volatilization, nitrate leaching, runoff and erosion. In vegetable production, nitrate leaching is the dominant process affecting the environment. Often, large amounts of nitrogen, including residual soil mineral nitrogen and the nitrogen present in crop residues remain in the soil after harvest of the crop. Both sources of nitrogen may affect groundwater quality through nitrate leaching. Emission of N from agriculture may affect the quality of the atmosphere, and ground and surface waters.

In the soil, nitrogen is present in several distinct forms: nitrates (NO\textsubscript{3}), nitrites (NO\textsubscript{2}), nitrogen gas (N\textsubscript{2}), ammonia (NH\textsubscript{3}), and ammonium (NH\textsubscript{4}). The oxidation of organic nitrogen through to nitrates via a number of reactions is called mineralization. The first step, conversion of organic nitrogen to ammonium is called ammonification. Organic matter e.g., plant residues is converted into ammonium by biological activity. In (very) acidic (or waterlogged) soils, ammonium is the final product. However, in most soils, ammonium is converted first into nitrites and then into nitrates in a stage of mineralization that is called nitrification. Bacteria, Nitrosomonas and Nitrobacter, found in most soils, perform nitrification. Ammonia is present either dissolved in the soil water or is captured by cation adsorption and remains in the soil for a long time. Adsorption in the soil is increased if montmorillonitic clays are present. Adsorbed ammonia is slowly released, making it more available to plants. More ammonia is converted to nitrates through nitrification, or lost through volatilization, than adsorbed via \textit{Cation Exchange}, a process that occurs in soils.

Nitrification generally occurs very rapidly, before the through-flow of soil-water with the dissolved ammonia comes into contact with a sufficiently effective volume of soil with a significant proportion of the ammonia to be removed by Cation Exchange. The mineralization process is reversible. The soil biomass can also contain bacteria that can destroy nitrates; process is called denitrification. Mainly, this process occurs in wet soils. Any nitrate that is denitrified is reduced to ammonia and either dissolves in water or evaporates through the soil (sometimes called volatilization). An area’s climate and variation of agricultural practices from season to season alter the relative significance of

\textsuperscript{19} In agriculture, a cash crop is a crop (e.g., sugarcane, bannana, potatotes and others) which is grown for money. The term is used to differentiate from subsistence crops, which are those fed to the producer’s own livestock or grown as food for the producer’s family.
each in the unsaturated zone of transformation between ammonia and nitrogen. For example, the volatilization of nitrogen to the air increases as the soil becomes drier in summer period. The distribution of nitrogen in the soil is also dependent upon denitrification in the root zone, and on transportation processes between the root zone and the water table. To minimize adverse effects, it is important that all these processes are well understood in the content of local crop production.

12. Types of Pesticides for the Farm

The type (and quantities) of insecticides to be used at the demonstration could not be ascertained during the period of study. Common plant diseases according to AEM include: mildews, black spot, and corn leaf blight. If organic farming for apples and cherries is to be practiced, pesticides may not be involved especially during the early years. An important issue in the proposed use is the lack of facilities and weak regulatory issues as they related to pesticide procurement, storage, use and other management aspects.

However, insecticides that are likely to be used would be similar to those in use in the bordering Republic of South Africa. These include: pyrethroids, chlor pyriphos, Delta methryn, prothiophos, cabaryl, permethrin and teflubenzuron, methamidophos, metolachlor, carbendazim and carbosulfan. While their insecticidal properties are well documented, it is useful to know that among these, the last four have shown high leaching potential in alluvial soils common in the project area. In several field studies, cypermethrin has shown low leaching potential in similar soils. Trizol is a common fungicide used. While selecting an insecticide, in addition to the cost and availability, environmental issues should also be considered. Several pesticides are currently banned for use in agriculture. Call Box: List of Insecticides and Chemicals Banned provides this list.

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Call Box: List of Insecticides and Chemicals Banned

<table>
<thead>
<tr>
<th>1. Aldrin</th>
<th>10. Nitrofen</th>
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<tbody>
<tr>
<td>2. Dieldrin</td>
<td>11. Captafol</td>
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<tr>
<td>3. DDT</td>
<td>12. Toxapene</td>
</tr>
<tr>
<td>4. Dinoseb</td>
<td>13. Endrin</td>
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<tr>
<td>5. Fluoroacetamide</td>
<td>14. Phenol, pentachloro-</td>
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<tr>
<td>6. HCH (mixed isomers)</td>
<td>15. Ethylenedibromide</td>
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<tr>
<td>8. Chlordimeform</td>
<td>17. Oxirane</td>
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<tr>
<td>9. Cyhexatin</td>
<td>18. Lindane, and others</td>
</tr>
</tbody>
</table>

Source: www.epa.gov

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20 A “banned” pesticide is defined as a pesticide for which all registered uses have been prohibited by final government action or for which all requests for registration or equivalent action for all uses have, for health or environmental reasons, not been granted.
Agricultural chemicals pose a particular risk to people and environment. Data published by the International Labor Organization (ILO) indicate that 10 percent of fatal accidents in developing countries are associated with agricultural chemicals. Women are particularly exposed to the risks of handling plant protection products. While international conventions try to create conditions necessary for safe management of chemicals, including agro-chemicals, each country, however need to develop and implement their specific legislation mandating safe use. Such framework conditions are weak or missing in Lesotho. In addition of effective legislation, the GOL should also, as a start, test-use modern less toxic and more easily degradable plant protection products and environmentally sound spraying devices and techniques that are commercially available.

Potential Risks of agricultural chemicals include: improper storage, poor labels including lack of information about the substance, human health dangers due to inhalation (including from drifts from neighboring fields) or skin contact without adequate personal protective equipment (such as masks) and from contamination of soil surface water, the atmosphere and clothing. Some of these issues are particularly serious on small farms where spraying equipment and plant protection products are expensive. Given the paucity of formal storage space, and to guard against theft, agricultural chemicals including pesticides tend to be stored in living areas of the house. Furthermore, leftover pesticides are decanted and kept in used bottles. Empty pesticide and fertilizer containers, after casual washing, are used to store food products or dirking water. The practice poses high risks particularly to children and pregnant women; often, there are no ‘protection periods’ for pregnant women. Women are also at risk when they wash contaminated clothes for their husbands; the group (women and children) while valued for their manual dexterity in the agricultural fields, their health and safety interests are ignored.

The handling of chemicals, and particularly agricultural chemicals, is regulated by a number of international conventions and standards. These conventions have not been signed or ratified all countries, which have signed them; implementation is far from being completed. Despite worldwide efforts involving parts of the industry, safe management of agricultural chemicals has yet to be achieved in many developing countries, where the reality falls a long way short of the standards. In Lesotho, currently, there is no complete and reliable statistics on chemicals and information or organizational structure on agrochemicals management. MTEC in partnership with other organizations, as relevant should look into this situation on a priority basis.

There is a need for a coherent Lesotho government policy that ensures that the requirements of the World Bank, and also objectives of Agenda 21 (UNEP)\(^1\), such as

integrated pest management, and the relevant conventions are developed. At the farmer level, therefore, among regulatory and other mitigation measures, education and awareness, including through training are essential. Furthermore, such regulatory structures are necessary because no country can relinquish responsibility at its own borders. The consumer such as in Europe (for Lesotho products) can also play an important role in improving the situation by buying products with an Eco-label or another one, as applicable. The issue of contamination of the environment with the agricultural chemicals is very complex and a coordinating, cooperative action among various Lesotho ministries is urgently needed.

Programs to Ensure that Only Pesticides of Acceptable Quality Are Available

In Lesotho, currently, there are minimum control on the importation and use of pesticides. Anecdotal evidence shows that often, inferior quality (and sometimes of unknown quality) pesticides are procured and used. Some of these pesticides came under donor programs and over time, gotten deteriorated, given poor storage and management. They often contain a lower level of active ingredient than is listed on the label, encouraging the farmer to apply the product more frequently than recommended on the label.

In other cases, the inferior quality products may contain toxic contaminants or degradation products that represent a greater hazard to human health and the environment than the pesticide itself. Stringent regulatory requirements including those related to imports need to be in place. Better management of pesticide stocks should be made a recurrent theme in training programs including for pesticide dealers and retailers. Such training should emphasize the importance of storing pesticides under appropriate conditions (adequate ventilation, etc.) and ensuring appropriate rotation of stocks so that product viability is maintained.

Competence of End Users for Pesticide Use

Generally speaking, farmers in Lesotho are illiterate, experienced only in growing small acreages, normally re-growing the same kind of plants in the same fields over a long period and with very little, if any, crop rotation. As a consequence, there is a serious lack of understanding of the agronomic character of other crops such as apples, cherries and except for cabbage, other vegetables proposed under the farm. Included are the quantities of fertilizers and pesticides to be applied, and more importantly, their proper storage, use and environmental management. Given the environmental and health dangers associated with pesticides, it is very important that such aspects are well understood by the farmers
and well disseminated by the authorities. To highlight its important, one teaspoonful of spilled pesticide concentrate could pollute the water supply of 200,000 people for a day.22

The majority of pesticide application for agriculture is by spraying. Pesticide spray can drift and vaporize, causing non-target effects. Incorrect application in windy conditions, or using equipment that is not properly calibrated means that the pesticide may not reach its intended target. But a large proportion even of a pesticide that is properly applied will vaporize into the atmosphere. Many people have been affected by spray drift.

Given the very high illiteracy levels of Lesotho farmers, development of innovative training programs would be required. It may include use of audio-visual tools and hands-on demonstrations. In addition, a more "holistic" approach to training may also be needed where entire community is involved, as part of the training programs. Training techniques have proved more useful where they have focused on identified local needs and use of local dialects during training.

Some countries such as Thailand are also targeting children by incorporating environmental programs into the school curriculum at several levels. Call Box: STOP – Safety Towards Our People shows such programs in South Africa that involves close public and private sector participation. Also, in South Africa, all Pest Control Officers (PCOs) must successfully complete the prescribed training and be registered with the ministry of Agriculture. PCOs include salaried applicators (ground and aerial) that apply pesticides in agriculture as well as for structural pest control.

3.4.3.1 Training

Training is an important component of pesticide risk reduction activities and improving farmers’ competence in its use. However, it is important to design training programs to reach as broad an audience as possible, because the hazards associated with pesticides are not limited to the farmer/applicator or end user. For example, while the importance of proper storage of pesticides is a component of training programs in safe use, there are continuing problems owing to the fact that many farmers store pesticides in their living quarters, often in close proximity to food preparation areas and within the reach of children.

STOP – Safety Towards Our People:

In South Africa, a program, being implemented in five regions, informs young people of the potential hazards of chemicals including pesticides. It is seen as a means to foster a positive attitude in the adults of the future. In the short term, parents can be used as vehicle to reach their children to pass the information. A syllabus, "The safe handling and storage of pesticides", prepared for teachers; Others: "Don't fool be cool with pesticides", aimed at children, and a pamphlet, "What you should know about the safe handling and storage of pesticides", have all been prepared. Since its initiation, approximately 225 teachers from 154 schools were trained. A total of 9,400 students have participated in the program to date. The importance of community involvement in the successful implementation of this project has been emphasized.

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22 http://www.pan-uk.org/briefing/tgwu.pdf; See background paper on the control of pesticides.
If training programs attempt to address such problems, they must be directed not just at the end user but also at all members of the community including children and women. It is only through such an approach that lasting changes in the attitude of farmers towards a more judicious handling and use of pesticides will be achieved. "Holistic" approaches to training and education are relatively new, and it may be several years before their full impact can be assessed. Initial indications are that attitudes at the farm level are changing and that, where viable and affordable alternative chemicals or agricultural practices have been identified and/or protective equipment is available, farmers will make use of them.

13. Pesticide Use Policies

Lesotho does not have specific legislation on the management of hazardous wastes. The Environment Act 2001 has provision relating to hazardous wastes but such provision is only with respect to issuing of waste licenses, exportation of wastes and the general administrative issues such as record keeping. Also, there are no plant protection policies in Lesotho.23

The authority, which has overall control over pesticides, should be inter-ministerial or at least interdisciplinary in character, as issues of health and safety, food and environmental protection, agricultural production and economic affairs will be involved. In order to help to meet this obligation, a designated board or agency is normally required to control pesticide hazard programs and schemes.

In addition, plant protection and consumer protection law must embrace issues of pesticide application and this is a clear requirement. There is a need for a regulatory authority with statutory powers to control the use of, and exposure to, pesticides and this should include the assessment and certification of workers who operate application equipment.

Specific Institutional and Legislative Arrangement for Pesticide Management

A strong and effective management of pesticides (and other hazardous wastes) depends on the existence of strong and efficient institutional arrangements, adequate technical infrastructure, public awareness and participation, clear mandates, political will (not to mention the rule of law) and the muscle to implement the regulatory regimes.

In Lesotho, at present, overall the institutional set up ranges from non-existent to weak. It is fragmented through several ministries and agencies that also have responsibilities for several other, many non-related to plant protection, key functions. Based on anecdotal evidence, a very weak inter- and intra-agency co-ordination also exists between these agencies. Appendix A: Key Ministries Responsible for Management of Pesticides in Lesotho synopsizes the role of various organizations.

23 Personal Communication with Mrs. Mapales Mothokho, Chief Horticulturist, Department of Crops, Ministry of Agriculture and Food Security, August 28, 06
In terms of regulations, currently, there are rudimentary laws that directly relate to the management of pesticides in Lesotho. Overall pesticides management issues are included under hazardous waste management. The Department of Environment established multi-sectoral committees such as Committee on Waste Management (COWMAN) and Committee on Environment Data Management (CEDAMA) as provided for under the National Environmental Policy in Article 4.17 and the Environment Act 2001 in Section 76, 77 and 78. Further, under the auspices of United Nations Institute for Training and Research (UNITAR), Lesotho developed a National Chemicals Management Profile that amongst others analyses a problem of hazardous wastes, including pesticides, within the country.

The first attempt to put some regulatory instrument took place in the form of Pesticides Management Bill of 1986, which was intended to regulate the general use of pesticides. The Bill requires an EIA for large-scale use of pesticides. However, to date the Bill not had been approved. Lesotho therefore is faced with a situation where any chemical could be used regardless of its significant impact on the environment and human health. In the textile industry, given the privacy issues, it is known what chemicals and dyes the industry is using in its manufacturing. The existing situation needs an urgent review.

14. Use of Integrated Pest Management (IPM)

Pest management can be compared to walking a tight rope: striving to balance prospective pest damage, control costs and any health or environmental liabilities of management actions. IPM offers a good option. IPM does not entirely exclude the use of pesticides but advocates their rational use in the context of environmentally sound pest management practices. Its goal of IPM is to mitigate pest damage while protecting human health, the environment and economic viability. Many aspects of plant health care/crop protection in ways that mitigate harmful environmental impacts and protect human health are incorporated by IPM. IPM can also help identify where additional education or expert advice is needed. However, well-informed decisions depend on collecting both current and historical information about the situation including the site and the pest(s). However, in all cases, a pesticide “use” must mean activities conforming to product labeling, which include mixing, loading, disposal, application, and storage of pesticides.

Pesticides application alone or without economic considerations is not recommended under an IPM approach. Components of IPM systems include biological, environmental, and economic monitoring, predictive models such as economic thresholds, biological control, host plant resistance, and habitat management through crop rotations, intercropping, antagonistic plants or other organisms, trap crops, cover crops, and sanitation, among other practices. Ecologically based IPM involves various combinations of these management tools, with chemical inputs applied only when absolutely needed to restrict pests from reaching economically damaging densities. Educational programming, policies, and regulations can be used as enablers to provide an environment conducive to IPM adoption.
Also, under an IPM approach, in addition to the judicious use and safe handling and disposal, pesticide selection must be made with an aim to minimize impact on the agro-systems. It is also important to consider use of non-conventional pest control practices—biological control, bio-pesticides, and growth regulators, and pheromones included—before considering use of pesticides. Also, such a use must be employed only when compatible with other pest management practices and is also economically justified in terms of having a positive effect on net farm profits that is not offset by increased short and long term risks to health, environment or profit. Applying pesticides alone or using them without a cost benefit analysis is not recommended under an IPM approach.

Management Options for IPM

Assessing outcomes provides information on the effectiveness of management options, help improve the IPM program and help identify any unintended outcomes. Evaluation should begin with a review of the original goals of the IPM program. The next step is the review of records kept throughout the season to help review and identify the management options that were implemented. Finally, outcomes should be evaluated based on the effectiveness of IPM activities through an assessment of current pest, host, and site status.

Decision-making however is complex and decisions must be tailored to minimize risk to humans and the environment and at the same time maximize benefits. IPM uses a combination of methods (sampling, thresholds, forecasts, biological and cultural controls, etc.) to manage pests without solely relying on chemical pesticides to produce a safe, economic crop. Call Box: Management options for IPM highlights key elements. Some organically (approved) growers, as envisaged under the project, believe that only natural pesticides should be used in agricultural production systems because they are naturally occurring and are perceived to be less harmful to the environment.

Overall, IPM decisions are predicated on three very important considerations including economics, environment, and human health. The choice of management tools rests with the value assigned to each of these three considerations. The key to using IPM is being...
flexible and planning for adjustments or fine-tuning. The more flexible the IPM program, the greater the chances of finding an effective solution, which will provide long lasting benefits.

**IPM and the World Bank**

According to the World Bank, IPM involves:

- Managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them;
- Relying, to the extent possible, on non-chemical measures to keep pest populations low; and
- Selecting and applying pesticides, when they have to be used, in a way that minimizes adverse effects on beneficial organisms, humans, and the environment.

Implementation of IPM, given the lack of experience even with conventional pest control practices is not recommended for the proposed farm. Over time, in few years, as the current pesticide regulatory system is revise and experience with demonstration farm takes a foothold, IPM use may be considered.

**Application of World Bank Safeguard Policies**

Based on the environmental evaluations, it appears that the horticulture demonstration farm is likely to have minor environmental impacts. These impacts are expected to be minimal, site-specific and manageable to an accepted level. Furthermore, the proposed monitoring and evaluation plan will assure mitigation environmental impacts, as they relate to the project activities. Given this situation, the project has been classified as a Category B, with OP 4.09 triggered under the World Bank guidelines, which presided to the decision to prepare this Pest Management Plan.

The World Bank’s pest management plan reflects the policies set out in OP 4.09, Pest Management. According to OP 4.09, "The Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides." On Bank-financed agricultural operations, OP 4.09 continues, "Pest populations are normally controlled through IPM approaches, such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest." Furthermore, a condition for pesticide purchases is that "Their use is justified under an IPM approach". The policy also contains criteria for pesticide selection and use, namely that any pesticides used in Bank projects must have negligible adverse human health effects and minimal effects on non-target species and the natural environment.

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OP 4.09 prohibits the purchase of pesticide products categorized as WHO Classes IA, IB, or II. Given the potential funding for the project, it is important that the GOL, in addition to its own legislative and other requirements also adheres to the Bank’s requirements. IPM is also recognized as the preferred option for pest management under Agenda 21 of the United Nations Conference on Environment and Development (UNCED) 1992.

15. IPM For Lesotho/Action/Implementation

*Actions depend upon the pest problem, site situation, and the available management options.*

IPM, a dynamic system, is adaptable to diverse management approaches, providing flexibility to key participants such as the government, industry and the individual farmers. To implement IPM, it should first assess the pest situation, evaluates the merits of pest management options and then implements a system of complementary management actions within a defined area. A proactive rather than a reactive mode should be adopted.

Ongoing monitoring and timely detection to minimize loss and/or safeguard human health and the environment are critical to successful implementation. For example, monitoring of a site allows for the early detection of pests and aids in the accurate assessment of the current situation. Ongoing observation of the pest, the host, the site, and related environmental factors are necessary in order to detect and assess emerging problems. Through timely monitoring, pest numbers and distribution patterns can be determined. Focusing on the key pests and mapping out problem areas is the only way to understand the extent of the problem so that timely pest management decisions can be initiated. Monitoring should also measure the effectiveness of IPM introduction such as through number of farmers trained, number using the IPM and other parameters. It should assess built up IPM capacity and identify barriers to establishing sustainable IPM use.

Likewise, the proper Identification—the cause of the problem must be correctly identified. Incorrect pest identification leads to misdirected management efforts or ineffective control. Knowledge of a pest's biology, habits, and life cycle will aid in identifying the weak link in the pest's life cycle. Differentiating between beneficial organisms and pests is essential in making treatment decisions. Information gathered through monitoring coupled with correct identification is utilized when deciding on a plan of appropriate actions.

It is important that the GOL develops a detailed IPM (and Pesticide Management Plan, (PMP), the later outside the scope of the current study; see Appendix B) to help coordinate activities necessary to protect Lesotho’s soil and in particular surface and groundwater contamination, as well as human health. In addition to agriculture, such a PMP is also useful for other uses (e.g., urban, structural, forestry, and rights-of-way). It can also help guide the relevant ministries in the development of pesticide Best Management Practices (BMPs) or other necessary responses in a framework containing prevention, evaluation and mitigation components.
Currently, no integrated pest management approach exists in Lesotho. There appears to be a general lack of awareness about IPM including among the technical field staff. Significant efforts to develop and strengthen pesticide procurement and use including under IPM, as needed, and other measures will be required. Such measures may include: (i) activities of the Integrated Pest Management Plan, (ii) key participants including private sector, (iii) Institutional arrangements for implementation, and (iv) Cost estimates. Mandatory IPM programs, either state or federal, can be difficult to implement in Lesotho given the technical, budgetary and non-existence of the IPM legislation and other issues.

Some of the IPM program activities include generating IPM information, such as via newsletters, for growers, producers and land managers which inform them of relevant issues and can help them make alternative choices in their pest management decisions; developing an IPM in Schools program to educate school districts on IPM and how to implement its use; and providing funding for IPM research.

The Ministry of Tourism, Environment and Culture, which is responsible for all national plant protection matters, is proposed as the national government institution that will undertake supervision of the implementation of the IPM, which must have a wide national coverage rather than only in the project sites. This will not only minimize pest infestation but will provide support to other areas where the demonstration farms may be replicated, if found successful. A phased plan should aim at national coverage over time.

Training to Implements IPM

The GOL: should target key groups to provide education and training, as relevant on such issues as: land use, land management, community health, crop production, economic profitability, and risks versus benefits, relevant to pesticide use as it impacts on water quality, not only in the project areas but across Lesotho as technical and budgetary constraints are minimized. Effective prevention strategies are encouraged through education and promotion and training. Target groups include pesticide users, policymakers, landowners, retailers, general public, crop consultants, institutions, financial institutions, agencies, and residents. It may also be useful to form Community IPM Action Committees at the rural level as trainees.

Conventional training modules such as study tours, workshops, use of field brochures, CD/ROM’s including in local languages/dialects, training of trainers (TOT) courses and others have also proved useful for IPM. The GOL should develop detailed plans—beyond the scope of this study—upon identification of its needs.

3.7.1.1 Farmers Field School
One training model, proven particularly suitable for training farmers is Farmers Field School (FFS), a group-based learning process. The IPM farmer field school has become a model approach for farmer education in Asia and many parts of Africa and Latin America. The approach has been used with a wide range of crops including cotton, tea, coffee, cacao, pepper, vegetables, small grains, and legumes. The FFS has produced other developmental benefits that are broadly described as ‘empowerment’, necessary to make informed decisions, and has also stimulated continued learning, and that it strengthened social and political skills, which apparently prompted a range of local activities, relationships and policies related to improved agro-ecosystem management.

The concept has been successfully used by a number of governments, NGOs and international agencies to promote IPM use. The School brings together concepts and methods from agro-ecology, experiential education and community development. FFS provides hands-on education necessary to improve farmers’ expertise. As a result, hundreds of thousands of rice farmers in countries such as China, Indonesia, Philippines and Vietnam have been able to reduce the use of pesticides and improve the sustainability of crop yields.

Given the wide variation in cost and benefits, the GOL should, via pilot field programs, evaluate the potential of this concept for IPM. Pilot projects often compared pesticide use and yields or profits of field plots grown with IPM practices and those under regular farmer practice, to demonstrate the merit of the approach.

![Figure 3-1. Rice farmers in Indonesia attending an FFS, 1991, organised by FAO](Photo by JM Micaud)

For the technical and policy staff, facilitated techniques to foster participatory learning can be implemented. These include: review of pesticide pollution prevention from case studies, interactive exercises, problem-solving techniques and group discussion. The process can help develop a participatory framework for possible roles for government,

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25 Key activities involve simple experiments, regular field observations and group analysis. The knowledge gained from these activities enables participants to make their own locally-specific decisions about crop management practices. IPM Farmer Field Schools were started in 1989 in Indonesia to reduce farmer reliance on pesticides in rice.

26 Photo by JM Micaud
industry (and academia) in developing such a program. The framework should focus on the use of IPM and should also include: (i) options for the disposal of small and bulk quantities of pesticides; (ii) provide a basic technical, legal, and logistical framework; (iii) develop national and regional pesticide procurement, use and disposal expertise; and (iv) provide guidance to avoid future problems. Key pesticides issues and actions required are shown below under *Table 3-3 Major Issues and Actions Required*. Various items are provided as broad guides and should be reviewed at the time of implementation.

**Table 3-2. Major Issues and Actions Required**

<table>
<thead>
<tr>
<th>MAJOR ISSUES</th>
<th>ACTIONS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased use and reliance on chemical pesticides</td>
<td>• Promote adoption of IPM practices through farmer education and training</td>
</tr>
<tr>
<td></td>
<td>• Develop strategies to move farmers away from pesticide-dependent pest control practices and promote use of biological control</td>
</tr>
<tr>
<td>Change current pest management practices</td>
<td>• Allocate adequate resources to implement National Plant Protection Policy</td>
</tr>
<tr>
<td></td>
<td>• Increase IPM awareness amongst policy makers and farming community;</td>
</tr>
<tr>
<td></td>
<td>• Abolish free distribution of pesticides to farmers and promote safe handling and application of pesticides.</td>
</tr>
<tr>
<td>Enforcement of legislation</td>
<td>• Strengthen institutional capacity of DPVC to effectively supervise compliance with pesticide legislation</td>
</tr>
<tr>
<td>IPM research and Extension</td>
<td>• Strengthen IPM research at ITRAD</td>
</tr>
<tr>
<td></td>
<td>• Strengthen IPM extension</td>
</tr>
<tr>
<td></td>
<td>• Strengthen collaboration between ITRAD and DPVC for field implementation of IPM</td>
</tr>
<tr>
<td></td>
<td>• Involve NGOs in promoting IPM activities</td>
</tr>
<tr>
<td>Environmental hazards of pesticide misuse</td>
<td>• Create public awareness of the hazards of pesticide misuse through public awareness campaigns</td>
</tr>
<tr>
<td></td>
<td>• Regular assessment of pesticide residues in irrigated agricultural production systems and in harvested produce.</td>
</tr>
<tr>
<td></td>
<td>• Monitoring of pesticide poisoning in the farming and rural communities.</td>
</tr>
<tr>
<td>Increase in vector populations and of vector borne diseases such as malaria</td>
<td>• Establish strong collaboration between ASPOP project and national malaria control project</td>
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<td></td>
<td>• Conduct regular vector surveillance.</td>
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</tbody>
</table>

3.7.1.2 Implementation Costs

The following Table 3-3: Estimates for Developing, Strengthening and Disseminating IPM provides various costs. In absence of relevant information, these are rough estimates and need a careful review. Also, some training is provided under M&E and can be combined with IPM for efficiencies.

Table 3-3. Cost Estimates for Developing, Strengthening and Disseminating IPM

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Development of: (i) an IPM plan, and (ii) a Database (over time)</td>
<td>$30,000</td>
</tr>
<tr>
<td>2 Strengthen National IPM Expertise</td>
<td></td>
</tr>
<tr>
<td>(i) Additional staff: 2 Entomologists</td>
<td>$35,000/yr.</td>
</tr>
<tr>
<td>(ii) Additional technical (junior) and support staff</td>
<td>$20,000/yr.</td>
</tr>
<tr>
<td>(iii) Research Lab for Monitoring/Surveillance: equipment only</td>
<td>$60,000</td>
</tr>
<tr>
<td>3 IPM Training and Information Dissemination (spread over 5 years)</td>
<td></td>
</tr>
<tr>
<td>(a) In-country training of farmers, TOTs and selected tech staff</td>
<td>$25,000</td>
</tr>
<tr>
<td>(b) One overseas (e.g. West Africa) Study tour for 3 persons</td>
<td>$15,000</td>
</tr>
<tr>
<td>(c) Production and Distribution of IPM material</td>
<td>$10,000</td>
</tr>
<tr>
<td>4 Monitoring and Surveillance (over 5-year)</td>
<td>$30,000</td>
</tr>
<tr>
<td>5 Participatory Research and Development</td>
<td>$25,000</td>
</tr>
<tr>
<td>6 Miscellaneous including contingency costs.</td>
<td>$10,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$260,000</td>
</tr>
</tbody>
</table>

The proposed activities should be phased over time, as appropriate. All efforts should be made to provide in-country training or in neighboring South Africa which has a sound IPM program. This work should be coordinated with the two South African partners, in addition to other stakeholders.

16. Organic Farming for Fruit Trees

According to DENMAR, the apple and cherry demonstration farm, for most part, will practice organic farming at the Leribe site. Organic farming is a method of crop (and livestock) production that involves much more than choosing not to use certain pesticides, fertilizers, genetically modified organisms, antibiotics, and growth hormones that are not permitted by existing organic standards.

Organic agriculture is a holistic system of crop and livestock production designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem,
including soil organisms, plants, livestock and people. The principle goal of organic agriculture is to develop productive enterprises that are sustainable and harmonious with the environment. Many organic farmers believe that a successful organic system begins with the soil — a healthy soil produces healthy plants, and in turn, healthy livestock and people. They regard soil as a living organism of inter-dependent processes and life forms. Organic farming promotes the use of crop rotations and cover crops, and encourages balanced host/predator relationships. Organic residues and nutrients produced on the farm are recycled back to the soil. Cover crops and composted manure are used to maintain soil humus. Preventative insect and disease control methods are practiced, including crop rotation, improved genetics and resistant varieties.

Integrated pest and weed management, and soil conservation systems are also valuable tools on an organic farm. Some "natural" or non-synthetic pesticides may be permitted. In the U.S., these products must be registered for use in the specific crop-pest situation by federal and provincial regulations and allowable for use within the organic crop production standards as specified by the certification body. All grains, forages and protein supplements fed to livestock must be organically grown.

Organic food production prohibits using highly soluble or synthetically compounded mineral fertilizers, synthetically compounded pesticides, growth regulators, antibiotics, hormones, coloring or other artificial additives, ionizing radiation, and recombinant genetic engineered plants or animals (genetically engineered organisms). Prohibited products and practices must not be used on certified organic farms for at least 3 years prior to harvest of the certified organic products. Livestock must be raised organically and fed 100% organic feed ingredients. For the Leribe organic farming, DENMAR intends to use such brand names as Ecocert, Atlas organic fertilizers supplied by the South African firm, Talbome. No soil preparation, either of organic or the conventional farming, has been done at the time of study. It was also true for irrigation, fertilization or other needs. Given the continuing delays, project’s apple tree seedlings, suitable for planting, were (temporarily) stored in a cold storage in South Africa; extended storage has the potential to make seedlings unfit for transplanting.

Organic farming presents many challenges. Some crops are more challenging than others to grow organically. However, nearly every commodity can be produced organically. There are successful organic farmers, particularly in the U.S. and Canada. While some experience in organic farming exists in South Africa,29 there is no such experience in Lesotho and implementing organic farming is fraught with number of uncertainties. DENMAR should review the situation with the Lesotho government authorities.

17. Monitoring and Evaluation

Since the mobility and decay rates of different agrochemicals result in a pattern of contamination in both space and time that is difficult to predict, a monitoring and

28 Proposed varieties include: Granny Smite, Ruby Gala, Golden Delicious, Fuji, and Sundowner.
29 (i) SEE: http://www.go-organic.co.za/ (ii) Examples of few organic farms are: Polkadraai Farm (strawberries), in Stellenbosch; Moolherbe (strawberries) in Metro Capetown; and Wildebraam Berry Farm (black berries, young berries and grapes etc.), in Western Cape Province
evaluation (M&E) plan to safeguard environment and also improve crop productivity is essential. There is a chemically interactive relationship between fertilizers/pesticides with soil particles, which is strongly affected by the presence of air and water in the soil. Soil processes such as adsorption, de-sorption, decay rates and biological detoxification and transfer all play a part in determining how quickly and where a contaminant will move. For instance, most of the risks of biocide pollution come from the risk of these attaching to the soil particles.

Many activities can affect the above interactions. For example, short- and long-term application regimes of irrigation water can alter groundwater levels, soil oxygen availability, and the biological characteristics of the soil micro-fauna. Theses changes can impact nutrient leaching, pesticide decay, detoxification, bioaccumulation, and transfer to the groundwater aquifers. Soil pH management, for instance by the application or withdrawal of liming, can significantly affect the mobilization of agrochemicals.

Monitoring for agrochemical pollution is usually difficult to implement. It requires an understanding of the linkages of a chain that stretches from the underlying causes and consequent effects, through to perceptions and costs, including in the context of the region and its cultivation practices. Nevertheless, there is a need to invest in cost-effective techniques to identify problems before they become acute. Although in the short term problems are unlikely to occur, there is a need to create awareness among the areas farmers while strengthening the technical and training capacity of the official staff.

The horticulture project is conceived as a demonstration mechanism, with a potential aim of long-term sustainability. It requires (i) an appropriate institutional structure and capacity that should operate beyond the end of the project, (ii) mechanisms that will provide an on-going flow of funds to finance payments to participating land users and operating cost of the program; given the export element of the farm’s produce, potential profits, in later years, may be able to contribute to needed funds. M&E activities are key element to long-term sustainability as well as to ensure that leased land for the farm does not suffer land degradation as a result of the proposed crops.

Land degradation has the potential to threaten integrity and function of ecological systems that support life such as the soil formation and the Carbon, hydrological, and the nutrient cycles, as well as Lesotho’s unique biological diversity.
Evaluation is the periodic assessment of the relevance, performance, efficiency, and impact (both expected and unexpected) of (development) intervention in relation to stated objectives. Evaluation measures achievements in relation to institutional policies, program’s objectives, and the goals set for each operation.

Monitoring is a continuous function that uses systematic collection of data on specified indicators such as: plant growth, rates and applications of fertilizers and pesticides and the quality of each, movement of nutrients through soils profile, plant diseases, and others to provide management and the main stakeholder with information on the status of various activities. A regular tracking of inputs, activities, outputs, outcomes and impacts is therefore required at the levels. The other part, evaluation is a process to determine the worth or significance of the intervention, including its design. Evaluation, a time consuming activity, is more detailed and can help enable the incorporation of lessons learnt as a result of an intervention. It is important to note that Monitoring and Evaluation (M&E) are synergistic. While monitoring information is necessary, by itself, is an insufficient input to the conduct of an (rigorous) evaluation. Call Box: World Bank Requirements for Project and Program Monitoring and Evaluation

The World Bank Monitoring and Evaluation requirements of both program and project lending are presented in the Operational Directive 10.70 and Operational Policy (OP)/Bank Procedure (BP) 13.05. The Operational Directive (OD) 10.70 defines Monitoring as “the continuous assessment of project implementation in relation to agreed schedules and the use of inputs, infrastructure, and services by project beneficiaries. Evaluation is defined as “the periodic assessment of the relevance, performance, efficiency, and impact (both expected and unexpected) of the project in relation to stated objectives.” In addition, OD 10.70 sets out the concept of M&E, and provides general guidance on the design and implementation of the information systems required for M&E activities. The OP 13.05 explains the rationale for Bank’s supervision of Bank-financed projects, which include monitoring, and evaluative review and reporting. It also explains the responsibilities of Task Teams (TT), and requires that the borrower and the TT agree on implementation arrangements that include M&E arrangements, and use of appropriate performance indicators. Source: World Bank Operational Manual

At the beginning a comprehensive list of various parameters to be monitored, updated as needed, should be developed. The lead ministry, in this case, the Ministry of Agriculture in participation with the organization managing the demonstration farm, and other stakeholders should be involved. Several activities under the program require M&E to provide accountability, efficiency and better management. For example, soil loss (suspended sediment), nutrients (fertilizers), and pesticides may need to be monitored to determine if they were getting into the (areas) streams. Pesticides and nutrients also can be flushed from the fields during storm runoff or can percolate into the soils; therefore, agrochemical migration in the soil should also be evaluated to determine if ground water

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30 The entity responsible for managing the proposed demonstration farm was not defined at the time of the study.
has been affected. Thus, stream sampling may be necessary during rain events. Likewise, soil and ground water samples should also be collected after storm infiltration to see if the agrochemicals moved downward to the water table.

Furthermore, collecting and identifying aquatic organisms at numerous stream sites can help measure the biological health of the stream. Since farming by definition directly affects biodiversity, it is important to monitor for any related changes as a result of diversification\(^{31}\) and introduction, in particular, of apples, cherries and Brussels sprouts, the last two generally are unknown in Lesotho and may be perceived as *Invasive Species*. Furthermore, Pesticides can reduce species diversity and cause ecological damage. Pesticides also have effects, often adverse, on an area’s wildlife.

Given the diversity of requirements, it is important to define clearly the objectives of a monitoring and evaluation (M&E) program. At the time of this study, this information did not exist. Given the absence of information, in particular, the extent of M&E and institutional set up, it is not possible to provide cost of needed M&E activities.

**Institutional Responsibility for Monitoring and Evaluation**

Currently, institutional capacities to monitor, collect, and analyze data such as on the causal links between land uses and potential environmental degradation does not exist in Lesotho. For their projects, various government organizations, (mostly given the mandates from the fund donors and international import organizations) carry very limited M&E activities. The situation is constrained by lack of skills, awareness, funding and enforcement of regulatory mandates. It is particularly true for Lesotho.

\(^{31}\) Diversification, according to the World Bank’s recommendations, also requires development of a pest management plan when there are significant pest management issues such as diversification into new crops in agriculture, and (b) new land-use development or changed cultivation practices in an area, (c) significant expansion into new areas.
For the project, there is no defined responsibility, and it appears that it would be split between the Ministry of Agriculture and the Ministry of Environment. It is suggested that given the short- and long-term (potential for replication and wider adoption etc.) that a specialized unit under the Ministry of Agriculture with technical strengths drawn from Ministry of Environment is established. Since the needed laboratory resources may not be available, the analytical and other services, as needed and cost effective, are contracted out to resources in Africa. The lead organization, in participation with key stakeholders, should design a (strong) monitoring program. Included should be: the parameters to be monitored, their prioritization and monitoring frequency, data analysis and storage, and other specific needs, as identified. Call Box: Pitfalls in Monitoring and Evaluation Program highlight key areas of concern.

The entity managing the project and the two South African firms, DENMAR and ALPHA Estates should be actively involved. All result should be carefully analyzed since they can provide valuable guidance to other potential sites that may consider replication of the farm within Lesotho. Given the lack of information on the above issues, it is difficult to give cost estimates for monitoring and evaluation. Table 3-3. Input, Activity and Impact Indicators for various M&E Activities, as these relate to pesticides.

**Table 3-4. Input, Activity and Impact Indicators for various M&E Activities**

<table>
<thead>
<tr>
<th>Input</th>
<th>Activity</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect information on soils, water quality, areas vegetation, topography, irrigation systems, and others.</td>
<td>Meet relevant agencies, do Internet and literature research, and other sources, including this study. Work with DENMAR and ALPHA.</td>
<td>Relevant baseline information for M&amp;E identified. Team working together.</td>
</tr>
<tr>
<td>Develop separate M &amp; E Plans with participation of key players, and in terms of project’s objectives.</td>
<td>Identify monitoring parameters, frequency, and techniques for vegetable farm and the orchard, and responsible agencies, individuals. Inform/involve key stakeholders.</td>
<td>Helps assure proper progress; brings stakeholder together.</td>
</tr>
<tr>
<td>Develop a list of lab, technical, and other resources needed.</td>
<td>Work with the Ministry of Environment, DENMAR, and Alpha Estates to secure needed resources</td>
<td>Needed resources for Monitoring in place.</td>
</tr>
<tr>
<td>Develop evaluation requirements</td>
<td>Identify data analysis and interpretation</td>
<td>Needed resources for evaluation in</td>
</tr>
</tbody>
</table>

**Pitfalls in a Monitoring and Evaluation Program**

Common pitfalls in an M&E program include: (i) Defining a loose collection of disparate indicators with little or no relationship to each other, instead of a system in which indicators relate to each other and to the strategy goals, objectives and tar-gets in a meaningful way, (ii) Building a system based on bad baseline data and/or unreliable indicators: Indicators need to provide a consistent measure of progress. This means that the starting point (the baseline data) is accurate and that the indicator provides an objectively verifiable result, i.e. two people applying the same indicator should get the same result, (iii) Not taking into account that impacts may differ according to location and to the gender and socio-economic status of intended beneficiaries, and (iv) Poor feedback mechanisms: Developing a system in which indicator results do not feed back into the strategy process and into decision-making and planning processes. M&E systems are worthless if the information they provide is not acted upon.

Source: [www.gwpforum.org](http://www.gwpforum.org)
Table 3-4. Input, Activity and Impact Indicators for various M&E Activities

<table>
<thead>
<tr>
<th>Input</th>
<th>Activity</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>for each farm, vegetables and orchard.</td>
<td>and storage resources. Identify participating agencies.</td>
<td>place. Concerned agencies informed.</td>
</tr>
<tr>
<td>Interact with farmers and other key stakeholders including government ministry (ies).</td>
<td>Invite key stakeholders for a tour of the farms, and review of the progress to date.</td>
<td>Helps in: getting farmers input/continued buy-in, provides some training to farmers etc.</td>
</tr>
<tr>
<td>Procure pre-approved pesticides: time of application according to each farm’s needs. Procure personal protective equipment.</td>
<td>Develop and disseminate pesticide storage, use and management policy and training material to selected farmers. Apply doses of pesticides, as needed at appropriate/as-needed time(s).</td>
<td>Farm workers are sensitized to the importance of safety in pesticides use. Community is aware of the activities.</td>
</tr>
<tr>
<td>Review Integrated Pest Management Practices (IPM) for potential use.</td>
<td>Use IPM to the extent practical; Train and sensitize farm workers and selected area farmers.</td>
<td>IPM is understood through information material and field demonstrations.</td>
</tr>
<tr>
<td>Measure soil runoff and soils leaching at pre-agreed intervals.</td>
<td>Install appropriate instruments, follow acceptable procedures, collect, secure and analyze data for interpretation/use and storage. Disseminate, as needed.</td>
<td>Any harmful impact of pesticides identified. Information disseminated. Any changes required incorporated.</td>
</tr>
<tr>
<td>Review Health and Safety Issues.</td>
<td>Conduct meetings with workers; resolve relevant issues, organize a refresher course covering pesticide use/safety.</td>
<td>Workers are monitored for any potential impacts; importance of health and safety issues reinforced.</td>
</tr>
<tr>
<td>Reporting and communication.</td>
<td>Develop quarterly, bi-yearly and other reports; disseminate as needed. Implement agreed upon changes in M&amp;E.</td>
<td>Project’s monitoring results analyzed, discussed and changes, if any implemented.</td>
</tr>
</tbody>
</table>

Monitoring and Evaluation Costs

The study shows that, under proper project management, potential environmental impacts from the project are likely to be insignificant. These can be covered either through project’s negative list or through use of standard agronomic and some civil engineering procedures. For independent verification, if required, community groups or NGO’s can be requested and compensated.

Monitoring and Evaluation (M&D) costs for the horticulture project will depend on the number of indicators collected, the frequency and quality of information sought, and the comprehensiveness of the system proposed. Once these (practical) indicators are defined, M & E work plan developed, and field instruments needed installed, M&E work can start with data collection, analysis and reporting, skill for which minimum cost is budgeted in the total M$E costs indicated below. It is assumed that participating personnel have some level of knowledge and training.

M & E in data collection and analyses should not only consider non-point runoff (pollution) from vegetable- and orchard-applied fertilizers—both organic and inorganic, and pesticides, but also how soil type, slope, watersheds, and groundwater relate to surface runoff, drainage, and persistence in and leaching through the soil profile. For apples and cherries, planting single rows helps to promote optimal spray coverage, in
addition to light penetration, and air circulation. The demonstration project’s orchards being new, it is important that soils should have good tilth and fertility and are provided adequate soil drainage to prevent root diseases and promote healthy root development. While the vegetable farm(s) at Berea will use the proposed center pivot irrigation system, it is suggested that fruit and Cherry orchards, for irrigation use trickle or drip irrigation so that water quantity and placement minimizes disease development, optimizes water use, and minimizes erosion, factors that have the potential to reduce M&E costs and provide better yields.

Furthermore, it is also important to base pesticide treatments against pests on established thresholds, pest forecast models, if available, weather conditions, established presence of the pest, and available history, such as from South Africa, of damage to such trees, or on the fruit at harvest. Keeping records of pesticide applications, including: date, time, weather, operator, sprayer, field identification (vegetable farm, orchard, block, rows—as applicable), targeted pest, pesticide name (and registration number, if available, formulation, rate applied, and number of hectares or trees treated etc., will help lower M&E costs. Likewise records on herbicide rates and selections should be kept and based on weed surveys. While several types of sprayers are available, use of drift-reducing sprayers (tunnel, sensor, tower) or a sprayer modified to direct the air (towers, deflectors, angled fans, side baffle plate, air induction nozzles) is recommended.

The following M&E parameters and associated costs assume that: (i) tillage practices, as applicable, for each of the two farms were used (ii) judicious use of fertilizers and pesticides following requirements such as those on the (pesticide container) label, Lesotho or South African guidelines, as applicable, (iii) participating (field) personnel have some level of training, (iv) access to field instrumentation and laboratory services, as needed, will be provided by the project’s two South African partners, and (v) where government is the implementing agency, no costs will be incurred. Table 3.5, Monitoring and Evaluation Costs provides specific items. The total cost estimated is $80,000. It does not include costs of pesticides, fertilizers including organic fertilizers, agrochemicals storage costs, cost of procuring and planting seedlings, cost of developing an M&E plan, and similar other project costs. It is assumed that these will either be covered under the contract with the two South African partners or provided by the Lesotho government at no cost to the project. Also, as per TOR, all costs relate to the M&E function. It is suggested that an environmental review be conducted mid term of the project to see what (significant) environmental problems, if any, have arisen and corrective action can be implemented.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Objective</th>
<th>Implementing Agency</th>
<th>Output</th>
<th>Cost ($)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Development of Management Information System</td>
<td>Help Project Management of all fields, budget and planning.</td>
<td>Alpha Estates &amp; DENMAR</td>
<td>Monthly and /Other reports, database etc.</td>
<td>10,000</td>
<td>Software, computers/lab, labor etc.</td>
</tr>
<tr>
<td>2 Training: Participants from METC, NGO’s and others Training in Lesotho.</td>
<td>Assure sound environmental management and help capacity building</td>
<td>Private firm: local or from S. Africa.</td>
<td>Trained personnel, METC, NGO’s, others.</td>
<td>25,000</td>
<td>Carefully select participants. Cost includes per diems etc.</td>
</tr>
<tr>
<td>3 Monitoring instrumentation procurement</td>
<td>To measure pre-defined M&amp;E parameters.</td>
<td>Alpha and, DENMAR; oversight-- METC</td>
<td>For relevant data generation.</td>
<td>10,000</td>
<td>Source: South Africa.</td>
</tr>
<tr>
<td>4 Sampling and chemical analyses, project farms soil and leaf tissues.</td>
<td>To maintain nutritional status primarily of trees; correct deficiency.</td>
<td>Private, approved Analytical Lab, Use applicable procumbent protocols.</td>
<td>Relevant analytical data/interpretation.</td>
<td>7,500</td>
<td>Lesotho or RSA lab. 85 analyses and their interpretations.</td>
</tr>
<tr>
<td>5 Sampling and chemical analyses: irrigation water</td>
<td>To assess and monitor water quality during project period.</td>
<td>Private, approved, Analytical Lab, as above</td>
<td>Water Quality data.</td>
<td>2,500</td>
<td>25-30 samples.</td>
</tr>
<tr>
<td>6 Chemical analysis for Pesticides</td>
<td>To assure quality.</td>
<td>Private, approved, Analytical Lab.</td>
<td>Pesticide quality verifications</td>
<td>1,000</td>
<td>4-6 or more samples.</td>
</tr>
<tr>
<td>7 Chemical analysis for leachates</td>
<td>Monitor groundwater</td>
<td>Private, approved, Analytical Lab</td>
<td>Groundwater data.</td>
<td>2,000</td>
<td>15-20 samples at selected locations.</td>
</tr>
<tr>
<td>8 Oversight &amp; review of M&amp;E by Government Officials</td>
<td>Report on field program, assist in trouble-shooting etc.</td>
<td>MTEC, assisted by Health and Social Welfare Ministry.</td>
<td>Problem resolution and general oversight.</td>
<td>None</td>
<td>Costs borne by the Ministry; Use trained personnel</td>
</tr>
<tr>
<td>9 Oversight (by applicable and trained NGO)</td>
<td>Independent oversight provides community input.</td>
<td>Agriculture oriented, trained (see item # 2 above) NGOs</td>
<td>Minutes from meetings, letters</td>
<td>8,000</td>
<td>Some (labor) compensation + indirect costs.</td>
</tr>
<tr>
<td>10 Complaint Resolution Process</td>
<td>Document and resolve field problems.</td>
<td>Environmental Ministry, i.e. (MTEC), others, as needed.</td>
<td>Complaints Database, Lessons-learnt.</td>
<td>10,000</td>
<td>Potential costs; any mitigation measures.</td>
</tr>
<tr>
<td>11 Miscellaneous management activities, review of Health/safety plans etc.</td>
<td>Administrative/Logistics, information dissemination etc.</td>
<td>As needed or as indicated above</td>
<td>Information dissemination, Upkeep of instruments etc.</td>
<td>3,000</td>
<td>Misc. Labor, upkeep of instrumentation, Costs shared by METC.</td>
</tr>
<tr>
<td>12 Development of the Pesticide management Plan</td>
<td>Address the health and safety issues</td>
<td>Private firm: local or from S. Africa.</td>
<td>Review institutional capacity, guidance to technical and policy aspects</td>
<td>25,000</td>
<td>Cost includes per diems etc.</td>
</tr>
</tbody>
</table>

**Total Cost** $105, 000
Appendix A: Key Ministries Responsible for Management of Pesticides in Lesotho

The Ministries include:

1. **Ministry of Tourism, Environment and Culture (MTEC):** The Ministry through its department of Environment (DOE) the Ministry is responsible for all policy matters related to the protection of the Environment. The environment Act 2001, however, establishes the Lesotho Environment Authority (LEA), a body corporate to execute this duly; currently efforts are underway to remove this authority and substitute it with the Department of Environment. The Act is not yet operational.

Furthermore, the DOE has set up the following committees to advise it on issues of environment.

- Chemical management committee (CheMaC)
- Committee on waste Management (COWMAN)
- Committee on Environment Data Management (CEDAMA)

While these committees are useful, they lack clearly defined mandates and are often made up of people, the majority of whom do not have a decision-making authority.

2. **Ministry of Agriculture and Food Security:**

The Ministry is responsible for regulating pesticides among other duties and is said to be a major importer of agro-chemicals used for pest control, Veterinary services as well as fertilizers and herbicides for improved crop yields. However, at present, no reliable data exists on extent of pesticides used as well as their management. This is in spite of the fact that Lesotho is a signatory of stock helm convention, the Bamako convention and others. Lack of such data and information as well as other information is also not in line with the World Bank’s safeguard policies on pesticides.

3. **Ministry of Health and Social Welfare**

The Ministry is concerned with the human health and safety issues related to pesticides among its other activities. Within the ministry, the Environment Health Section was established few years back to deal with risk factors, pest control and respond to incidences. The section therefore has the responsibility to acquire, store and develop measures for their responsible use for control of various pests in the country.

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32 See: www.worldbank.org/safeguards
4. **Ministry of Employment and Labor**

The Ministry covers occupational health and safety issues related to generation, use, storage and handling and disposal of hazardous waste at workplaces. The ministry also administers the labor code and Labor regulations.

5. **Ministry of Trade, Co-operatives and Marketing**

It deals with the regulations of imports and exports issuing trading licenses and permits. It also houses standard offices. Hazardous waste imports, exports, licenses or permits will be dealt with, as they are issues.

6. **Other relevant ministries include:**

   (i) Ministry of Natural Resources  
   (ii) Ministry of Education  
   (iii) Ministry of Conservation and Forestry  
   (iv) Ministry of Local Government
Appendix B: Terms of Reference (TOR):

Environmental evaluation of establishing a laundering facility and a fabric mill, and a commercial horticulture demonstration farm in Lesotho:
Government of Lesotho
Private Sector Competitiveness Project

BACKGROUND

- The Government of Lesotho (GOL) is committed to fight poverty, accelerate economic growth and improve the welfare of the Basotho. In 2002 Government formulated its broad National Development Goals to guide national planning and overall development agenda of the country. The National Vision 2020 was launched in 2004, which provides the overall framework that defines the aspirations of the people. The Poverty Reduction Strategy (PRS) finalized in 2005 attempted to translate the strategies into actions which will enable the economy to develop rapidly, and poor people to be the main beneficiaries of growth. One of the four building blocks or pillars identified for achieving the strategy is private sector development (PSD), which will manifest in equitable economic growth and rapid employment creation.

- To strengthen private sector growth and development by increasing its productivity and competitiveness, the Government has requested the World Bank to prepare a Private Sector Competitiveness (PSC) Project, which includes a component relating to the development and diversification of the Textile and Garment Sector. It is the intention of the Government to commence the design of the PSC project by utilizing the PHRD grant obtained from the Government of Japan through the World Bank.

OBJECTIVES OF THE CONSULTING ASSIGNMENT

- The objectives of the consultant assignment will be twofold. First to evaluate the environmental aspects of establishing a laundering facility, and a fabric mill and a commercial horticulture demonstration farm in Lesotho. It is anticipated

33 Emphasis should be placed on knitted fabric with an option for accommodating woven.
that a thorough assessment of the quality of water available for use by a potential laundering facility as well as the treatment of effluence from the laundering facility will be required. Second, it is anticipated that a thorough assessment of soil leaching and run offs from the use of agrichemicals will be required for establishing a commercial horticultural demonstration farm in Lesotho.

- For the laundering and fabric component of the assignment, it is anticipated that the consultant will work closely with the financial analyst to define the size of the laundering facility, and the potential cost of establishing an input-output water treatment facility.

- In addition to evaluating the water input-output treatment, the consultant is also expected to assess the technical interventions required to comply with environmental standards required for establishing a fabric mill.

- For the commercial horticultural demonstration farm, it is anticipated that the consultant will work closely with the private sector partners (Denmar Estates, and Alpha Farms) and Technical Team Leader to meet the environmental safeguards requirements for World Bank projects.

- In addition to evaluating the environmental impact assessment from use of agrochemicals, the consultant is also expected to assess the technical interventions and monitoring needs to comply with environmental standards required for World Bank projects.

18. SCOPE OF WORK

Laundering and Fabric Mill

- Once the size and capacity of the proposed laundering facility has been defined, the consultant is expected to conduct an assessment the technical and financial needs for establishing a water input and output treatment facility. Specifically, for water input, work closely with the Lesotho Textile Exporters Association (LTEA) and the WG to define the water quality required for use by the laundering facility.

- It has been brought to the attention of the garment manufacturers in Lesotho from a major buyer that the quality of water used for laundering needs to be evaluated, particularly given that the current quality of finishing is inadequate due to poor water quality.

  (a) The consultant is expected to identify specific problems with the quality of the water currently available for use;
  (b) Propose a technical solution for resolving the water quality issues; and

46
(c) Provide cost estimates and time required to implement the proposed technical solution.

- In addition, the consultant is expected to conduct a thorough technical evaluation of establishing a wastewater treatment facility. It should be noted that Lesotho already has a water treatment facility in operation. In this context, consideration is required to assess the prospect of locating the potential laundering facility within the vicinity of the existing wastewater treatment facility.

- Taking into account that potential factory shell space is available within the Polytechnic compound, which is located near the water treatment facility, the environmental expert, in coordination with the financial analyst and the WG to explore the possibility of locating the laundering facility within the Polytechnic compound to help reduce the cost of establishing a treatment facility.

- In addition to assessing the water input-output evaluation, the consultant is expected to review the technical and financial needs to meet environmental standards required by major buyers. In this context the consultant is expected to address the following issues:
  
  (a) Given the size of the fabric mill required to meet the demands of the garment sector, provide an in-depth evaluation of technical interventions required to comply with environment standards expected by major buyers;
  
  (b) Assess the financial requirements for meeting the proposed technical interventions;
  
  (c) Formulate a strategy of implementation of an environmental safeguards measure, which outline both resource and time requirements for effective implementation of a pollution control measure; and
  
  (d) In addition, the consultant is expected to identify and provide guidance on safeguards against health and safety issues associated with the implementation of an environmental safeguard measure.

Specifically, the consultant should provide detailed information on the following in carrying out the environmental assessment:

**Description of the Environment** -- Assemble, evaluate and present baseline data on the environmental characteristics of the study area. Include information on any changes anticipated before the project commences.

- **Physical environment** -- geology (general description for overall study area and details for land application sites); topography; soils (general description for overall study area and details for land application sites); rainfall and runoff characteristics; description of receiving waters. (Identity of streams, lakes, or marine waters; annual average discharge or current data by month, chemical quality; existing discharges or withdrawals).
• **Biological environment** -- terrestrial communities in areas affected by construction, facility sitting, land application or disposal; aquatic, estuarine or marine communities in affected waters; sensitive habitats, including parks or preserves, significant natural sites; species of commercial importance in land application sites and receiving waters.

• **Socio-cultural environment**: present land use in the vicinity of the plant; planned development activities; community structure; recreation; public health; cultural properties; indigenous peoples.

**Legislative and Regulatory Considerations** -- Describe the pertinent regulations and standards governing environmental quality, pollutant discharges to surface waters and land, industrial discharges to public sewers, water reclamation and reuse, agricultural and landscape use of sludge, health and safety, protection of sensitive areas, protection of endangered species, land use control, etc., at international, national, regional and local levels etc.

**Determination of the Potential Impacts** -- In this analysis, distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts, which are unavoidable or irreversible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact.

**Development of Management Plan to Mitigate Negative Impacts** -- Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Estimate the impacts and costs of those measures, and of the institutional and training requirements to implement them. Consider compensation to affected parties, if applicable, for impacts, which cannot be mitigated. Prepare a management plan including proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures.

**Commercial Horticulture Demonstration Farm**

• Once crop selection has been established, the consultant is expected to work closely with the private sector partners to identify all agrichemicals required for the proposed farming operation. Based on this list, the consultant is expected to make an assessment of possible soil leaching and run off, and the impact that it may have on ground water and other environmental hazards.

(a) Assess the amounts and types of agrichemicals to be provided and/or used under the project;

(b) Conditions of agrichemical use and the capability and competence of end-users to handle products within acceptable risk margins; and

(c) Propose mitigation measures.
• In addition, the consultant is expected to ensure that all agrichemical used under the pilot project does not fall under the band chemicals list.

• Policy, regulatory framework and institutional capacity:
  
  (a) Describe the Government’s polices on plant protection;
  (b) Assessment of the country’s regulatory framework for control of the distribution and use of pesticides; and
  (c) Assessment of the institutional capacity for effective control of the distribution and use of pesticides.

• Monitoring and Evaluation: Propose a monitoring and evaluation plan to be followed during project implementation to ensure that the objectives are being met, with respect to ensuring safe handling and use of agrichemicals of pesticides:
  
  (a) Include input, activity and impact indicators;
  (b) Identify specific M&E activities, indicate who should carry them out, and identify any external technical assistance that may be required for this purpose; and
  (c) Estimate the cost of implementing the M&E plan

19. QUALIFICATIONS AND EXPERIENCE

• The candidate is expected to have a background in environment science and management with experience in the textile and garment, and agricultural sector. The selection of candidates will not be limited to an individual from Lesotho, but will give preference to candidates with international experience.

The following specialties should be represented on the core consulting team to provide input on issues regarding: environmental engineering, ecology (terrestrial, aquatic or marine, depending on type of discharge); water quality; soils science (for land application); wastewater treatment/management; water quality modeling and sociology/anthropology. Other specialties that may be needed depending on the nature of the project are public health, hydrology, land use planning.

• An advanced degree in the field of environmental sciences is required, but the selection of candidates will place emphasis on practical field experience, particularly in the context of successful implementation of environmental safeguard measures at the factory and farm level. It is anticipated that the project will seek an individual with a minimum 15 years of field experience. Further preference will be given to candidates with practical knowledge and experience in the field of textiles and garments, and pesticide management.
20. **TIMING AND OUTPUT**

**1. Laundering and Fabric Mill**

- In addition to the periodic reporting to the WG and the WB team as indicated in the TOR, the environmental expert is expected to deliver a comprehensive report covering the environmental safeguards requirements to establish a fabric mill in Lesotho.

  (a) The analysis will include an assessment of technical requirements for water input-output for the laundering facility, and for establishing a fabric mill;
  (b) **Investment requirements** to establish an water input-output treatment facility and a comprehensive environmental safeguard program for a fabric mill;
  (c) **Formulation of a safeguard and pollution management strategy** for both laundering facility and a fabric mill;
  (d) **Assessment of health implications for workers** within a factory and in the surrounding areas;
  (e) Translate the analytical findings into a **marketing package** to be used by LTEA to promote investments in a fabric mill.

**2. Commercial Horticulture Demonstration Farm**

- In addition to the reporting to the WB team as indicated in the TOR, the environmental expert is expected to deliver the following:

  (a) A comprehensive report covering the environmental safeguards requirements to establish the proposed demonstration farms in Lesotho.
  (b) Assess the amounts and types of agrochemicals to be provided and/or used under the project;
  (c) Conditions of agrochemical use and the capability and competence of end-users to handle products within acceptable risk margins;
  (d) Propose mitigation measures;
  (e) Describe the Government’s polices on plant protection;
  (f) Assessment of the country’s regulatory framework for control of the distribution and use of pesticides;
  (g) Assessment of the institutional capacity for effective control of the distribution and use of pesticides; Include input, activity and impact indicators;
  (h) Identify specific M & E activities, indicate who should carry them out, and identify any external technical assistance that may be required for this purpose; and
  (i) Estimate the cost of implementing the M & E plan.

- **Timing:** The PHRD Grant is expected to become effective at the beginning of April 2006, at which time the proposed project design activity can commence. Similarly, the WG is expected to request proposals from other consultants who
will provide inputs to the overall project design. The recruitment of other consultants is expected to commence immediately.
ANNEX 1

BACKGROUND AND RESPONSIBILITIES OF THE WORKING GROUP

The PSD Project will comprise of the following three key components: (i) Improving the Business Environment through Reducing Costs of Doing Business and Strengthening Legal Framework; (ii) Strengthening the Competitiveness of the Private Sector and the Capacities of its Representative Organizations; and (iii) Supporting Economic Diversification through Development of Skills and Market Linkages. The scope and coverage of each of the components will be further refined and determined in detail based on the results of the preparatory work funded under the PHRD Grant Finance by the Government of Japan and coordinated through the Ministry of Trade and Industry, Cooperatives and Marketing (MTICM).

Within component 2 of this project, namely strengthening the Competitiveness of the Private Sector and the Capacities of its Representative Organizations, three sectors will be covered. The sectors include: horticulture; textiles and tourism. For each of the target sectors, a Working Group (WG) has been formed to help guide the project design process.

Working Group

Composition: Each working group comprises of representatives from the public and the private sectors. The number of core group members does not exceed 4 - 5 people, as the group will draw on relevant external expertise if and when necessary. A Group Leader (representing the relevant Ministry or from the private sector) has been appointed for each Working Group and she/he is a point of contact for the technical discussions with the World Bank (WG) project team. He/she reports to the Project Coordinator on the work and the progress.

Reporting arrangements: The WG works under the leadership of the already existing Technical Committee (TC) comprising high level Government officials from the Ministry of Finance and Development Planning (3 people) and Ministry of Trade and Industry, Cooperatives and Marketing (3 people). The TC oversees, coordinate and monitor the work and the progress of the individual WG. One of the members of the TC will serve as a Task Team Leader (TTL) on the Government side and is responsible for the project preparation and be a liaison person (point of contact) for the World Bank. In addition, the Government will hire a local consultant as a Project Coordinator (funded by the PHRD Grant), who would assist the TTL to initiate, coordinate and monitor the work progress.

Scope of work: The Working Group is responsible for the following tasks:

(i) Gather and share with the Bank project team and the consultants relevant documents, legislation, regulations, directives, operating procedures, reports, data and other information pertinent to the preparation of the project components;
(ii) Prepare and finalize the Terms of Reference for specific preparatory activities funded under the PHRD Grant;

(iii) Identify and select in accordance with the World Bank procurement rules suitable consultants to undertake the preparatory work;

(iv) Monitor and report progress of the specific consultancy assignments;

(v) Provide quality control throughout the consultancy assignments and of the final product (i.e., provide comments to the draft reports);

(vi) Ensure that on issues with high cross-border significance there is a close coordination and collaboration with the South African counterparts. Where there is already a framework in place for this cooperation, the WG will utilize it as well as deepen it when necessary;

(vii) Ensure the participation of all the relevant stakeholders throughout the preparation process (through consultations, round table discussions, workshops, etc.), especially that of the private sector, to assure their ownership and buy-in. This also includes the donors so that the overlapping and duplication is minimized;

(viii) Assist the consultants in conducting the preparatory activities. Where necessary, play an active role in organizing and/or facilitating Consultation Workshops (funded separately under the PHRD Grant) with various stakeholders; and

(ix) Assist the World Bank project team in conducting the pre-appraisal and appraisal missions.
Textile and Garment Sector Diversification Strategy: DCC Training Trust Matching Grant Scheme

**PHRD Activities**
- Financial Analysis & Investment Needs Assessment
- Environmental Impact Assessment
- Training Needs Assessment
- Inventory of Curriculum & Training Capacity

**Diversification Activities**
- Finishing/Laundering
- Printing
- Medium/Long-Term
- Fabric Mill

**Training Activities**
- Textiles Innovation Center (Lesotho)
- Formulate training package using DCC Trust Fund
- Regional Training Providers
- Individual Training Experts

**DCC Training Trust Fund**
- DCC Training Trust Matching Grant

**Garment Sector**

Preliminary Organization Structure for the Management of the Horticultural Development Component for Lesotho

Lesotho Horticulture Development Program: Project Board

Members:
Rep. from Lesotho Village Corporation (2), Private Sector Partners (2), Gov’t Representative (1)

Lesotho-South Africa Horticultural Marketing & Logistics Agent (Joint Venture)

Private Sector Partners
- On-farm technical support;
- Quality control;
- Marketing;
- Packaging;
- Logistics

Markets:
EU (UK), South Africa, Lesotho

Lesotho Village Corporate 1
Leosothe Village Corporate 1
Lesotho Village Corporate 1