Government of Assam
Assam Rural Infrastructure and Agricultural Service Project Society

Assam Agriculture Competitiveness Project
(World Bank Funded)

FINAL REPORT
Environmental Codes of Practice

PUBLIC DISCLOSURE AUTHORIZED
Department of Agriculture
ECP AGRI-1.0: Collection, Cultivation & Processing of Medicinal &Aromatic Plants
ECP AGRI-2.0: Irrigation Management
ECP AGRI-3.0: Soil and Nutrient Management
ECP AGRI-4.0: Fertilizer & Pesticides - Handling & Storage
ECP AGRI-5.0: Land Development

Department of Fishery
ECP-Fishery-1: Beel (Open Water) Fishery Management
ECP-Fishery-2: Community Tank & Farmers Ponds
ECP-Fishery-3: Fish Seed Production Management

Department of Animal Husbandry
ECP AH&VS 1: Management of Bio-Medical, Solid & Liquid Wastes

Department of Dairy Development
ECP Dairy 1: On Farm Waste Management
ECP Dairy 2: Management of Wastes from Milk and Meat Processing Plants and Abattoirs

Common Code of Practice
ECP Common 1: Biodiversity Management
ECP Common 2: Building Activities
ECP Common 3: Guidelines for Training & Awareness

TABLE OF CONTENTS OF ECP’s

Government of Assam, India
Assam Agriculture Competitiveness Project July 2004
1.1 General

1.1.1 The Draft Agriculture Policy of Assam identifies commercial production and harvesting of medicinal plants and herbs as a thrust area for development of horticulture. This ECP specifies the procedures to ensure adequate protection to natural environment during collection, cultivation & production of medicinal plants and material. Though the cultivation of medicinal and aromatic plants and their extraction is not likely to have adverse impacts on environment, the following activities need due consideration in assessing environmental implications: (i) Selection of medicinal plants (ii) Site selection and cultivation of Medicinal Plants (iii) Collection practices for medicinal plants, and (iv) Processing of medicinal plants and materials.

1.1.2 The code of practice shall apply to (i) area beyond 1km of protected areas; (ii) Outside Grade II and Grade III beels; (iii) Outside Community ponds; (iv) near drainage channel (v) near rural settlements vi) agriculture fields areas, vii) outside marshes and swamps. In case of interventions outside these areas the ETO shall categorise the project based on information provided by the beneficiary in the Project Information Document as per format presented in Appendix ECP AGRI 1.1.

1.1.3 The provisions of this ECP comply with the legal requirements and conventions, which govern the collection, cultivation processing, handling, packaging & storage of medicinal plant or its derivatives. The provisions of the legislations pertaining to medicinal plants are presented in Table 1-1.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Legislation</th>
<th>Relevant provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drug &amp; Cosmetic Act 1940</td>
<td>Section 33EEB. Regulation of manufacture for sale of Ayurvedic, Siddha and Unani drugs.</td>
</tr>
<tr>
<td>2</td>
<td>Assam Forest Regulation, 1891</td>
<td>Section 3: Defines forest Produce Section 25: Acts prohibited in such forests Section 40: Power to make rules to regulate transit of forest produce</td>
</tr>
</tbody>
</table>
| 3    | Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) | Article II: Categories endangered flora and fauna as:  
  - Appendix I: All species threatened with extinction  
  - Appendix II: All species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their Survival  
  - Appendix III: All species which any signatory to the convention identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and needing the co-operation of other signatories in the control of trade Article III: Regulations on Trade of Species included in Appendix I Article IV: Regulation on Trade of Species included in Appendix II. Article V: Regulation on Trade of Species included in Appendix III Article VI: Permits and Certificates granted under provision of Article III, IV V |
1.2 Selection of medicinal plants

1.2.1 Prior to selection of species, the cultivator shall apply for and obtain permission from State Medicinal Plants Board1 (SMPB), Government of Assam and National Horticulture Board (NHB). The specified format for the same is presented in Appendix ECP Agri. 1.2 and Appendix ECP Agri 1.3 for medicinal and aromatic plants respectively. The proof of obtaining clearance shall be a pre-requisite for inclusion as beneficiary in the project. The District Agriculture Officer (DAO) shall be responsible for verification of the same.

1.2.2 Indigenous medicinal plant species shall be selected for cultivation in the project. A List of medicinal plants suitable for Assam is provided as Appendix ECP Agri. 1.4

1.2.3 The package of practice for each medicinal and aromatic plant shall be developed by the Assam Agriculture University or SMPB or NHB or NEDFI research Station at Khetri, Kamrup for plants, which are suited to the climatic conditions prevalent in region.

1.2.4 Suppliers of seeds and other propagation materials shall provide all necessary information relating to the identity, quality and performance of their products, as well as their breeding history. The propagation or planting materials shall be of appropriate quality and free from contamination and diseases in order to promote healthy plant growth. Planting material should be resistant or tolerant to biotic or abiotic factors.

1.3 Site selection and cultivation of medicinal plants

1.3.1 The quality of medicinal plant materials derived from the same species can show significant differences when cultivated at different sites, owing to the influence of soil, climate and other factors. Towards these, the site selection for cultivation of medicinal plants needs to be worked out based on a careful evaluation of environmental characteristics of site, as illustrated in Box 1-1.

Box 1-1: Guidelines for site selection...

<table>
<thead>
<tr>
<th>Climatic conditions</th>
<th>Length of day, rainfall (water supply), field temperature etc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site conditions</td>
<td>Risks of contamination by hazardous substances, including heavy metals, agricultural chemical agents, and other industrial waste.</td>
</tr>
<tr>
<td>Impacts of past land uses</td>
<td>History of previous crops, Evaluation of any applications of plant protection products</td>
</tr>
<tr>
<td>Drainage and soil conditions</td>
<td>Well-drained and well-irrigated soil to be preferred, soil type, drainage, moisture retention, fertility and pH to be considered</td>
</tr>
<tr>
<td>Risk of contamination</td>
<td>Domestic animals and human beings should not contaminate water for irrigation and harvest of medicinal plants</td>
</tr>
</tbody>
</table>

1.3.2 The cultivation of medicinal plants shall be as per the guidelines2 developed by Department of AYUSH (Ayurveda, Yoga & Neuropathy, Unnani, Siddha & Homeopathy), Ministry of Health & Family Welfare, Government of India. Towards cultivation of local species of medicinal plants, traditional methods of cultivation shall be adopted.

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1 The Medicinal Plants Board was set up under a Government Resolution (No. Z.18020/19/97-M.P.Cell) notified on 24th November 2000 under the Chairpersonship of Union Health & Family Welfare Minister. The Medicinal Plants Board at the national level is devoted for overall development of the medicinal plants sector in the country. However, for the development of the medicinal plants sector at the regional/state level, the National Board has initiated action and the respective state/Union Territories governments were requested to constitute the State Medicinal Plants Boards (SMPBs).

2 http://indianmedicine.nic.in/html/plants/mcmain.html#med
1.3.3 Prior to application of fertilizers for medicinal plants, the following aspects shall be considered:
- Appropriate types and quantities of fertilizers should be used.
- Human excreta must not be used as a fertilizer owing to the potential presence of infectious microorganisms or parasites.
- Land should be manured with well-fermented organic compost either prior to planting or immediately after the first harvest.
- All fertilizing agents should be applied sparingly and in accordance with the needs of the particular medicinal plant species and supporting capacity of the soil. *(Refer ECP AGRI 5: Nutrient Management)*
- Growers shall implement practices that contribute to soil conservation and minimize erosion.

1.4 Collection and harvesting practices for medicinal plants

1.4.1 Collection from Wild: The collector shall obtain permission from SMPB, State Forest Department and sub regional office of wildlife preservation prior to collecting any plants from the wild. Sufficient time (at least three months) for the processing and issuance of these permits shall be allocated at the planning stage *(Refer Box 1-2)*

**Box 1-2: Pre-requisites for collection...**

<table>
<thead>
<tr>
<th>The collector prior to initiating a collection expedition shall:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Determine the geographical distribution and population density of the target medicinal plant species</td>
</tr>
<tr>
<td>• Obtain essential information on the target species (taxonomy, distribution, phenology, genetic diversity, reproductive biology and ethnobotany)</td>
</tr>
</tbody>
</table>

1.4.2 The collector shall send sample of the medicinal plant to the SMPB/NEDFI/AAU for identification and offsite conservation.

1.4.3 To ensure all stakeholders namely traders, collectors and farmers undergo training to familiarise with techniques for collecting, handling and transportation of medicinal plants collected from wild.
- The PCU shall work out dissemination materials containing illustrations of the target medicinal plant(s) and ethnographical information (common or local names) of the target species and plant parts for wide dissemination in the project areas.
- The Department shall prepare a management plan containing details of (i) the species and the plant parts (roots, leaves, fruits, etc.) to be collected; and (ii) specify collection levels and collection practices. The framework shall provide for setting sustainable harvest levels and describe appropriate collection practices. It is incumbent on the government or environmental authority to ensure that buyers of collected plant material do not place the collected species at risk *(Refer Box 1.3)*.
### Box 1-3: Guidelines for collection of plants from wild...

The collector of medicinal plant from wild should:

- Determine as to whether the target species at collection site are not rare or scarce.
- Ensure medicinal plant materials are collected during the appropriate season or time.
- Practice ecologically sustainable system of collection. The collectors would however have to be trained by ecologically sustainable system of collection (Refer ECP Common 3: Training).
- Avoid collecting in or near areas where high levels of pesticides or other possible contaminants are used or found.
- In the course of collection, efforts should be made to remove parts of the plant that are not required and foreign matter, in particular toxic weeds.
- Avoid clearing of vegetation in the area (other than the target species), as the locations of collection are generally rich in biodiversity.
- In general, the collected raw medicinal plant materials should not come into direct contact with the soil. If underground parts (such as the roots) are used, any adhering soil should be removed from the plants as soon as they are collected. Collected material should be placed in clean baskets, mesh bags, other well-aerated containers or drop cloths that are free from foreign matter, including plant remnants from previous collecting activities.
- If more than one medicinal plant part is to be collected, the different plant species or plant materials should be gathered separately and transported in separate containers.

### 1.4.4 Harvesting of Cultivated Plant: To ensure the production of medicinal plant materials and finished herbal products of the best possible quality, the cultivator shall harvest the medicinal plants during the optimal season or time period. The DAO shall be responsible for providing information to the beneficiaries on the timing of harvest. To ensure good quality of produce and harvest environmentaly safe product the following guidelines should be adopted:

- The time of harvest would depend on the part of the plant to be used. The best time for harvesting (quality peak season or time of day) shall be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts.
- Medicinal plants shall be harvested under the best possible conditions, avoiding dew, rain or exceptionally high humidity. If harvesting occurs in wet conditions, the harvested material shall be transported immediately to an indoor drying facility to expedite drying so as to prevent any possible deleterious effects due to increased moisture levels, which promote microbial fermentation and mould.
- Cutting devices, harvesters, and other machines shall be kept clean and adjusted to reduce damage and contamination from soil and other materials.
- The harvested plants shall be stored in an uncontaminated, dry place or facility free from insects, rodents, birds and other pests, and inaccessible to livestock and domestic animals.
- Decomposed medicinal plant materials shall be discarded during harvest, post-harvest inspections and processing, in order to avoid microbial contamination and loss of product quality.

### 1.5 Storage, transportation, processing and supply

1.5.1 The following aspects shall be taken care of by personnel directly or indirectly involved in the storage, transportation, processing and supply of medicinal plants:

- The botanical identification, cultivation characteristics and environmental requirements (soil type, soil pH, fertility, plant spacing and light requirements), as well as the means of harvest and storage.
- All personnel (including field workers) involved in the propagation, cultivation, harvest and post-harvest processing stages of medicinal plant production should maintain appropriate personal hygiene and should have received training regarding their hygiene responsibilities.
- Only properly trained personnel, wearing appropriate protective clothing (such as overalls, gloves, helmet, goggles, face mask), should apply agrochemicals.

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3 When collecting roots of trees and bushes, the main roots should not be cut or dug up, and severing the taproot of trees and bushes should be avoided. Only some of the lateral roots should be located and collected. When collecting species whose bark is the primary material to be used, the tree should not be girdled or completely stripped of its bark; longitudinal strips of bark along one side of the tree should be cut and collected.
Growers and producers should receive instruction on all issues relevant to the protection of the environment, conservation of medicinal plant species, and proper agricultural stewardship. The Department should collate these information from SMPB, Forest Department, Wild Life Boards and that farmer, collectors and traders have easy access to this information.

1.5.2 For medicinal plant materials intended for export from the country, all statutory requirements such as export permits, phytosanitary certificates required as per the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit(s) (for export and import), CITES certificates (for re-export), and other permits shall be obtained as and when required from State Wildlife Department and sub regional offices of Wildlife Preservation located at Guwahati.

1.6 Processing

1.6.1 Appropriate measures of primary processing are dependent on the individual materials. These processes should be carried out in conformity with good manufacturing practices specified by Department of AYUSH (Refer Appendix ECP Agri. 1.5). Raw medicinal plant materials should be inspected and sorted prior to primary processing. The inspection may include:

- Visual inspection for cross-contamination by untargeted medicinal plants and/or plant parts;
- Visual inspection for foreign matter;
- Organoleptic evaluation, such as: appearance, damage, size, colour, odour, and possibly taste.

1.6.2 Processed medicinal plant materials shall be packaged as quickly as possible to prevent deterioration of the product and to protect against unnecessary exposure to potential pest attacks and other sources of contamination. The packaging and labelling of the products should be in accordance with Section 161 of Drug & Cosmetic Act 1940.

1.6.3 Conveyances used for transporting bulk medicinal plant materials from the place of production to storage for processing should be cleaned between loads. Bulk transport, such as rail wagons, trucks and other vehicles shall be cleaned and, where appropriate, well ventilated to remove moisture from medicinal plant materials and to prevent condensation.

1.6.4 All equipment and utensils used in the handling of medicinal plants shall be made of materials that do not transmit toxic substances, odour or taste, are non-absorbent, are resistant to corrosion and are capable of withstanding repeated cleaning and disinfection. (Refer Appendix ECP Agri. 1.5)
**ECP Agri. 1: Collection, Cultivation & Processing of Medicinal Plants**

**Selection and Approval of Medicinal Plants**
- Clause 1.2.1: Approval from SMPB prior to cultivation

**Site Selection for Cultivation**
- Clause 1.3.1: Selection of site as per soil and climatic condition

**Selection of Inputs for Cultivations**
- Clause 1.3.2: Guidelines of Cultivations
- Clause 1.3.3: ECPs of soil and nutrient management
- Clause 1.4.1, 1.4.2 & 1.4.3: Collection practices from wild

**Cultivation of Medicinal Plant**
- Clause 1.4.4: Harvesting of medicinal plants
- Clause 1.4.4: Storage of plants shall be in good condition

**Collection & Harvesting of Medicinal Plants**
- Clause 1.4.1

**Transport Handling Storage On-Site**
- Clause 1.5.1: Inspection and sorting

**Primary Processing & Extraction**
- Clause 1.5.1 & 1.5.4: Good Management Practice

**Disposal of Waste**
- Clause 1.5.1: Good Management Practice

**Marketing and Packaging**
- Clause 1.5.2: Packaging and labeling as per Drug Acts

**Storage**
- Clause 1.5.3: Clean and ventilation of transport
### APPENDIX ECP AGRI 1.1: PROJECT INFORMATION DOCUMENT

#### CULTIVATION, COLLECTION AND EXTRACTION OF MEDICINAL PLANTS

<table>
<thead>
<tr>
<th>District</th>
<th>Block</th>
<th>Village</th>
<th>Name of Beneficiary</th>
</tr>
</thead>
</table>

#### 1. Type of Intervention

<table>
<thead>
<tr>
<th>Collector</th>
<th>Farmer</th>
<th>Trader</th>
<th>Extractor</th>
</tr>
</thead>
</table>

#### 2. Distance of the Facility from:

<table>
<thead>
<tr>
<th>i) Sensitive Location</th>
<th>National parks,</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sanctuaries,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ramsar sites,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grade I Beels,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Classified Forests</td>
<td></td>
</tr>
</tbody>
</table>

#### 3. Nature and Scale of Operation

**Species of Medicinal Plant Collected or Cultivated**

<table>
<thead>
<tr>
<th>Type of Plant Collected</th>
<th>Botanical Name</th>
<th>Area from Which it is collected (name of Village, District or Forest area if any)</th>
<th>Approximate Quantity Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Cultivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Plant Collected</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Trader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Plant</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Extractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Species for Extraction (both name of the plant and the Botanical name):</td>
</tr>
<tr>
<td>ii) Source of water</td>
</tr>
<tr>
<td>iii) Number of extractor</td>
</tr>
<tr>
<td>iv) Is there a provision for a secondary extraction Unit: Yes</td>
</tr>
</tbody>
</table>
APPLICATION FOR GRANT OF CERTIFICATE OF REGISTRATION/RENEWAL AS MEDICINAL PLANTS COLLECTOR(s)/FARMER(s)/TRADER(s)

1. a) Name of the applicant(s)/contact person
   (in block letter)
b) Status (individual/firm/company/society/association/contractor/Govt. undertaking)
c) Date of establishment/engagement in the field of medicinal plants (trader enclose profile, if any)
d) Fresh or renewal, if renewal, give previous year's certificate
e) Amount and details of fee remitted
f) If already registered, furnish details with the name of the State and agency GO or NGO (attach copy of registration)

2. a) Address in full of the place(s) of storage/shop/processing plant/unit(s) etc., if any
b) Telephone, Fax and E-mail number(s)

3. Whether A) Collector; B) Farmer; C) Trader (mention specifically)

A. COLLECTOR(s):

4. Items of medicinal plants/parts/products collected (furnish details including approx. Quantity collected in following table):

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of herb(s)</th>
<th>Botanical name</th>
<th>Area of collection with Dist/ forest Div.</th>
<th>Aprox. Quantity (kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Are you an authorised collector of medicinal plants? (with permission of Govt. or other authorised body)

6. Years during which the application was in possession of Board's certificate of registration (for renewal only)

7. Whether collected product supplied under some brand name(s)/trademark(s)

8. Medicinal plants material collected and supplied i.e. raw/semi processed or processed during last 03 years.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Year</th>
<th>Name of species collected</th>
<th>Area from where collected</th>
<th>Approx. quantity</th>
<th>To whom supplied (kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>200</td>
<td>to 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>200</td>
<td>to 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>200</td>
<td>to 200</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B. FARMER (s):

9. Details of Land:
   i) Location (giving name of State/district/ tehsil/village/ khasra no. etc.)
   ii) Status & title of land, whether on lease or free hold (attach a copy of
       ownership/land registration)
   iii) Area (in acre)

10. Medicinal plants cultivated; furnish list with details:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Common name of plant</th>
<th>Botanical Name with plant part/product</th>
<th>Area under cultivation (acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. TRADERS:

   i) Sources of purchase/collection: from wild or cultivated:
   ii) State areas where items supplied in last three years

<table>
<thead>
<tr>
<th>S. No</th>
<th>Year</th>
<th>Name of species</th>
<th>State</th>
<th>Approx. quantity (qtl.)</th>
<th>FOB Value (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2000-2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2001-2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2002-2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DECLARATION

I/We, declare that the information given above are true to the best of my knowledge and belief and that I/We shall abide by the Board Rules, the condition laid down in the certificate and any instruction (s) given by the Board from time to time regarding the conducting of business.

Place: ____________________________
Dated: ____________________________
Signature of the Applicant(s) with seal
APPENDIX ECP AGRI 1.3 APPROVAL FOR DEVELOPMENT OF COMMERCIAL PRODUCTION OF HORTICULTURE CROPS

i) Date of application

ii) Control No.: (to be given by NHB)

To
The Managing Director
National Horticulture Board
Plot No. 85, Sector 18, Institutional Area,
Gurgaon – 122015
(Haryana)

(Application for in-Principle Approval (IPA) under the scheme “Development of Commercial Horticulture through Production and Post Harvest Management” of National Horticulture Board)

A GROWER/ENTREPRENEUR
1. Name and address of the beneficiary
2. Promoters Profile
   i) Principal Promoter
   ii) other
3. Name of the Associate Bank/FI and term loan account number of the Project/ Beneficiary.
4. Details of Financial assistance, availed by the applicant in past for the similar activity at the same piece of land, if any
5. Details of financial assistance, if availed for any other project.

B PROPOSED PROJECT
1. Name of the project
2. Location
3. Nature/main activity under the project
   a) Area under cultivation (In Acres)
   b) Capacity in MT in case of primary processing
   c) Technology Tie-up, if any

C PROJECT COST (Component-wise)

Component/Item
1. Cultivation of Crops
   i) Irrigation infrastructure (Like wells/pipeline)
   ii) Drip/Sprinkler irrigation (including fogger/mister)
   iii) Cultivation expenses (Planting material, fertilizer, pesticides, etc.)
   iv) Infrastructure (like store, generator room, pump house, labour quarter, etc with cost break-up of each item)
   v) Land development (including fencing)
   vi) Land

2. Cost of Post Harvest Management (PHM)/Primary Processing lines, if any (with cost detail of individual components)

3. Other components, if any

Total
PROPOSED MEANS OF FINANCE

I) Promoter's share with details
II) Bank/FI term loan
III) NHB subsidy (Bridge loan contribution made either by Promoter through Bank finance or other means may be clarified)
IV) Other sources with details (Assistance from State Govt./Govt of India Agencies should clearly be mentioned)

Total

DETAILS OF LAND

SURVEY/KHASRA No

i) In case of lease/tenancy/contract, a copy of the registered agreement may be enclosed
ii) In case of own land copy of latest title/papers be enclosed

PRESENT STATUS

Details of already existing assets which will form part of the proposed project on completion.

IMPLEMENTATION SCHEDULE

I) Proposed month for undertaking + land development.
II) Proposed month for plantation
III) Expected date/month of first commercial crop
IV) Proposed date for start of unit in case of processing

MARKETING

Detail of Marketing tie-up (Backward/forward linkages)

RECOMMENDATION OF THE BANK

(Signature of the Authorised Bank Officer)
Name of the Officer ________________
Designation ________________
Name of the Bank ________________
Bank Branch Address ________________
Telephone/Fax No.: ________________

Place: ___________________

Date: ___________________

NOTE: ATTACH FOLLOWING DOCUMENTS
i) Fact sheet from Bank (as per guidelines)
ii) Appraisal note from Bank
iii) Sanction letter of term loan from Bank
iv) Proof of land ownership/lease
## APPENDIX ECP AGRI 1.4: LIST OF MEDICINAL PLANTS FEASIBLE IN ASSAM PROPOSED BY STATE MEDICINAL PLANT BOARD

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Name</th>
<th>Botanical Name</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Amla</td>
<td>Emblica officinalis</td>
<td>10 t fruit</td>
</tr>
<tr>
<td>2.</td>
<td>Ashok</td>
<td>Saraca asoca</td>
<td>2,000 bark</td>
</tr>
<tr>
<td>3.</td>
<td>Bael</td>
<td>Aegle marmelos</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Bhumi amlaki</td>
<td>Phyllanthus amaracus</td>
<td>5 qtls herbage</td>
</tr>
<tr>
<td>5.</td>
<td>Bramhi</td>
<td>Bacopa monnieri</td>
<td>20 qtls herbage</td>
</tr>
<tr>
<td>6.</td>
<td>Chandan</td>
<td>Santalum album</td>
<td>1,500 kg heart wood</td>
</tr>
<tr>
<td>7.</td>
<td>Giloe</td>
<td>Tinospora cordifolia</td>
<td>4 kg dry stem</td>
</tr>
<tr>
<td>8.</td>
<td>Gymdar</td>
<td>Gymnema sylvestre</td>
<td>4 qtl leaves</td>
</tr>
<tr>
<td>9.</td>
<td>Kalihari</td>
<td>Glorisia superba</td>
<td>13 qtls seed/ 30 qtls tuber</td>
</tr>
<tr>
<td>10.</td>
<td>Kalmegh</td>
<td>Andrographis paniculata</td>
<td>12 qtl herbage</td>
</tr>
<tr>
<td>11.</td>
<td>Makoy</td>
<td>Solanum nigrum</td>
<td>5 qtl herbage</td>
</tr>
<tr>
<td>12.</td>
<td>Safed Musali</td>
<td>Chlorophytum borivillianum</td>
<td>3.5 dry roots</td>
</tr>
<tr>
<td>13.</td>
<td>Pathurchar</td>
<td>Coleus barbatarius</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Pippali</td>
<td>Piper Longum</td>
<td>2.5 qtls spikes/ 1 qtls root</td>
</tr>
<tr>
<td>15.</td>
<td>Sarpagandha</td>
<td>Rauwolfa Serpentina</td>
<td>6 qtl dry root</td>
</tr>
<tr>
<td>16.</td>
<td>Shatavari</td>
<td>Asparagus racemosus</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Tulsi</td>
<td>Ocimum sanctum</td>
<td>20-25kg of oil</td>
</tr>
</tbody>
</table>
ANNEXURE ECP AGRI 1.5: GOOD MANUFACTURING PRACTICES FOR AYURVEDIC, SIDDHA AND UNANI MEDICINES NOTIFIED UNDER DRUGS & COSMETIC ACT 1940 ON 23rd JUNE 2000

The Good Manufacturing Practices are prescribed to ensure that:
(i) Raw materials used in the manufacture of drugs are authentic, of prescribed quality and are free from contamination.
(ii) The manufacturing process is as has been prescribed to maintain the standards.
(iii) Adequate quality control measures are adopted and
(iv) The manufactured drug, which is released for sale, is of acceptable quality.
(v) To achieve the objectives listed above, each license shall evolve methodology and procedures for following the prescribed process of manufacture of drugs, which should be documented as a manual and kept for reference and inspection. However, teaching institutions and registered qualified Vaidyas, Siddhas and Hakeems who prepare medicines on their own to dispense to their patients and not selling such drugs in the market are exempted from the purview of G.M.P.

PART I
GOOD MANUFACTURING PRACTICES

Factory Premises:
The manufacturing plant should have adequate space for:
(i) Receiving and storing raw material.
ii. Manufacturing process Areas
iii. Quality control section.
iv. Finished goods store
v. Office
vi. Rejected goods/drugs store

1.2 General Requirements:

1.1(A) Location and surroundings:
The factory buildings for manufacture of Ayurveda, Siddha and Unani medicines shall be so situated and shall have such construction as to avoid contamination from open sewerage, drain, public lavatory or any factory which produces disagreeable or obnoxious odour or fumes or excessive soot, dust or smoke.

1.1(B) Buildings:
The building used for factory shall be such as to permit production of drugs under hygienic conditions and should be free from cobwebs and insects/rodents. It should have adequate provision of light and ventilation. The floor and the walls should not be damp or moist. The premises used for manufacturing, processing, packaging and labeling will be in conformity with the provisions of the Factory Act. It shall be located so as to be:

(I) Compatible with other manufacturing operations that may be carried out in the same or adjacent premises.
(II) Adequately provided with working space to allow orderly and logical placement of equipment and materials to avoid the risk of mix up between different drugs or components thereof and control the possibility of cross contamination by other drugs or substances and avoid the risk of omission of any manufacturing or control step:
(III) Designed, constructed and maintained to prevent entry of insects and rodents. Interior surface (walls, floors and ceilings) shall be smooth and free from cracks and permit easy cleaning and disinfection. The walls of the room in which the manufacturing operations are carried out shall be impervious to and be capable of being kept clean. The flooring shall be smooth and even and shall be such as not to permit retention or accumulation of dust or waste products.
(IV) Provided with proper drainage system in the processing area. The sanitary fitting and electrical fixtures in
the manufacturing area shall be proper and safe.

(V) Furnace/Bhatti section could be covered with tin roof & proper ventilation, but sufficient care should be
taken to prevent flies and dust.

(VI) There should be fire safety measures and proper exits should be there.

1.1(C) Water Supply:

The water used in manufacture shall be pure and of potable quality. Adequate provision of water for washing the
premises shall be made.

1.1(D) Disposal of Waste:

From the manufacturing sections and laboratories the waste water & the residues which might be prejudicial to
the workers or public health shall be disposed off after suitable treatment as per guidelines of pollution control
authorities to render them harmless.

1.1(E) Container’s Cleaning:

In factories where operations involving the use of containers such as bottles, vials and jars are conducted, there
shall be adequate arrangements separated from the manufacturing operations for washing, cleaning and drying
of such containers.

1.1(F) Stores:

Storage should have proper ventilation and shall be free from dampness. It should provide independent adequate
space for storage of different types of material, such as raw material, packaging material & finished products.

1.1(F)(A) Raw Materials:

All raw materials procured for manufacturing will be stored in the raw materials store. The manufacture based on
the experience and the characteristics of the particular raw material used in Ayurveda, Siddha and Unani system
shall decide the use of appropriate containers which would protect.

Quality of the raw material as well as prevent it from damage due to dampness, microbiological contamination or
rodent and insect infestation, etc. If certain raw materials require such controlled environmental conditions, the
raw materials stores may be sub-divided with proper enclosures to provide such conditions by suitable
cabinization. While designing such containers, cabins or areas in the raw materials store, care may be taken to
handle the following different categories of raw material:-

1. Raw material of metallic origin.
2. Raw material of mineral origin.
3. Raw material from animal source.
4. Fresh Herbs.
5. Dry Herbs or plant parts.
6. Excipients etc.
8. Plant extracts and exudates/resins.

Each container used for raw material storage shall be properly identified with the label which indicates name of
the raw material, source of supply and will also clearly state the status of raw material such as ‘UNDER TEST’ or
'APPROVED' or 'REJECTED'. The labels shall further indicate the identify of the particular supply in the form of batch No. or lot No. and the date of receipt of the consignment.

All the raw materials shall be sampled and got tested either by the in house Ayurvedic, Siddha and Unani experts (Quality control technical person) or by the laboratories approved by the Government and shall be used only on approval after verifying. The rejected raw material should be removed from other raw material store and should be kept in separate room. Procedure of 'First in first out' should be adopted for raw materials wherever necessary. Records of the receipt, testing and approval or rejection and use of raw material shall be maintained.

1.1(F)(B) Packaging Materials:

All packaging materials such as bottles, jars, capsules etc. shall be stored properly. All containers and closure shall be adequately cleaned and dried before packing the products.

1.1(F)(C) Finished Goods Stores:

The finished goods transferred from the production area after proper packaging shall be stored in the finished goods stores within an area marked "Quarantine". After the quality control laboratory and the experts have checked the correctness of finished goods with reference to its packing/labeling as well as the finished product quality as prescribed, then it will be moved to "Approved Finished Goods Stock" area. Only approved finished goods shall be dispatched as per marketing requirements. Distribution records shall be maintained as required.

If any Ayurvedic, Siddha and Unani drug needs special storage conditions, finished goods store shall provide necessary environmental requirements.

1.1(G) Working space:

The manufacturing area shall provide adequate space (manufacture and quality control) for orderly placement of equipment and material used in any of the operations for which these are employed so as to facilitate easy and safe working and to minimize or to eliminate any risk of mix-up between different drugs, raw materials and to prevent the possibility of cross contamination of one drug by another drug that is manufactured, stored or handled in the same premises.

1.1(H) Health Clothing, Sanitation and Hygiene of Workers:

All workers employed in the Factory shall be free from contagious diseases. The clothing of the workers shall consist of proper uniform suitable to the nature of work and the climate and shall be clean. The uniform shall also include cloth or synthetic covering for hands, feet and head wherever required. Adequate facilities for personal cleanliness such as clean towels, soap and scrubbing brushes shall be provided. Separate provision shall be made for lavatories to be used by men and women, and such lavatories shall be located at places separated from the processing rooms. Workers will also be provided facilities for changing their clothes and to keep their personal belongings.

1.1(I) Medical Services:

The Manufacturer shall also provide:-

(a) adequate facilities for first aid;

(b) medical examination of workers at the time of employment and periodical check up thereafter by a physician once a year, with particular attention being devoted to freedom from infections. Records thereof shall be maintained.

1.1(J) Equipment:

For carrying out manufacturing depending on the size of operation and the nature of product manufactured, suitable equipment either manually operated or operated semi-automatically (Electrical or steam based) or fully
automatic machinery shall be made available. These may include machines for use in the process of manufacture such as crushing, grinding, powdering, boiling, mashing, burning, roasting, filtering, drying filling, labeling and packing etc. To ensure ease in movement of workers and orderliness in operations a suitably adequate space will be ensured between two machines or rows of machines. These Equipments have to be properly installed and maintained with proper cleaning.

Proper standard operational procedures (SOPs) for cleaning, maintaining & performance of every machine should be laid down.

1.1(K) Batch Manufacturing Records:

The licencee shall maintain batch manufacturing record of each batch of Ayurvedic, Siddha and Unani drugs manufactured irrespective of the type of product manufactured (classical preparation or patent and proprietary medicines). Manufacturing records are required to provide an account of the list of raw materials and their quantities obtained from the store, tests conducted during the various stages of manufacture like taste, colour, physical characteristics and chemical tests as may be necessary or indicated in the approved books of Ayurveda, Siddha and Unani mentioned in the First Schedule of the Drugs and Cosmetic Act, 1940 (23 of 1940). These tests may include any in-house or pharmacopoeial test adopted by the manufacturer in the raw material or in the process material and in the finished product. These records shall be duly signed by Production and Quality Control Personnel respectively. Details of transfer of manufactured drug to the finished products store including dates and quantity of drugs transferred along with record of testing of the finished product, if any, and packaging, records shall be maintained. Only after the manufactured drugs have been verified and accepted quality shall be allowed to be cleared for sale.

It should be essential to maintain the record of date, manpower, machine and equipments used and to keep in process record of various shodhana, Bhavana, burning in fire and specific grindings in terms of internal use.

1.1(L) Distribution Records:

Records of sale and distribution of each batch of Ayurveda, Siddha and Unani Drugs shall be maintained in order to facilitate prompt and complete recall of the batch, if necessary.

1.1(M) Record of Market Complaints:

Manufacturers shall maintain a register to record all reports of market complaints received regarding the products sold in the market. The manufacturer shall enter all data received on such market complaints, investigations carried out by the manufacturers regarding the complaint as well as any corrective action initiated to prevent recurrence of such market complaints shall also be recorded. Once in a period of six months the manufacturer shall submit the record of such complaints to the licensing authority. The Register shall also be available for inspection during any inspection of the premises.

Reports of any adverse reaction resulting from the use of Ayurvedic, Siddha and Unani drugs shall also be maintained in a separate register by each manufacturer. The manufacturer shall investigate any of the adverse reaction to find if the same is due to any defect in the product, and whether such reactions are already reported in the literature or it is a new observation.

1.1(N) Quality Control:

Every licensee is required to provide facility for quality control section in his own premises or through Government approved testing laboratory. The test shall be as per the Ayurveda, Siddha and Unani pharmacopoeial standard. Where the tests are not available, the test should be performed according to the manufacturers specification or other information available. The quality control section shall verify all the raw materials, monitor in process, quality checks and control the quality of finished product being released to finished goods store/ware house. Preferably for such Quality control there will be a separate expert. The quality control section shall have the following facilities:
1. There should be 150 sq. feet area for quality control section.

2. For identification of raw drugs, reference books and reference samples should be maintained.

3. Manufacturing record should be maintained for the various processes.

4. To verify the finished products, controlled samples of finished products of each batch will be kept for 3 years.

5. To supervise and monitor adequacy of conditions under which raw materials, semi-finished products and finished products are stored.

6. Keep record in establishing shelf life and storage requirements for the drugs.

7. Manufacturers who are manufacturing patent proprietary Ayurveda Siddha, and Unani medicines shall provide their own specification and control references in respect of such formulated drugs.

8. The record of specific method and procedure of preparation, that is, "Bhavana", "Mardana" and "Puta" and the record of every process carried out by the manufacturer shall be maintained.


10. All raw materials will be monitored for fungal, bacterial contamination with a view to minimise such contamination.

11. Quality control section will have a minimum of

12. 

   a. one person with Degree qualification in Ayurveda/Siddha/Unani (A.S.U.) as per Schedule II of Indian Medicine Central Council Act, 1970 (84 of 1970) of a recognized university or Board.

   b. Provided that Bachelor of Pharmacy, Pharmacognosy and Chemistry may be associated with the quality control section.

3.0 Requirement for Sterile Product:

(A) Manufacturing Areas

For the manufacture of sterile Ayurvedic, Unani and Siddha drugs, separate enclosed areas specifically designed for the purpose shall be provided. These areas shall be provided with air locks for entry and shall be essentially dust free and ventilated with an air supply. For all areas where aseptic manufacture has to be carried out, air supply shall be filtered through bacteria retaining filters (HEPA Filters) and shall be at a pressure higher than in the adjacent areas. The filters shall be checked for performance on installation and periodically thereafter the record of checks shall be maintained. All the surfaces in sterile manufacturing areas shall be designed to facilitate cleaning and disinfection. For sterile manufacturing routine microbial counts of all Ayurvedic, Siddha and Unani drug manufacturing areas shall be carried out during operations. Results of such count shall be checked against established in-house standards and record maintained.

Access to manufacturing areas shall be restricted to minimum number of authorised personnel. Special procedure to be followed for entering and leaving the manufacturing areas shall be written down and displayed.

For the manufacturing of Ayurvedic, Siddha and Unani drug that can be sterilised in their final containers, the design of the areas shall preclude the possibility of the products intended for sterilisation being mixed with or taken to be products already sterilised. In case of terminally sterilised products, the design of the areas shall preclude the possibility of mix up between non-sterile and sterile products.
(B) Precautions against contamination and mix:

a. Carrying out manufacturing operations in a separate block of adequately isolated building or operating in an isolated enclosure within the building.

b. Using appropriate pressure differential in the process area.

c. Providing a suitable exhaust system.

d. Designing laminar flow sterile air systems for sterile products.

e. The germicidal efficiency of UV lamps shall be checked and recorded indicating the burning hours or checked using intensity.

f. Individual containers of liquids, and ophthalmic solutions shall be examined against black-white background fitted with diffused light after filling to ensure freedom from contamination with foreign suspended matter.

g. Expert technical staff approved by the Licensing Authority shall check and compare actual yield against theoretical yield before final distribution of the batch.

All process controls as required under master formula including room temperature relative humidity, volume filled, leakage and clarity shall be checked and recorded.

PART – II

A. LIST OF MACHINERY, EQUIPMENT AND MINIMUM MANUFACTURING PERMISES REQUIRED FOR THE MANUFACTURE OF VARIOUS CATEGORIES OF AYURVEDIC, SIDHAA SYSTEM OF MEDICINES.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Category of Medicine</th>
<th>Minimum manufacturing space required</th>
<th>Machinery/ equipment recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anjana/Pisti</td>
<td>100 Sq. feet</td>
<td>Karel/mechnised/motorised, khare, End runner/ Ball-Mill Sieves/Shifter</td>
</tr>
<tr>
<td>2.</td>
<td>Churna/Nasya Kwath Churn</td>
<td>200 Sq. feet</td>
<td>Grinder/ Disintegrator/ Manjan/Lepa Pulverisar/ Powder mixer/ sieves/shifter</td>
</tr>
<tr>
<td>3.</td>
<td>Pills/Vatti/Gutika Matirai</td>
<td>100 Sq. feet</td>
<td>Ball Mill, Mass mixer powder mixer pill/vati cutting machine, stainless steel trays/ Containers for Storage. Driers/Mechanised chattee(for mixing guggul) where required.</td>
</tr>
<tr>
<td>4.</td>
<td>Tablets</td>
<td>100 Sq. feet</td>
<td>Ball Mill, Mass Mixer/Powder mixer/Granulator drier, Tablet compressing Machine and sugar-Coating, foliching pay in case of sugar coated tablets, mechanised chattee (for mixing of guggulu) where required.</td>
</tr>
<tr>
<td>5.</td>
<td>Kupi pakva</td>
<td>150 Sq. feet</td>
<td>Bhatti, Karahi/ Stainless Steel</td>
</tr>
<tr>
<td>Ksara/Parpati/</td>
<td>Vessels/Patia Flask, Multani Matti/Plaster</td>
<td>6 Kajal</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Lavana Bhasma</td>
<td>of Paris, Copper Rod, Earthen container,</td>
<td>7 Capsules</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td>Satva/ Sindura</td>
<td>Gaj Put Bhatti, Muffle furnace (Electrically</td>
<td>8</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Earthen lamps for Collection of Kajal, Tipple Roller Mill, End Runner, Sieves, S.S.Patila, Filling/packing and manufacturing room should be provided with exhaust fan &amp; ultra violet lamps</td>
<td>9</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Air Conditioner, Dehumidifier, hygrometer, Thermo-meter, Capsule filling machine and chemical balance.</td>
<td>10 Panak Syrup/Pravahi</td>
<td>150 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Tube filling Pasai machine, Crimping Medicine/Ointment Mixer, End Runner/Mill (Where required), S.S. Storage Container S.S. Patila</td>
<td>11 Asava/Aristha</td>
<td>200 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Bhatti section fitted with Exhaust fan and should be fly proof, Iron Kadahi/S.S. Patila and S.S. Storage container</td>
<td>12 Sura</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Same as mentioned above, Fermentation tanks containers and Distillation Plant where necessary, Filter Press</td>
<td>13 Ark Tinir</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Same as mentioned above plus Distillation plant and Transfer pump</td>
<td>14 Tail/Ghrit Ney</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Maceration tank, Distillation plant, Liquid filling tank with tap/Gravity filter/Filter press, Visual inspection box</td>
<td>15 Aschyotan/Netra Malham Panir</td>
<td>100 Sq. feet</td>
</tr>
<tr>
<td></td>
<td>Bhatti, Kadahi/S.S. Patila S.S. Storage Containers, Filtration equipment, filling tank with tap/Liquid filling machine.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hot air oven electrically heated with thermostatic control, cettle gas or electrically heated with suitable mixing arrangements colation mill or ointment mill, tube filling equipment, mixing and storage tanks of stainless steel or of other.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
suitable material sintered glass funnel, seitz filter or filter candle, liquid filling equipment, autoclave.

Each manufacturing unit will have a separate area for Bhatti, furnaces, boilers, pata, etc. This will have proper ventilation, removal of smoke, prevention of flies, insects, dust etc. The furnace section could have tin roof.

| LIST OF MACHINERY, EQUIPMENT AND MINIMUM MANUFACTURING PERMISES REQUIRED FOR THE MANUFACTURE OF VARIOUS CATEGORIES OF UNANI SYSTEM OF MEDICINES. |
|---|---|---|
| Sl.No. | Category of Medicine | Minimum manufacturing space required equipment |
| 1 | Itrifal Tiryao/ majoon/Laooq/ JawarishKhamiras | 1200 square feet covered area with separate abins. Partitions for each activity. If Ayurveda/Siddha Medicines are also manufactured in same premises an additional areas of 400 square feet will be required |
| 2 | Arq. | 100 Sq.feet |
| 3 | Habb (Pills) | 100 Sq.feet |
| 4 | Sufoof (Powder) | 100 Sq. feet |
| 5 | Raughan (oils) (Crushing & Boiling) | 100 Sq.feet |
| 6 | Shiyaf, Surma, Kajal | 100 Sq. feet |

Grinder/Pulveriser, Sieves, powder mixer (if required), S.S. Patilas, Bhatti and Other accessories, Planter mixer for Khamiras Distillation Plant (garem bic) S.S. Storage Tank, Boiling Vessel, Gravity filter, Bottle Filling machine, Bottle washing machine, Bottle drier. 

Grinder/Pulversier, Sieves, Powder Mixer, (Where required) Trays. 

Grinder/pulversier, Sieves, Trays, Scoops, Powder mixer, (Where required). 

Oil Expeller, S.S. Patilas Oil filter Bottle, filling Machine, Bottle drier, Bhatti 

End runner, mixing S.S. Vessel
<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Category of Medicine</th>
<th>Minimum manufacturing space required equipment</th>
<th>Machinery/recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Marham, Zimad, Ointment)</td>
<td>100 Sq.feet</td>
<td>Kharal. (Bhatti, End runner, Grinder, Pulveriser, Tripple Roller Mill (if needed).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Grinder/Pulveriser, Sieves, Powder mixer (Where needed), Granulator, Drier, Tablet Compressing Machine, Die punches Trays, O.T. Apparatus, Balance with weights, Scoops, Sugar Coating Pan, polishing pan, Heater.</td>
</tr>
<tr>
<td>8.</td>
<td>Qurs (Tab)</td>
<td>100 Sq.feet</td>
<td>Bhatti, Kharal, Sil Batta, Eartern pots.</td>
</tr>
<tr>
<td>9.</td>
<td>Kushta</td>
<td>100 Sq.feet</td>
<td>Bhatti, Kharal, Sil Batta, Eartern pots.</td>
</tr>
<tr>
<td>10.</td>
<td>Murabba</td>
<td>100 Sq.feet</td>
<td>Aluminium Vessels 50-100 kgs. Capacity, Gendna, Bhatti.</td>
</tr>
<tr>
<td>11.</td>
<td>Capsule</td>
<td>100 Sq.feet</td>
<td>Pulveriser, Powder mixer (Where needed), capsule filling machine, Air Conditioner, Dehumidifier Balance with weights, storage-containers, ooo glass.</td>
</tr>
<tr>
<td>13.</td>
<td>Qutoor Chasm and Marham (Eye drops Eye ointment)</td>
<td>100 Sq.feet</td>
<td>Hot air oven electrically heated with Thermostatic control, Cettle.</td>
</tr>
<tr>
<td></td>
<td>Each manufacturing unit will have a separate area for Bhatti, furnaces, boilers, putta, etc. This will have proper ventilation, removal of smoke, prevention of flies, insects, dust etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td>200 Sq.feet</td>
<td></td>
</tr>
</tbody>
</table>
2.1 General

2.1.1 AACP envisages provision of irrigation facilities to increase productivity through (i) Shallow tube wells, and (ii) lift irrigation through river pumping stations. The environmental issues associated with the installation of shallow tube wells for irrigation purposes are i) Concentration of tube wells ii) High iron; fluoride and oil contents, and iii) soil contamination due to oil spillages. This ECP provides information and practices to be adopted by the Agriculture Department towards minimisation of the environmental impacts during planning, design and operation of the irrigation systems.

2.1.2 The ECP shall be applicable to STWs and DTWs located outside 1km of the boundary of National Parks, Sanctuaries, Ramsar Sites, Grade I Beels, Classified Forest and Open Space.

2.1.3 The ECP for RLP shall also not be applicable for areas where STW/DTW is restricted. In addition, provisions of ECPs shall not apply for areas near Grade I, Grade II and Grade III beels and natural water channels. The Provisions of the ECP shall apply to projects which are classified as "Low Impacts" by the ETO based on information furnished in the PID.

2.2 Legislation

As per the report of Central Ground Water Board in 18 out 23 districts of state tube wells are feasible.

Legend


Relevant provisions of Assam Irrigation Act are presented in Table 2-1

Table 2-1: Relevant Provisions of Irrigation Act

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Relevant Provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Assam Irrigation Act 1983</td>
<td>Section-3: Notification of intention to apply or regulate water for irrigation:</td>
</tr>
<tr>
<td></td>
<td>Section 28: Supply of Water</td>
</tr>
<tr>
<td></td>
<td>Section 29: Factor to be taken into consideration in determining supply of water</td>
</tr>
<tr>
<td></td>
<td>Section 52: Removal and modification of obstructions</td>
</tr>
</tbody>
</table>

2.3 Selection of Appropriate System

2.3.1 Prior to selection of appropriate irrigation system, the aspects to be considered by the Extension officer/beneficiary are presented in Table 2.2.
Table 2-2: Criteria for Selection of Appropriate System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>1. Free of contamination from pesticides herbicide, heavy metals (iron, Fluoride and Arsenic), Hydrocarbons, organic solids, salts, nematode and other parasitic organisms</td>
</tr>
<tr>
<td></td>
<td>2. Desirable temperature and pH</td>
</tr>
<tr>
<td>Water Quantity</td>
<td>3. Availability of sufficient volumes on demand</td>
</tr>
<tr>
<td></td>
<td>4. Design to accommodate peak crop needs</td>
</tr>
<tr>
<td>Legal Considerations</td>
<td>5. To be complied with before drawing water to irrigate</td>
</tr>
<tr>
<td>Capital &amp; operating costs</td>
<td>6. Minimal costs of power and O&amp;M</td>
</tr>
<tr>
<td>Environmental Impacts</td>
<td>7. There shall not be any impact on the water cycle of the fragile ecosystem, nor interfere with quantity or quality of flowing water for downstream users</td>
</tr>
<tr>
<td></td>
<td>8. Not impair indicators of soil health - soil water holding capacity, total organic Nitrogen and Carbon, pH and conditions of soil surface aggregates</td>
</tr>
<tr>
<td>Safety</td>
<td>9. Not be a potential safety hazard</td>
</tr>
</tbody>
</table>

2.3.2 To achieve optimum irrigation intensities in alluvial plains, conjunctive use of ground and surface water, accompanied by an efficient system of surface drainage is necessary. The fixing of intensity of irrigation shall be done as per guidelines suggested in the IS: 13668:1993 (Refer Appendix ECP Agri. 2.2). The conjunctive use of ground and surface water can be proposed in whole state except hill districts and southern Assam (Refer Figure 2.1), wherein surface irrigation is the only viable option.

Option 1: Surface-Ground Water  
Option 2: Surface Water

\[1\] The hill districts of State are North Cachar Hills and Karbi Anglong. And the Southern Districts are Cachar, Hailakandi and Karimganj respectively.
2.4 Design and Installation of Shallow Tube wells

2.4.1 STWs shall be discouraged in 36 blocks in 12 districts in which high concentration of Arsenic has been identified. In such blocks alternate sources of irrigation such as surface water or rain water harvesting shall be encouraged.

2.4.2 The quality of ground water shall be tested for Iron, Arsenic, and Fluoride prior to commissioning of tube wells. Based on the results appropriate method for removal shall be suggested by the District Agriculture Officer or extension officer. Table 2-3 shows the region wise problems in water quality in Assam, which shall be revised every two years. The construction and testing of the tube wells shall be done as per IS: 2800:1991 (Part 1: Construction) (Refer Appendix ECP Agri 2.3).

Table 2-3: Region wise Problems in ground water quality for irrigation uses

<table>
<thead>
<tr>
<th>Name of Region*</th>
<th>Permissible Limit (mg/l)</th>
<th>Iron</th>
<th>Fluoride</th>
<th>Arsenic</th>
<th>Hydrocarbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Assam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North of Brahmaputra</td>
<td>Iron above 5mg/l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South of Brahmaputra</td>
<td>(as per NERIWALM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Assam</td>
<td>Fluoride above 5mg/l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North of Brahmaputra</td>
<td>(as per CGWB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South of Brahmaputra</td>
<td>Arsenic above 0.1 mg/l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Assam</td>
<td>Hydrocarbon above 10mg/l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North of Brahmaputra</td>
<td>(as per NERIWALM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South of Brahmaputra</td>
<td>(as per NERIWALM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Assam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hill Districts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend*: High | Medium | Low | Nil

Source: Study on Safe Yield of Groundwater and level of iron, fluoride, arsenic and hydrocarbon in Assam, North Eastern Regional Institute of Water and Land Management, Tezpur (Assam), India, March 2004

2.5 Mitigation measures for issues pertaining to ground water quality

2.5.1 Iron Content: Where iron content in ground water is beyond the permissible limits (above 5mg/l) the practice adopted for irrigation shall be

- Water shall be cascaded from a height of at least 2m.
- Water shall be allowed to move through the water channel for a distance of about 200m before being applied to the field.
- Application of Organic matter and lime in crop field shall help in reducing the iron content in soil and water. For details on lime application refer ECP AGRI-4: Soil and Nutrient Management.
- Fixation of applied phosphorus by iron can be reduced through use of Rock Phosphate and PSB bio fertilizer in soil. For details on bio-fertilizer application refer ECP AGRI-4: Soil and Nutrient Management.
- Maintaining the riparian vegetation shall arrest iron.

---

* It shall be the responsibility of the PCU and Department for testing the water quality before commissioning of tube well

* The Districts considered in (i) North Brahmaputra in lower Assam are (a) Bongaigaon; (b) Barpeta; (c) Kokrajhar; (d) Nalbari; and (e) Part of Dhubri, (ii) South Brahmaputra in lower Assam are (a) Goalpara and (b) Part of Dhubri, (iii) North Brahmaputra in Central Assam are (a) Darrang and (b) Part of Kamrup, (iv) South Brahmaputra in Central Assam are (a) Morigaon; (b) Nagaon; and (c) Part of Kamrup, (v) North Brahmaputra in Upper Assam are (a) Lakhimpur; (b) Dhemaji; and (c) Part of Jorhat, (vi) South Brahmaputra in Upper Assam are (a) Dibrugarh; (b) Golaghat; (c) Sibsagar; (d) Sonitpur; (e) Tinsukia; and (f) Part of Jorhat.

* The ranges assigned to High is Above 50%; Medium is 25-50%; and Low is Below 25%
2.5.2 Fluoride Content: If the fluoride content in the ground water is above 5mg/l the DAO shall ensure that the tube well is closed as per the IS: 11632-1986 and alternate source for shall be identified to meet the future water demand (Refer Appendix ECP Agri. 2.4).

If the fluoride content is in the range of 3mg/l to 5mg/l, fluoride shall be reduced by (i) anion exchange; (ii) Adsorption by calcium phosphate, magnesium hydroxide or activated carbon and (iii) Reverse osmosis will remove 93 - 95 % of the fluoride.

2.5.3 Arsenic Content: The arsenic content of the ground water is within permissible limit in all over state (as per the NERIWALM, Tezpur) (Refer Table 2-3). If the arsenic content in the ground water is above permissible limits (above 0.1 mg/l) the DAO shall ensure that the tube well is closed as per the IS: 11632-1986 and alternate source shall be identified to meet future water demand. For treatment of ground water for arsenic content, the following techniques which shall be used are (i) In-situ Oxidation; (ii) Co-Precipitation and Adsorption Processes; (iii) Bucket Treatment Unit. There are treatment technique for removal of inorganic contaminants; as reverse osmosis, activated alumina, ion exchange, activated carbon, and distillation.

- Filtration through activated carbon will reduce the amount of arsenic in drinking water from 40 - 70%. Anion exchange can reduce it by 90 - 100%. Reverse Osmosis has a 90% removal rate, and Distillation will remove 98%.
- If the arsenic is present in organic form, it can be removed by oxidation of the organic material and subsequent coagulation.

2.5.4 It shall be the responsibility of PCU to undertake monitoring of Arsenic and fluoride of whole state in third year of the project. Further, half yearly monitoring of Arsenic in 36 blocks of 12 districts and Fluoride in 12 blocks of 8 districts shall be done though out the project period.

2.5.5 Hydrocarbons (Oil content): If the hydrocarbon content in the ground water is above 10mg/l the DAO shall ensure that the tube well is closed as per the IS: 11632-1986 and alternate source for the water has to be considered to meet the future water demand. Hydrocarbons can have considerable impact on soil environment because of its extreme stability and subsequent entry into food chain. Not much study on affect of hydrocarbon on soil and plant has been done. Hence, a detailed study of soil and agronomical aspects of hydrocarbon at micro-watershed level need to be taken. Where groundwater is used for irrigation with oil content, the water shall be allowed to fall in tank with outlet of water at the lower level of the tank, so that the oil content get accumulated at the surface, which can be drained out through separate pipe.

2.6 Distance between tube wells

2.6.1 The spacing of tube wells shall be determined by soil strata and its yielding capacity, depth of static water table, depth of tube wells, depth from which water is drawn and draws down. In no case, cone of depression of one tube well should interfere with that of adjacent tube well. For the safe yield of ground water region wise average distance between the shallow tube wells mainly ranges between 150-200m. The Field engineer/Extension officer shall make the site visit prior to sanction of tube wells to the identified beneficiary (as indicated in Table 2-4). If the distance between the tube wells is less than the permissible distances, the Field Engineer/Extension officer shall suggest appropriate alternative locations. In the
event of non-availability of such alternative locations, alternate sources of irrigation shall be explored and recommended to the beneficiary.

Table 2-4: Region wise Permissible distance between the tube wells

<table>
<thead>
<tr>
<th>Regions in State</th>
<th>Lower Assam</th>
<th>Central Assam</th>
<th>Upper Assam</th>
<th>Southern Assam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Distance Between Tube wells</td>
<td>150-200</td>
<td>150-200</td>
<td>100-150</td>
<td>200-250</td>
</tr>
</tbody>
</table>

2.7 Rehabilitation of Shallow & Deep Tube wells

2.7.1 The rehabilitation of tube wells shall be done as per the guidelines suggested in the IS: 11632-1986, Code of Practice of rehabilitation of tube wells. The tube wells shall normally be taken up for reconstruction/rehabilitation when its specific yield falls down below 1/2 to 1/3rd of the designed specific yield. Also, a tube well shall be taken up for repairs for improvement of discharge, when its specific yield falls about 80 per cent of the initial value.

2.8 Lift Irrigation System

2.8.1 During the installation of pumping stations, for utilising surface water sources for irrigation, the Field Engineer of Agriculture Department shall assess the condition of headraces as to whether full flow is ensured (reaching all parts of the system) without overflowing. The selection and installation of the pumps shall be as per guidelines suggested in the IS: 9694 (Part I to II)-1980&87, Code of practice for the selection and installation of horizontal centrifugal pumps for Agriculture applications (Appendix ECP Agri 2.5 (a) & (b)).

2.8.2 During planning, design and construction of new surface Channels and Water Carriage Systems, the irrigation department shall adopt the following practices:

- Protection of banks through slope protection measures as pitching, vegetating side slopes and maintenance of gentle slopes 2:1 (Horizontal: Vertical)
- Provision of vegetative buffers wherever land is available in coordination with FMC to strengthen the bund

2.9 Water Harvesting

2.9.1 Water harvesting shall be recommended in locations where (i) Ground water is not available for irrigation; (ii) head loss from surface water irrigation sources during conveyance is high; and (iii) Quality of ground water is above permissible limit for irrigation purposes.

Water harvesting for irrigation shall be (i) by storing water in the natural depressions / ponds / by pass ponds / impounded ponds through (a) Direct rainfall, (b) ground water, (c) Tile drainage system, (d) water wells and (e) Rivers or streams. The construction guidelines and Main water sources are presented in Table 2.5 and Table 2.7. The fixing of intensity of irrigation shall be as per IS: 13668:1993 (Refer Appendix 2.1).

---

7 The region wise classification of districts are (i) Lower Assam- Bongaigaon, Barpeta, Dhubri, Goalpara, Kokrajhar and Nalban; (ii) Central Assam- Kamrup, Darrang, Marigaon and Nagaon; (iii) Upper Assam- Sonitpur, Lakhimpur, Dhemaji, Golaghat, Sibsagar, Jorhat, Dibrugarh and Tinsukia; (iv) Southern Assam- Kamrup, Hailakandi and Cachar.
Table 2-5: Guidelines of Water Harvesting Tanks

<table>
<thead>
<tr>
<th>Natural Depression*</th>
<th>Dug out Ponds</th>
<th>By-Pass Pond</th>
<th>Impoundment Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Construction of Embankment</td>
<td>1. Depth of pond shall be 3m to 4m</td>
<td>1. Side slopes 2:1 (Horizontal:Vertical) or flatter</td>
<td>1. A dam is built across an intermittent stream</td>
</tr>
<tr>
<td>2. Preparation of side slopes to 2:1</td>
<td>2. Side slopes 2:1 (Horizontal:Vertical) or flatter</td>
<td>2. Depth of pond shall be 3m to 4m</td>
<td>2. Can hold back large volume of water depending on valley characteristics</td>
</tr>
<tr>
<td>3. Leveling of pond beds</td>
<td>3. Storage volume determined by how much is excavated</td>
<td>3. Locate adjacent to streams</td>
<td></td>
</tr>
</tbody>
</table>

Table 2-6: Main Water Sources for Water Harvesting

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Natural Depressions</th>
<th>Dug out Ponds</th>
<th>By-pass Ponds</th>
<th>Impoundment Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Rainfall</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ground Water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Drainage System</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Water Well</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>River, Streams</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Legend

- Full Water Requirement
- Partial Water Requirement
- Occasional Water Requirement

2.10 Operation and maintenance

2.10.1 The factors influencing the trouble free working of pump set depends on its operation and maintenance. The consideration for operation of pumps are (i) Priming; (ii) Lubrication; (iii) Starting and stopping procedures; (iv) Restarting motor driven pumps after power failure and (v) Restarting pump after long idle period. The considerations for maintenance of the pumps are (i) Selection of installation; (ii) Daily observation of pump operation; (iii) Annual inspection and complete overhaul. The Operation and maintenance of the pumps for irrigation purposes shall be as per provisions of IS: 9694 (Part III to IV)-1980, Code of practice for selection and installation of horizontal centrifugal pumps for Agriculture applications (Appendix ECP Agri. 2.5 (c) & (d)).

2.10.2 Though not a significant impact, towards addressing the soil contamination around the pump locations (due to spillage of oil during handling and operations), a sand bed of about 30 cm shall be created over an area of 2.5 x 2.5 m (approx), around the pump. It shall be the responsibility of the farmer/user to dispose the sand soaked with oil, if any, prior to rainy season.

2.11 Estimating irrigation requirements

2.11.1 The general guidelines for irrigation requirements of major crops are specified in IS: 9664 (Part-I)-1987. The department of agriculture shall work out quantity of water required to irrigate the field based on (a) type of soil; (b) type of crop (c) size of field (d) conveyance losses of water (e) local climatic conditions. The Extension officers of the Department of Agriculture in association with the Farm Management Committee shall prepare a irrigation plan. When irrigation system capacity will not satisfy crop water requirements during the peak of the irrigation season an irrigation plan shall be prepared based on:

* The natural depression are other than Beels or wetlands
The period of the season where limitations will occur shall be identified before the season starts, and a strategy developed to accommodate the limitation.

Preserving soil water moisture

2.11.2 Stress conditioning, and controlled deficit irrigation, that is deliberately stressing crops at various stages, can be planned at the start of the irrigation season.
### APPENDIX ECP AGRI 2.1: PROJECT INFORMATION DOCUMENT
INSTALLATION OF STW, DTW, RLP,

<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Block</th>
<th>Name of FMC</th>
</tr>
</thead>
</table>

#### 1. Type of Intervention
- STW
- DTW
- RLP

#### 2. Distance of the Facility from:

<table>
<thead>
<tr>
<th>Sensitive Location</th>
<th>STW</th>
<th>DTW</th>
<th>RLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>National parks,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanctuaries,</td>
<td>m</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Ramsar sites,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade I Beels,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade II Beels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade III Beels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classified Forests</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3. Nature and Scale of Operation
- Number of Members in the FMC
- Area of land under jurisdiction of FMC
- Number of Tubewells in the FMC

What is the minimum distance of the tubewell from the nearest STW in the following directions:

<table>
<thead>
<tr>
<th>Direction</th>
<th>STW</th>
<th>DTW</th>
<th>RLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Show the proposed site of the tubewell and location of nearest tubewell

What is the approximate depth of water?

#### 4. Quality of Water
- Has water in any of the tubewells within 0.5 km been tested: Yes | No
- If Yes, provide details of the test:
  - Arsenic
  - Iron
Indian Standard
GUIDELINES FOR FIXING INTENSITY OF IRRIGATION

UDC 625.81/84

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

January 1993

Price Group I
FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the River Valley Projects: Planning, Irrigation, Management and Evaluation Sectional Committee had been approved by the River Valley Divisional Council.

Intensity of irrigation can be defined as the percentage of cultivable commanded area proposed to be irrigated in a given period of time (season/year). The intensity may depend on the objective of the projects such as intensive irrigation system, where the intensity may be 100 percent or even more, as it depends on putting the same land under multiple cropping once or twice under different crops. While under protective irrigation system, the aim will be to extend facilities to a large area and hence intensity may be low taking into consideration, the dispersal of benefits to the community as a whole. However the lower intensity may be so fixed that viability of small holding is not affected.

The determination of a suitable intensity involves a careful consideration of various factors. Where the availability of water is not a limiting factor, the adoption of high intensities is obviously called for. The raising of more than one irrigated crop in any area leads to the better use of inputs like fertilizers and improved implements and also of residual soil moisture from the previous crop.
GUIDELINES FOR FIXING INTENSITY OF IRRIGATION

1 SCOPE

This standard deals with the guidelines for fixing intensity of irrigation.

2 REFERENCE

The Indian Standard 4410 (Part I): 1967 'Glossary of terms relating to river valley projects : Part I Irrigation practice' is necessary adjunct to this standard.

3 FACTORS

To fix the intensity of irrigation, the following factors need to be considered:

- Climate,
- Topography,
- Soil,
- Ground water condition,
- Amount and nature of available water supply,
- Drainage,
- Socio-economic needs of the area,
- Disposal of benefits,
- Crop pattern, and
- Water application method.

4 CLIMATE

Climate- logical factors such as temperature, humidity and wind will have relation to the intensity of irrigation, but mainly rainfall has a definite relation to the intensity of irrigation. Distribution of rainfall will also have a relation with the intensity of irrigation. In heavy rainfall zones the irrigation needs for crops will be very less and almost one less watering compared to the arid/semi-arid zones will be required hence higher intensities can be achieved in high rainfall zones. In semi-arid zones the intensity of irrigation should be kept low as irrigation needs will be very frequent. Not only the irrigation is required frequently in semi-arid zones, but there is a need for irrigation for preparing land and sowing.

5 TOPOGRAPHY

Topography has direct relation to irrigation intensity, because preparation of land to suit the irrigation needs is most important. In hilly areas, intensity will be naturally less. If the land is flat, the intensity of irrigation will be high.

Intensities in the alluvial plains have to be considered in the light of their drainage conditions. Where the natural drainage is sluggish because of flat slopes, the ground water table is likely to be already high. Adoption of high intensities with surface waters in such areas is fraught with the risk of water logging. To attain high intensities (say more than 100 percent), conjunctive use of surface and ground water, accompanied by an efficient system of surface drainage is necessary. Where natural drainage is good, the risk of water logging is less. High intensities should always be accompanied by efficient drainage.

In areas, where the total water resources are limited, the alternatives are either high intensity in a part of the area or low intensity over the whole area. In the former case the policy is maximum production per unit of area but the benefit of water would be restricted to few cultivators. In the latter case irrigation should be provided with an intensity which gives benefit per unit of irrigation water to as large a number of cultivators as possible.

6 SOIL

The nature of the soil is of prime importance. The field capacity of the soil is an important criterion for determining irrigability. The soil type has an intimate relationship with intensity of irrigation, because the water holding capacity depends on the nature of soil that is, sandy loamy or clayey. This may also depend on sub-soil drainage and depth of the soil. If the soil is shallow, then part of the applied water may be lost through drainage, but if the soil is deep, the applied water will remain in the sub-soil and it will be available to crops.

7 GROUND WATER CONDITION

If the ground water conditions are conducive (low water table) in any project, the intensity of irrigation may be suitably increased. High intensities help the farmer to derive the maximum economic benefit from the land and
provide continuous gainful agricultural employment, provided the soils are suitable and the ground water table is low enough to preclude the risk of water logging.

4 AMOUNT AND NATURE OF AVAILABLE WATER SUPPLY

The total amount of surface water available will vary from project to project. Similarly, the amount of groundwater depends upon the rainfall. Complete information of water available from both the sources is required (amount, character, seasons, periods) before one can arrive at the optimum intensity of irrigation for that command area.

9 DRAINAGE

High intensity of irrigation requires proper drainage conditions. Artificial drainage facilities will have to be provided where natural drainage is not adequate for disposal of excess rain water as well as ground water, before high intensity of irrigation can be proposed.

10 SOCIO-ECONOMIC CONDITIONS OF THE AREA

Socio-economic conditions like density of population and size of holding also dictate the intensity of irrigation. In densely populated area with small holding size, it is necessary to aim to a high intensity so that the total income per holding can be optimized.

11 DISPERsal of BENEFITS

Dispersal of benefits to the community as a whole and to as large an area as possible should be the aim while fixing intensity of irrigation. Considering family as a unit, the irrigation benefits should be dispersed in the command of the project. Every family will irrigate either full or part of its land according to the availability of water for irrigation.

12 CROP PATTERN

The intensity of irrigation will also depend upon the type of crops grown in the command. If the percentage of crops with high water requirement like sugarcane is high, the intensity of irrigation will be reduced. Hence to achieve higher intensity of irrigation crops requiring less water should be cultivated.

13 APPLICATION METHOD

As limiting the wastage of water and by adopting modern methods of application of water such as drip irrigation, sprinkler irrigation, it may be possible to bring more area under irrigation within the available quantum of water, thereby increasing intensity of irrigation.
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<th>Text Affected</th>
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FOREWORD

This Indian Standard (Second Revised) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This Code of practice was first published in 1964 and revised in 1979 for splitting the requirements in following two parts:

IS 2800 (Part 1) Code of practice for construction and testing of tubewells: Part 1 Construction
IS 2800 (Part 2) Code of practice for construction and testing of tubewells: Part 2 Testing

This standard is again revised to cover the latest developments in the field of tubewell/tubewell construction.
Indian Standard

CODE OF PRACTICE FOR CONSTRUCTION AND TESTING OF TUBEWELLS/BOREWELLS

PART 1 CONSTRUCTION

(Second Revision)

1. SCOPE

This Code applies to drilling and construction of tubewells/borewells for agriculture, drinking water, industrial and other allied purposes. It gives only general guidance as regards, design, drilling and construction of tubewells/borewells. Other improved method of construction, if any, may be adopted with prior agreement between the drilling agency and the well owners.

2. REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>226 : 1975</td>
<td>Structural steel (standard quality) (fifth revision)</td>
</tr>
<tr>
<td>4097 : 1988</td>
<td>Gravel for use as pack in tubewells</td>
</tr>
<tr>
<td>12/0 : 1983</td>
<td>Steel tubes used for water wells (first revision)</td>
</tr>
<tr>
<td>8189 : 1985</td>
<td>Well screens and slotted pipes (first revision)</td>
</tr>
<tr>
<td>2429 : 1989</td>
<td>Glossary of terms used in water-well tech.</td>
</tr>
<tr>
<td>10800 : 1983</td>
<td>Drinking water</td>
</tr>
<tr>
<td>11189 : 1985</td>
<td>Methods for tubewell development</td>
</tr>
<tr>
<td>13818 : 1939</td>
<td>Unplasticized PVC tubewell casing and plain casing pipes for bore/tubewells — Specification</td>
</tr>
</tbody>
</table>

3. TERMINOLOGY

For the purpose of this standard, definitions of the terms generally used in tubewell drilling technology specified in IS 9439 : 1980 shall apply.

4. TYPE OF TUBEWELLS

4.1 Type 1 (Cavity Well)

Cavity wells are generally shallow wells drilled in alluvial formations (see Fig. 1A and Fig. 1B). These are wells with casings resting in thick, hard impervious clay layer above the aquifer. It is a pre-requisite that the impervious clay layer should be of adequate thickness to support the well and should not disintegrate when water is pumped out.

4.2 Type 2 (Tubewell)

Tubewells are generally constructed in alluvial formations comprising a casing pipe, a housing pipe (if need be) and an intake section either screen or slotted pipe with or without gravel packing (artificially packed or naturally packed) as shown in Fig. 2A and Fig. 2B). These wells may be either under water table conditions or under artesian conditions (see Fig. 2C).

4.3 Type 3 (Borewell in Hard Rock Formation)

The overburden in such wells is encased to eliminate the risk of caving in. Drilling is further carried out in rock formations and the bore is left normally unsupported to allow the water to flow from crevices and fissures into the bore except in cases where caving formations are encountered (see Fig. 3).

5. DRILLING METHODS

5.1 Auger Drilling

The drilling is done with a spiral or worm auger connected to square rods turned manually with rod tillers, the cuttings produced as a result of drilling are removed with a sand shell. Steel casing pipes with drive shoes at the bottom are lowered as the drilling progresses. This method is employed where very shallow drilling in alluvium formation is involved (see Fig. 4A and Fig. 4B).

5.2 Water Jet Boring

A drill bit with nozzles is attached to the drill pipes at its bottom and through which water is pumped at high pressure. The water on its return flow through the annular space between the bore and the drill pipe, brings out the cutting along with it to the surface. Casing pipes are simultaneously used to avoid caving in. The method is suitable for drilling shallow wells in loose sandy formations (see Fig. 5).
FIG. 1A  CAVITY WELL (FOR CENTRIFUGAL PUMP)

FIG. 1B  CAVITY WELL (FOR TURBINE SUBMERSIBLE PUMP)
Fig. 2A Tubewell (Natural Gravel Pack)

Fig. 2B Tubewell (Artificial Gravel Pack)
FIG. 2C TUBEWELL (ARTESIAN FLOWING)

FIG. 3 BOREWELL IN HARD ROCK
5.3 Calyx Drilling

A bit made from hollow steel tube with two inclined slots called 'shot bit' is connected below another tube (core barrel) which is further connected to the drill rods. These are rotated mechanically. Chilled shots are fed to the bottom of the bit through the drill string along with water. These are ground by the shot bit to form abrasive material with sharp edges which cuts into the consolidated formation forming an annular ring to form a core inside the core barrel, which is then taken out from well by grouting the core with quartz chips, etc. This method is successful for shallow tube wells drilling in consolidated formations with large diameter holes.

5.4 Percussion Drilling

A heavy bit attached with a drill stem, a drilling jar to a cable is given up and down spudding motion, either manually or by power. Water is added to dissolve the cuttings which are lifted out by means of a bailor. Steel casing pipes with drive shoes are used as the hole progresses. This method of drilling is suitable for drilling in bouldery formations.

5.5 Rotary Drilling

5.5.1 Direct Circulation Method

A drill bit is rotated mechanically by means of drill pipes, through which drilling mud (usually bentonite mixed with other suitable material) is circulated under pressure. This process of circulation lubricates the bit, carries the cutting in suspension to the surface and also plasters the wall of the hole to prevent it from caving-in. Very deep wells can be constructed in alluvium formations by this method.

5.5.2 Reverse Circulation Method

A starting of drill pipes with a drill bit at the bottom is rotated by mechanical means. Plain water or a fluid of gelling quality depending on the strata conditions, is allowed to flow into the bore hole, when drill cuttings along with water are sucked through the drill pipes by a centrifugal pump and thrown into the setting pit. The
5.6 Down the Hole Hammer (DTH) Drilling

The method is used for fast and economical drilling in hard formations. Compressed air is utilized for rapid impacting action by the hammer to the bit thus crushing the formation into small chips which are flushed out through the annular space between the bore and the drill pipes by the upcoming compressed air.

5.7 The drilling bits generally used during the drilling by direct circulation method and by reverse circulation method are tricone rock...
roller bits, diamond drilling bits, reaming bits and thin wall core bits. Their use depends upon the type of soil formations such as soft, medium hard and hard formations. The bits used for percussion drilling are california pattern bits and for DTH drilling are button bits and drag bits.

5 ACCESSORIES

5.1 The accessories commonly used for tubewell construction, their description/functions and the typical material for their manufacture are given in Table 1.

5.2 A typical drawing showing details of bail plug, bail plug hook, centralizer, taper reducer, mild steel clamp, well cap and notch plate, is given in Fig. 6.

7 INFORMATION TO BE FURNISHED BY THE OWNER OF THE TUBEWELL

The owner shall furnish the following information to the drilling agency:

1) Information regarding tubewells and dug well, existing near his land. Their depth, formation encountered and discharge, etc, may be furnished as far as possible;
2) Static water level;
3) Expected yield;
4) Purpose for which the water is needed, such as irrigation, industrial or domestic purpose, etc; and
5) Any other information.

8 INFORMATION TO BE FURNISHED BY DRILLING AGENCY

When offering to sink a tubewell, the drilling agency shall furnish the owner with the following information:

1) Suitability of the site proposed by the owner (if a more suitable site, other than the one proposed by the owner is available, it should be suggested);
2) Whether a test bore hole is proposed and if so, its diameter and depth, and also depth of production tubewell proposed;
3) Likelihood of increase or decrease of the depth given at (b) above;
4) Method of drilling with size of bore in different depths;
5) Types of plain pipe with size, wall thickness and slotted/strainer pipes with opening, may be mentioned;
6) Guarantee with regard to the verticality of tubewell and sand content (ppm) in the discharge from the well at the time of handing over;
7) Development methods to be adopted may be stated; and
8) Any other information and conditions.

<table>
<thead>
<tr>
<th>Table 1 Nomenclature of Tubewell Parts</th>
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<tbody>
<tr>
<td>No.</td>
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</table>
FIG. 6 TYPICAL DETAILS OF TAPER REDUCERS, WELL CAP, V-NOTCH PLATE, CENTRALIZING GUIDE, BAIL PLUG AND CLAMP
3. GENERAL REQUIREMENTS

9.1 Design and Lancing of Pipe Assembly

9.1.1 Design of Pipe Diameter and Lengths

The length and diameter of the casing pipe is selected on basis of static water level, the drawdown, the discharge expected from the well and the size of pump to be installed. The size and length of slotted/strainer pipes are selected according to the actual requirement according to the strata met with, the expected discharge and the depth of tubewell. The casing pipes shall generally conform to IS 4270:1983 and slotted/strainer pipes shall conform to IS 8110:1985.

9.1.2 Design of Screen Slots

The entry of water in the tubewell shall be either through screens or slotted pipes. Following are the various types of well screens and slotted pipes used in water wells depending upon the type and size of well:

a) Plain slotted pipe,
b) Bridge slotted pipes,
c) Mesh wrapped screens,
d) Cage type wire wound screens,
e) Conical shaped mesh bonded gravel screens, and
f) Wire mesh.

The design, selection and type of screen or slotted pipe, size and distribution of slots shall be as specified in IS 8110:1985.

9.2 Gravel Packing

9.2.1 All gravel to be used as pack in tubewell construction shall be as specified in IS 4097:1967. The thickness of the gravel shroud around the screen shall generally be not less than 10 cm.

9.2.2 In percussion method of drilling, gravel is fed into the annular space between the casing pipe and the assembly pipe up to 3 m above the bottom of the slotted pipe. The well is developed using compressed air or by bailers and as the water becomes clear, surging or backwashing is done to make the development more perfect. More gravel is fed, if necessary, and when the water becomes free from sand, the casing pipe is jacked up to some height, and the process is repeated until all the aquifers are gravel packed.

9.2.3 In rotary method, the pipe assembly is lowered into position and gravel packing may be done up to a suitable depth below the bottom of the housing pipe in the first instance. Thereafter the gravel packing up to the required depth is completed after keeping the housing pipe vertical within limits. To make uniform gravel packing around the pipe assembly inverted cones should be used.
9.2.4 A provision for a well base to eliminate the possibilities of subsidence of the well structure may be incorporated. If the bottom of the well is in a soft formation, the well shall be provided with an artificial base for the casing and screen by overdrilling the hole about 1 to 2 m and filling the extra depth with concrete or gravel.

9.3 Development of Tubewell

9.3.1 The drilled well shall be developed by any of the methods specified in IS 11689 : 1983 depending upon the site conditions in order to get maximum sand free yield. The development process shall be continued until the stabilization of sand and gravel pack has taken place.

9.3.2 The development of the tubewell by overpumping should be done at 15 percent to 20 percent lesser discharge than the expected discharge from the tubewell. The final discharge should be free from sand with a maximum tolerance of 20 parts of sand in one million parts of water by volume after 20 minutes of starting the pump.

9.3.3 In case of tubewells for drinking water, the discharge shall be totally sand free. If the discharge is not sand free after 20 minutes of starting the pump, the well shall be redeveloped. If the discharge is still not sand free even after re-development, the pump set of lesser discharge capacity may be installed to get sand free water suitable for drinking. The turbidity and hardness of water of wells used for drinking purposes, shall be as specified in IS 10500 : 1983.

9.4 After completion of development by overpumping, the well shall be tested for its performance, that is yield characteristics and efficiency. This shall be achieved by conducting a step draw-down test determine draw downs at the end of the hour by pumping at 3 to 4 different rates of discharge.

10 DISINFECTION

10.1 The well shall be disinfected after completion of test for yield. All the exterior parts of the pump coming in contact with the water shall be thoroughly cleaned and dusted with powdered chlorine compound. In fact it should be disinfected every time a new pump is installed or the one replaced after repairs.

10.2 A stock solution of chlorine may be prepared by dissolving free chlorinated lime. For obtaining an applied standard concentration of 50 ppm. One litre of the stock solution should be used to treat 300 litres of water.

10.3 In case of waterwells for drinking water purposes, the quality of water should be as laid down in IS 10500 : 1983.

11 GROUTING AND SEALING

11.1 Grouting and sealing of tubewell may be done, if required by the owner, depending upon the site conditions and quality of the discharge of the strata encountered. To ensure that the grout will provide a satisfactory seal, it should be applied in one continuous operation. Sealing of the tubewell may be done by grouting the annular space between bore and the housing pipe, thickness of grouting depending upon the quality of water. In case of tubewells for drinking purposes, sealing and grouting shall always be done to maintain sanitary conditions.

11.2 It is desirable to plan an oversize bore hole of 7.5 to 15 mm more than the diameter of the well casing to an adequate depth during the design of well itself. The depth to be grouted varies with geologic and site conditions but a depth of 3 to 4.5 m from the surface is generally adequate.

11.3 Surface Apron

An apron around the well and sloping away from it protects the well from pollution caused by contaminated water flowing back into it and prevents muddy pools of standing water forming around the well.

12 HANDING OVER OF THE TUBEWELL

12.1 The tubewell should be handed over to the owner in a complete shape. The housing pipe should be closed by a well cap for the period between the completion of the tubewell and the installation of the pump set.

12.2 The following information shall be furnished by the drilling agency on completion of the tubewell:

a) Total depth of tubewell drilled,
b) Strata chart of the tubewell indicating different type of soil formations met with at different depths and indicating the depth of each type of soil formation,
c) Samples of strata collected, neatly packed and correctly marked in sample bays,
d) Position of every joint in well assembly,
e) Method used for development,
f) Total hours of development done,
g) Developed discharge in L.P.S.,
h) Discharge is totally sand free or presence of sand particles is there,
j) P.P.M. and turbidity after development,
k) Pumping water level at developed discharge, and
m) Static water level.

12.2.1 A typical proforma is given in Annex A to furnish the details given in 12.2.
### ANNEX A

(Clause 12.2.1)

**INFORMATION TO BE FURNISHED BY DRILLING AGENCY TO OWNER ON COMPLETION OF TUBEWELL**

<table>
<thead>
<tr>
<th>1. Agency drilling the tubewell</th>
<th>11. Assembly of production well</th>
<th>Size</th>
<th>Length</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Location of the tubewell</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Method of drilling adopted</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Date of starting</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Date of completion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Pilot hole or test hole</td>
<td>12. Top of tubewell above/below ground level</td>
<td>Bit size</td>
<td>Bit type</td>
<td>Hours</td>
</tr>
<tr>
<td>7. Coring done</td>
<td>13. Size of gravel</td>
<td>Quantity used before development</td>
<td>Quantity used during development</td>
<td>Bit type</td>
</tr>
<tr>
<td>8. Drilling</td>
<td>14. Method used for development</td>
<td>Total hours of testing</td>
<td>Development discharge</td>
<td>Bit size</td>
</tr>
<tr>
<td>9. Lithological data</td>
<td>15. Development discharge</td>
<td></td>
<td>Turbidity</td>
<td>Bit type</td>
</tr>
<tr>
<td>From</td>
<td>To</td>
<td>Formations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Total depth of tubewell drilled</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Further details appended:**

- a) Samples of strata, neatly packed in sample bags,
- b) Chart of pipe assembly lowered, and
- c) Results of mechanical analysis of samples of unconsolidated strata.

**Remarks:**

Owner: J.J.J.
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Amendments are issued to standards as and when the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Handbook’ and ‘Standards Monthly Additions’.

This Indian Standard has been developed from Doc : No. HMD 20 ( 3175 )

Amendments Issued Since Publication

<table>
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<th>Amend No.</th>
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In a strainer type well, incorrect size of mesh openings may either lead to clogging of the strainers resulting in loss of discharge or continuous flow of sand with water followed by cavity formation, which on sudden collapse may cause sinking of the pump house building. Not much can be done to avoid such failures due to faulty design or incorrect size of gravel or mesh openings. However, sometimes formation of cavities around the screen of the well may allow the formation of a cavity which on sudden collapse may cause sinking of the pump house building. Thus much caution should be exercised to avoid such failures due to faulty design or incorrect installation of gravel or mesh openings.格

3.2.4 Faulty construction — Failures due to deficiencies in tubewell construction methods and in construction inspection such as faulty or loose pipes and screen connections or joints are rare. This is indicated by sudden heavy rush of sand into the well pipe. To locate and rectify such defects, it is best to take noting of the wall and compare the sand discharged with the original wall tags. The well may be cleared up with a bailer.

If not substantial portion of the slotted pipe or screen is likely to be lost, it is best to plug the portion up to the defective joint. It would, of course, reduce the well yield in proportion to the length of the screen lost.

4. Information to be given by User

4.1 The causes of the sickness of a well shall be diagnosed before any remedial measures are adopted. The condition of the well may be judged from the performance data during its service life. Following information shall be made available by the user:

a) Initial and present well yield, depression, spring level as observed periodically during the well's service life.
b) Sand content in ppm, if any.
c) Grain size distribution of the strata tapped as a result of sieve analysis.
d) Location of screen, its opening size, percentage of screen surface area to the total open area, screen material length and diameter of screen and well pipes, etc., and data of acceptance of the well.
e) Size and quantity of pea-gravel used initially and during its service life.
f) Method used and details of development with results.
g) Method of drill, adopted, name of drilling agency, original pump and well test results and results of subsequent tests, if available.
h) Results of the initial and present chemical analysis of the well water.
i) Details of any chemical treatment, if ever given to the well and results achieved therefrom.
j) Sounding of the well assembly observed every year.
k) Details of repairs to the pumping equipment carried out every year.
l) Number of electricity units consumed per kilowatt ratings every year during service life of the well.

5. Investigations to be Carried out by the Contractor

5.1 The following data shall be determined for reference when starting rehabilitation on any well:

a) Date of acceptance of well
b) Name of contractor
c) Method of drilling
d) Method of formation sampling
   e) Formation log
   f) Mechanical analyses of aquifer samples
g) Mechanical analyses of pack material
5.2 The pump shall be pulled out and data determined before starting rehabilitation on any well:

a) Ground water hydrographs of the area, if available

b) Chemical and bacteriological analysis of the well water shall be carried out and compared with the original one, with regard to its original and the present apparent precipitation potential.

c) If the well is yielding sand, the discharged sand sample shall be collected and compared with the original formation log, so as to locate precisely the position of the possible rupture or hole connection, etc.

d) If equipment is available, an under water photographic survey shall be made on the shape of any evidence of instillation, organic growth or accumulation on the casing and screen recorded. Also, any planktonic algae, iron bacteria or similar organisms floating in the water shall be noted. Any evidence of mechanical damage to the casing and screen shall be carefully inspected with the camera and recorded with regard to its description and depth.

e) The present specific yield at a design discharge rate and draw down low enough to permit continuous pumping for 4 hours, without breaking suction, shall be determined. This will give a qualitative measure of the degree of deterioration and by comparison with the later tests, the success of rehabilitation programme.

f) The pump shall be pulled out and various parts be examined immediately as they are removed from the well. The column pipes, drive shaft, bearing spiders and bowl shall be inspected for evidence of excessive accumulations or deposits of ferric or ferrous hydroxides. If the deposits are present, sufficient samples shall be collected to fully fill a bottle capable of being sealed airtight. This shall be done as rapidly as possible and the samples sent to the laboratory immediately, so as to avoid generation of heat in the sample. The samples shall be sent to the chemical and biological laboratories for identification of chemical and biological laboratories for identification of chemical compounds present and identification, if possible, of organism involved.

g) Examine pump parts for evidence of pitting, tuberculations, graphitization, cavitation and wear. Pump bowls and impellers shall be inspected for evidence for graphitization in areas where sulphate bacteria are known or suspected to be present.

h) The static water level and depth of the bottom of the well assembly shall be checked again out of the well when the pump is taken out of the well.
5.3 Remedial Measures - After the causes of well failure or sickness are established on the basis of the performance and other data, appropriate remedial measures, as detailed in subsequent parts, may be adopted. In case reduction in yield is found to have been caused due to some sort of pump failure, the obvious remedy is to repair or replace the pump. In all such cases, it is a good practice to observe standing in the well and compare it with the original one.

6. Preliminary Steps for Well Rehabilitation

6.1 Usually a well shall not be rehabilitated until the specific capacity has decreased 15 percent or more. The proposed rehabilitation shall usually involve the use of the pump.

Data on the initial static water level, the present water level, the specific capacity at design discharge and the present specific capacity at a discharge rate and drawdown low enough to permit continuous pumping for 4 hours without breaking suction shall be obtained. This shall give a qualitative measure of the degree of deterioration and by comparison with later tests the success of the rehabilitation programme. When the pump is pulled, examine the various parts immediately as they are removed from the well. The column pipe, drive shaft, bearing spiders, and bowl shall be inspected for evidence of excessive accumulations or deposits of ferric or ferrous hydroxides. If present, sufficient samples shall be scrapped off for laboratory examination to fully fill a bottle capable of being sealed airtight. This shall be done as rapidly as possible and the samples sent to the laboratory immediately, since the oxidation and loss of original character of such material when exposed to the air, temperature changes, and drying is at times rapid as to generate sensible heat in the sample. Pump parts shall subsequently be cleaned thoroughly and examined for evidence of scaling, tuberculation, graphitization, cavitation, and wear by the machine shop. Any necessary repairs, replacements, or adjustments shall be made while the well is being worked over. The samples scraped from the pump shall be submitted to the chemical and biological laboratories for identification of chemical compounds present and identification, if possible, of organisms involved. Pump bowls and impellers shall be inspected for evidence of pitting or decarburization in areas where sulphate-reducing bacteria are known or suspected to be present.

The static water level and depth of the bottom of the hole shall be checked again with the pump out of the well.

If equipment is available, a TV camera survey shall be made of the well and the location of any evidence of incrustation, organic growth or accumulations on the casing and screen recorded. Any evidence of mechanical damage to the casing and screen shall be carefully inspected with the camera and recorded in regard to description and depth.

Identification of organisms that contribute to well deterioration is not primarily important initially since it is probable that they may be controlled by presently practiced chlorination or their sterilizing procedures. However, these shall be studied and identified eventually as part of the overall investigation since such knowledge may lead to more effective or less expensive methods of control.

7. Methods of Rehabilitation

7.1 Glossy Phosphates Treatment - Polyphosphates are used to disperse clays and silts, and loosen their adhesion to sand and gravel so they may be more readily drawn into the well during development. They are seldom used alone but usually in conjunction with a wetting agent, sodium carbonate and a chlorine compound. The wetting agent facilitates the penetration of the polyphosphate solution into the fine ground materials and hastens the operation. The sodium carbonate has a cleaning action towards rust on iron screens and pipes, and also serves to neutralize the effects of oil and other organic compounds that might interfere with the action of the chlorine. The chlorine acts somewhat as a catalyst and seemingly improves the action of the polyphosphates as well as being to sterilize the well and adjacent formations.
However, until more is known of the fabric and composition of the screen, it is recommended that wetting agents be omitted from the solutions. Under some circumstances the wetting agents may not be advisable for breaking down of some clays and a drastic breakdown of the fabric. As a consequence, screens are sometimes totally blocked to be adequately developed by any means.

Also in wells screened with fibreglass reinforced epoxy, the sodium carbonate may probably be left out of the solution without losing efficiency.

When first applied to water well development, the use of 13 to 13 kg of polyphosphate per 450 litre of water is the well is sustained. With experience, this was found to be an unreasonably strong solution for most wells. On the other hand, it was found that all wells did not respond similarly and that a desirable concentration might range from 2.3 to 9 kg of polyphosphate per 450 litre of water in the well. Initially it is suggested using 3 to 5 kg hexametaphosphate per 450 litre of water in the tank. Experimental notes on this water are shown in Table 4, which may show better performance with a greater or lower concentration, but it will be determined only by experiment.

While the percent of chlorination obtained in the solution appears to improve its action, if the amount of chlorine present is at least 50 ppm. Larger concentrations do not seem to either improve or improve the effectiveness of the solution. Consequently, chlorine may be used with polyphosphates either as a normal sterilizing agent or in shock treatments designed to oxidize and destroy not only the organisms but the intimate products of their metabolism that act to block packs and screens.

In view of these considerations and the probable nature of the aquifers and blocking materials in the screen, the initial procedure in rehabilitating any well is as follows:

Estimate the volume of water in the pack and screen between the water table and the bottom of the hole to the nearest 450 litre. On the basis of the following amount of reagents per 450 litre of water in the well, estimate the amount of various chemicals required:

- a) For fibreglass reinforced epoxy screens — Sodium hexametaphosphate 3.6 kg; available 103 ppm
- b) For metal screens — In addition to the above 300 g sodium carbonate
- c) Should experience show use of a wetting agent is helpful 450 g pluronic F68 or equivalent.

Most wells contain between 10,000 to 15,000 litre of water. A wooden or black iron tank 1.2 x 1.5 x 3 m is a convenient size for transportation, etc, and holds in excess of 6,350 litre of water. Therefore, two or three batches of solution mixed in the tank shall be required for each well. A convenient but not necessary arrangement that speeds up the operation is to use two tanks. In order that the next batch of solution may be mixed while the previous one is being placed in the well.

The solution is poured or pumped into the well through a 38 to 50 mm plastic or black iron pipe that initially is installed from the surface to about 1.5 m above the bottom of the well. Sufficient solution is put in the well to displace an estimated 1.5 to 3 m of the water in the casing and pack. The pipe is then raised 1.5 or 3 m and the procedure repeated until all water in the well and pack are displaced by the solution. The solution that has specific gravity that the water and displaced water from the tank. When all the solution is installed in the well, the volume of water equal to about one half that contained in the casing and screen is poured in at the top to displace the solution from the screen and force it out into the formation (see Table 1). A 200 m casing contains about 11 litre and 200 mm screen about 18 litre of water per metre of length. A surge block ball or similar tool is then run from the bottom of the well to above the water table two or three times of the inductor pipe for air surging may be replaced to near the bottom of the well and air bubbled up through the well to thoroughly mix the solution remaining in the casing screen.

| TABLE 1 LITRE PER 300 mm OF LENGTH—CONTENTS OF CASING AND SCREEN (Clause 7.1) |
|-------------------------------|-----------------|
| Nominal Pipe Size | Litre |
| 100 | 3.0 |
| 125 | 4.6 |
| 150 | 6.8 |
| 200 | 12.0 |
| 250 | 19.0 |
| 300 | 26.4 |
| 350 | 32.2 |
| 400 | 43.0 |
| 450 | 51.0 |
| 500 | 67.0 |
| 550 | 81.8 |
| 600 | 98.0 |
Allow the solution to remain in the well for a minimum of 8 hours, overnight is a commonly used period, during which the wall is surged about every hour by running the surge block from the top to bottom of the water column in the well three or four times at a moderate speed or by surging with air.

2.3 Acid Treatment - One of the most commonly used acids for treatment of well is 27.52 percent hydrochloric acid. The acid is used full strength initially in a volume sufficient to displace 1 to 2 times the volume of water in the casing, screen, and gravel pack between the bottoms of the wall and 3 m above the topmost screen slot. The acid is poured into the well through a black iron or plastic pipe 33 to 50 mm in diameter which extends to the bottom of the wall. The estimated volume of acid required to displace the water from 1 to 3 m section is poured in. The acid has a high specific gravity in water. Then the pipe is lifted 1.5 to 3 m and the process repeated until all the acid is added to the well. During pouring of the acid, 300 g of chelating agent per 15 litres of HCl shall be poured down the pipe.

Citric acid, Rochelle salts, tartaric acid, phosphonic acid, and glycine acid are sometimes chelating agents. Sulfamic acid dissolves iron compounds when added to the acid, and the reaction with the carbonates the pH rises to 3 and insoluble ferrous hydrate precipitates from the acid. The chelating agents tend to keep the iron in solution. It is possible to keep the iron in solution and raise the pH so the iron can be pumped from the well with the spent acid, rather than remaining as a contaminant to block the pack.

In metallic casing and screen, an inhibitor such as knox gelatina is added to the acid in the amount of 2.3 to 2.7 kg dissolved in warm water per 450 litres of acid to control attack on metal parts. However, there are no such parts in a fibreglass reinforced epoxy well so this is unnecessary when treating such wells.

The acid remains in the well for 4 to 6 hours. At the end of about 3 hours sufficient water is added to the well to displace the acid from 3 m above the topmost slot to the bottom of the well. While the acid is in the well and pack of the well is surged by air or with the surge block for 15 to 20 minutes each hour. At the end of about 6 hours, the acid is bailed or pumped out.

Use of hydrochloric acid is quite dangerous for inexperienced crew members. The acid gives off dangerous poisonous fumes and the reaction with the carbonates in a well is sometimes violent, resulting in spraying bystanders around the well. In addition, the transportation of the liquid hydrochloric acid to the field is difficult and sometimes dangerous. For these reasons sulfamic acid is becoming more popular for well rehabilitation. Sulfamic acid is more expensive but it is easily shipped as a dry crystal or powder. It is not as aggressive or as hydrochloric acid and it is generally much safer to use. It requires about two times as long to treat a well as does hydrochloric acid.

When using sulfamic acid in a well, the same estimates are made regarding the volume of water in the well to be displaced and 1 to 2 times that volume is poured into the well through a black iron or plastic pipe as described in the discussion on hydrochloric acid. It is available in granular form and may be poured into the well from the top.

Sulfamic sulfamic acid is a milder and less aggressive acid, it is mixed in a black iron or wooden tank at the surface. A tank about 1.2 × 1.5 × 3 m is usually adequate and holds about 6300 litres. The tank shall have a bottom valve through which the acid solution is drawn into the well. 41 kg sulfamic acid, 450 g of phosphoric F83 and 3 kg chelating agent such as Rochelle salts, citric acid, tartaric acid, etc., are added and dissolved in each 450 litres of water to be poured into the well. It is screened with metal, an inhibitor such as knox gelatina shall be used at the rate of 1.8 to 2.5 kg per 450 litres of solution. The acid shall remain in the well for at least 12 hours during which it shall be surged by air or surge block about 15 to 20 minutes every hour. Then it is bailed or pumped to waste.

Hydrochloric acid of adequate strength is readily available at a relatively low price. It is used successfully safety precautions that no injuries or casualties have resulted. Under the circumstances, it appears that hydrochloric acid, despite the danger and difficulties associated with its use, shall continue to be used. However, if the programme expands to the point where trained and experienced crews are not available to carry on the acidizing work, consideration shall be given to employing the less dangerous sulfamic acid.

The spent acid is bailed or pumped out of the well using a corrosion-resistant pump for the purpose. In many wells, pumping with a centrifugal pump shall be possible. Close observation of the bailing or pumping discharge and the draw downs during removal of the acid shall give an indication of the success of the treatment.
During acid treatment of a well the crew shall wear protective clothing and respirators. One or two 250 litre drums of concentrated sodium bi carbonate shall be available for quick neutralization of acid with which crew members may come in contact during the operation.

During treatment, incrustation is dissolved and the fines incorporated in the agent remains in the quick and may be material. On completion of acidizing the well shall be redeveloped using polyphosphates, sufficient chlorine for a shock treatment and one of the methods of surging or jetting.

7.3 Chlorine Treatment — In some localities where the bacterial growth or slime have changed the water bearing formation, the treatment with chlorine has been found effective. The destruction or burning up of the organism slime is accomplished by hypochlorous and hypochloric acids, which are formed when chlorine is added to water.

The chlorine shall be handled carefully with the aid of suitable containers and advising to avoid proper placement, as it is highly corrosive in the presence of water. When incrusted wells are heavily treated with chlorine, it shall be followed by dechlorination with sulphur dioxide.

For chlorine treatment, a concentration of 100 to 200 ppm of free chlorine is required. Sufficient amount of calcium hypochlorite sodium hypochlorite is put into the well either directly or in a water solution so as to give the required concentration of chlorine, alternatively chlorine gas is used in solution with water. The solution shall be introduced in the well through a small diameter plastic pipe. A quantity of chlorine, 14 to 18 kg., added slowly over a period of 12 hours, shall suffice to produce good results in a large well. After adding chlorine solution, it shall be forced out into the water bearing formations by adding considerable amount of water. About 50 to 100 times the volume of water standing in the well shall be used for this purpose.

The well shall be surged or solution agitated as is done in case of acid treatment.

7.4 Dry Ice Treatment — The use of dry ice, that is, solid carbon dioxide is still in the experimental stage. Dry ice changes from solid to gaseous state rapidly with considerable pressure, when put into well water. The rapidly expanding gas is confined within the well casing and is forced through the screen openings to loosen the clogge material. On account of high pressure developed, provision shall be made for the control and relief of pressure to guard against any damage. As dry ice may cause severe burns, it handled with bare hands, heavy gloves or tongs shall be used in handling the ice.

7.5 Explosives — These are sometimes employed to develop and enlarge cracks and fissures in tubewells drilled in hard rocks. Charges of 30 to 500 ppm are used according to the hardness of the rock and the depth at which the charge is to be detonated.

3. Criteria for Acceptance

3.1 An increase in yield of the well by 20 percent of the pre-rehabilitated yield of the well or attainment of 75 percent of the initial yield, whichever is more, shall be the basis of acceptance. Alternatively, it may be agreed to between the contractor and the owner.

9. Information to be Supplied by the Contractor to Owner for Future Use

9.1 The contractor shall supply the following information to the owner for future use:

a) Results of the investigations carried out before taking up work of rehabilitation.

b) Result of chemical tests carried out before and after rehabilitation work.

c) Methods used alongside name and quantity of chemicals used and number of treatments given.

d) Results of rehabilitation, that is, discharge, depression and sand content in ppm at start and after 20 minutes.

e) Soundings of the well after the treatment.

f) Condition of the pumping unit before rehabilitation and details of repairs carried out to it.

g) Suggestions, based on investigations, for future upkeep and maintenance of the well including recommended limit to continuous discharge and depression, that is, rate of pumping in order to avoid harmful over pumping and thereby limiting the entrance velocities.

h) Any other relevant information desired by the owner.
Indian Standard

CODE OF PRACTICE FOR
THE SELECTION, INSTALLATION, OPERATION AND
MAINTENANCE OF HORIZONTAL CENTRIFUGAL PUMPS
FOR AGRICULTURAL APPLICATIONS

PART 1 SELECTION

(First Revision)

1. Scope — Lays down the general guidelines for the selection of horizontal centrifugal pumps for agricultural applications.

2. Selection Criteria — The following major points shall be considered while selecting a pump:
   a) Water requirement,
   b) Water source, and
   c) Operating conditions.

2.1 Water Requirements — For correct selection of a pump, the quantity of water required to irrigate the field shall be known. This quantity depends on:
   a) type of soil,
   b) type of crop,
   c) size of the field,
   d) conveyance losses of water, and
   e) local climatic conditions.

2.1.1 For general guidelines for irrigation requirements of some of the crops are given in Appendix A for information.

2.1.2 Table 1 gives the area of land irrigated in 8 h pumping. This table also indicates the rate of flow in l/s for obtaining the required depth of water in 8 h of pumping.

2.1.2.1 To allow for conveyance losses of water from the pumps to the fields, it may be advisable to increase by appropriate percentage up to 10 percent the quantity of water required as indicated from Table 1. A worked out example is given in Appendix B.

2.2 Water Source — The major sources from where water can be taken for irrigation purposes are:
   a) Rivers,
   b) Canals,
   c) Walls,
   d) Ponds, and
   e) Water stream.

2.2.1 Pumps for different site conditions — If the water has to be brought to the fields from a nearby river or a stream or a nallah, a horizontal centrifugal pump shall be installed by the side of the water. Select the position of pumpset at site in such a way that centre of suction branch is as close to the highest water level as possible. It is recommended to install the pump in such a way so as to limit the maximum manometric suction lift to 6 m. If these values are exceeded on any installation, the pump would give reduced rate of flow, develop reduced total head, run on lower efficiency and would get damaged due to cavitation and vibration.

2.2.1.1 If the water level is likely to be such that the recommended total suction lift is exceeded at any time, the pump may run with 'cavitation' or may not discharge water at all. In such cases, where the total suction lift cannot be limited to recommended value, other types of pumps such as vertical turbine or submersible pumps may be used.

2.2.1.2 The suction lift is to be reduced for higher altitudes at the rate of 1.15 m for every 1000 m above sea level. The temperature correction shall be obtained from steam tables.
2.2.1.3 Centrifugal pumps and motors are available as direct coupled units using flexible couplings between the pump and its prime mover, that is, electric motors or diesel/petrol/kerosene engines, spark ignition engines, etc., and mounted on base plates. These pumps can also have an impeller and a common shaft between each pump and its prime mover, dispensing the use of flexible coupling and base plates, at the same time eliminating all alignment problems between the pumps and their prime movers. Such pumps are also known as monoblock pumps. Both these arrangements of direct coupled and monoblock types have their own features with various pros and cons. Centrifugal pumps are also available as belt-driven units.

2.2.1.4 When the speed of the prime mover does not match with the required pump speed for direct coupling, it is considered undesirable and difficult to install a prime mover, e.g. a diesel engine, along with the pump inside an open well on a platform as near the source as possible, a belt drive is adopted between the pump and its prime mover. This would enable the user to allow required distance between the pump and its prime mover, which can also be installed at different levels as necessary and convenient for site conditions.

2.2.1.5 Suitable size of pulleys shall be provided on the shafts of such pumps and their prime movers for arranging the required belt drive. For calculating the size of these pulleys, the speed of the prime mover of the pump shall be known.

2.3 Operating Conditions

2.3.1 Total head — After the required rate of flow of the pump is determined, the user has to find out the total head against which the pump shall have to operate. Total head does not mean only the static vertical height from lowest water level to the highest delivery point. To this static height shall be added loss of head due to friction in foot valve, reflex valve, entire length of suction pipe (both horizontal and vertical), suction bend, delivery sluice valve (if installed), delivery bend and entire length of delivery pipe (both horizontal and vertical) and the velocity head at the delivery point. This fractional head loss depends on the rate of flow of water through a particular size of pipe line and its fitting.

2.3.2 Operating head range — The minimum total head corresponding to the maximum water level shall also be worked out for determining the operating head range.

3. Pipe Friction — When water or any other liquid moves through a pipe line, the latter offers some resistance to the flow. This resistance depends on the size, type and condition of the pipe and its fittings, and velocity of flow. The head loss due to friction is given in Tables 2 and 3.

3.1 When calculating pipe losses, allowance shall be included for tees, bends, valves and other fittings and obstructions in a particular pipe line. This is done by adding an allowance of stright pipe equivalent to each fitting or by taking resistance coefficient for each fitting. The relevant extracts from IS : 2951 (Part 2)-1965 'Recommendation for estimation of flow of liquids in closed conduits: Part 2 Head loss in valves and fittings' are given in Appendix C.

4. Pipe Size Selection — Before installing an agricultural horizontal centrifugal pump, it is very essential to determine correct selection of the sizes of suction and delivery pipe to be connected to the pump. The prevailing idea that such a pump should always be installed with suction and delivery pipes of the same sizes as pump suction and delivery openings is not sound in every situation. Quite often it involves the farmer in paying higher charges for electrical energy or fuel and oil consumption. In several cases, it makes the pump run with cavitation resulting in reduced discharge, low efficiency and damage to equipment, etc., or at times stop pumping.

For proper selection of sizes of pipes, Tables 1 to 3 of IS - 10804-1986 'Recommended pumping system for agricultural purposes (first revision)' shall be referred. An example is described in Appendix A of IS - 10804-1986 for determination of flow rate, head and selection of pumps.

5. Foot Valves Selection

5.1 Foot valves conforming to IS : 10805-1986 'Foot valve, reflex valves or non-return valves and bore valves to be used in suction lines of agricultural pumps (first revision)' shall be selected and installed in vertical position.

5.2 The shape and height of the housing shall be such that even when the valve is fitted on the pipe, it should be possible to raise the disc or discs sufficiently to provide, at any cross-section, a passage of area at least equal to the bore area of the pipe.

5.3 Strainers shall be robust so as to withstand the normal forces which may come upon while in transit or at the time of installation.

5.4 For satisfactory operation, a foot valve shall not get exposed to atmospheric air when the pump is in operation. It shall also not get submerged in any silt which may gradually get settled down from water on the bottom of the well. It is, therefore, recommended to select the length of vertical portion of pump suction pipe in such a way that the top of the valve is at least 0.35 m below minimum water level in the well and bottom of the foot valve strainer is 0.5 m above the bed (or bottom) and away from sides of the well.

6. Final Selection of Pumps — Once the rate of flow and total head are worked out on the basis of the above guidelines, selection of suitable pump may be made from performance tables or characteristic
curves provided by pump manufacturers for various sizes and types of the pumps. The pump which has the highest pump efficiency for the capacity and head required shall be selected. The power of the prime mover required for driving the pump shall be fixed from the data given by the pump manufacturer or from Tables 4 to 7 of IS : 16804-1986.

For selecting a pump, and suction and delivery pipes to be installed with it, main consideration should be the overall efficiency and minimum consumption of power, either electrical energy or diesel oil. The cost is, of course, a consideration but it shall be viewed in relation to its running cost, maintenance expenses, and losses during shut down for repairs.

The Indian Standards applicable to pumps, motors, diesel engines, petrol, kerosene engine, spark-ignition engine, valves, pipes and fittings for agricultural pumping sets are given in Appendix B.

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**Example 1.**

It is required to find volume rate of flow in l/hr per second for irrigating 10.00 ha in 8 hr pumping for a depth of water of 100 mm.

**Procedure.**

Enter Table 1 under the column depth of water 100 mm and read 12.5 l/s volume rate of flow corresponding to 0.36 m.

**Example 2.**

It is required to find the area irrigated in hectares in 8 h pumping for a volume rate of flow of 100 l/s and depth of water of 75 mm.

**Procedure.**

Enter Table 1 at the row corresponding to volume rate of flow of 100 l/s and read 0.84 hectares under column depth of water 75 mm.
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<td>0.187</td>
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</tr>
<tr>
<td>10.00</td>
<td>2.585</td>
<td>0.713</td>
<td>0.253</td>
<td>0.106</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>11.00</td>
<td>4.083</td>
<td>1.171</td>
<td>0.450</td>
<td>0.167</td>
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</tr>
<tr>
<td>12.00</td>
<td>1.704</td>
<td>0.625</td>
<td>0.282</td>
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<td></td>
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</tr>
<tr>
<td>13.00</td>
<td>2.870</td>
<td>0.914</td>
<td>0.361</td>
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</tr>
<tr>
<td>14.00</td>
<td>1.281</td>
<td>0.510</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15.00</td>
<td>2.423</td>
<td>0.729</td>
<td>1.376</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>16.00</td>
<td>2.601</td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

TABLE 2: FRICTION LOSS IN METRES FOR 10 METRES LONG NEW STEEL GALVANIZED PIPE (C=140)

[IS: 1239: Part 1-1976 and steel tubes medium grade (fourth revision)]
### TABLE 3 FRICTION LOSS IN METRES FOR 10 METRES LONG NEW UPVC PIPE (C - 150)
(IS: 4985-1981 Unplasticised P.V.C. pipes for potable water supplies [First revision] (0.6 mA water))

(Calculated)

<table>
<thead>
<tr>
<th>Nominal Pipe Outer Dia in mm</th>
<th>40</th>
<th>50</th>
<th>63</th>
<th>75</th>
<th>90</th>
<th>110</th>
<th>125</th>
<th>140</th>
<th>160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Rate of Flow 1/s</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>0.50</td>
<td>0.074</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td>0.269</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.25</td>
<td>0.405</td>
<td>0.134</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.60</td>
<td>0.640</td>
<td>0.211</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>0.967</td>
<td>0.319</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.50</td>
<td>1.462</td>
<td>0.483</td>
<td>0.156</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>3.2</td>
<td>2.309</td>
<td>0.762</td>
<td>0.250</td>
<td>0.106</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>3.491</td>
<td>1.153</td>
<td>0.337</td>
<td>0.160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>4.161</td>
<td>1.301</td>
<td>0.357</td>
<td>0.237</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6.0</td>
<td>4.910</td>
<td>2.034</td>
<td>0.856</td>
<td>0.317</td>
<td>0.177</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>6.00</td>
<td>3.151</td>
<td>1.293</td>
<td>0.479</td>
<td>0.266</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>7.52</td>
<td>4.315</td>
<td>1.556</td>
<td>0.725</td>
<td>0.592</td>
<td>0.226</td>
<td>0.117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td>11.18</td>
<td>7.031</td>
<td>2.234</td>
<td>1.145</td>
<td>0.629</td>
<td>0.356</td>
<td>0.169</td>
<td></td>
<td></td>
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<tr>
<td>16</td>
<td>15.71</td>
<td>10.13</td>
<td>2.493</td>
<td>1.731</td>
<td>0.827</td>
<td>0.537</td>
<td>0.279</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>21.77</td>
<td>14.16</td>
<td>3.115</td>
<td>2.617</td>
<td>1.415</td>
<td>0.912</td>
<td>0.421</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>30.68</td>
<td>21.95</td>
<td>3.988</td>
<td>3.668</td>
<td>1.954</td>
<td>1.138</td>
<td>0.550</td>
<td></td>
<td></td>
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<tr>
<td>32</td>
<td>43.01</td>
<td>31.95</td>
<td>4.811</td>
<td>5.080</td>
<td>2.502</td>
<td>1.599</td>
<td>0.706</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>60</td>
<td>46.97</td>
<td>6.123</td>
<td>7.300</td>
<td>3.129</td>
<td>2.321</td>
<td>1.271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>84</td>
<td>74.95</td>
<td>8.142</td>
<td>9.820</td>
<td>4.293</td>
<td>3.127</td>
<td>1.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>114</td>
<td>112.91</td>
<td>10.16</td>
<td>12.84</td>
<td>5.614</td>
<td>3.927</td>
<td>2.521</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>358</td>
<td>358.97</td>
<td>32.18</td>
<td>40.98</td>
<td>10.08</td>
<td>6.927</td>
<td>4.521</td>
<td>2.521</td>
<td></td>
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<tr>
<td>125</td>
<td>482</td>
<td>482.97</td>
<td>40.24</td>
<td>51.99</td>
<td>13.18</td>
<td>8.927</td>
<td>5.521</td>
<td>3.221</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX A
(Clause 2.1.1)
GENERAL GUIDELINES FOR IRRIGATION REQUIREMENTS

A. Irrigation requirements - Irrigation requirements are dependent upon the factors of the soil, rock, and alluvial areas. The irrigation requirements of various crops in the country vary from place to place depending upon the various factors such as nature of soil, climate, and rainfall. Therefore, the exact water requirements of a particular area should be worked out in consultation with the local authorities (see Tables 4 and 5).

### TABLE 4 Irrigation Requirements of Some Crops in Hard Rock Areas

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Crop</th>
<th>Cropping Period in Days</th>
<th>Depth of Watering in mm</th>
<th>Watering Interval in Days</th>
<th>Irrigation Requirements in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Rice</td>
<td>100 to 150</td>
<td>75</td>
<td>7</td>
<td>300 to 1600</td>
</tr>
<tr>
<td>(2)</td>
<td>Wheat</td>
<td>90 to 100</td>
<td>75</td>
<td>10</td>
<td>300 to 150</td>
</tr>
<tr>
<td>(3)</td>
<td>Maize</td>
<td>100 to 120</td>
<td>50</td>
<td>7 to 10</td>
<td>150 to 300</td>
</tr>
<tr>
<td>(4)</td>
<td>Gram</td>
<td>150 to 180</td>
<td>75</td>
<td>15 to 20</td>
<td>150 to 300</td>
</tr>
<tr>
<td>(5)</td>
<td>Sugarcane</td>
<td>100 to 300</td>
<td>75</td>
<td>15 to 20</td>
<td>150 to 300</td>
</tr>
</tbody>
</table>

Note: Sugarcane can be either a 12-month crop or a 18-month crop known as 4/4.

### TABLE 5 Irrigation Requirements of Some Crops in Alluvial Areas

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Crop</th>
<th>Cropping Period in Days</th>
<th>Depth of Watering in mm</th>
<th>Watering Interval in Days</th>
<th>Irrigation Requirements in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Rice</td>
<td>100 to 150</td>
<td>75</td>
<td>7</td>
<td>300 to 1600</td>
</tr>
<tr>
<td>(2)</td>
<td>Wheat</td>
<td>90 to 100</td>
<td>75</td>
<td>10</td>
<td>300 to 150</td>
</tr>
<tr>
<td>(3)</td>
<td>Maize</td>
<td>100 to 120</td>
<td>50</td>
<td>7 to 10</td>
<td>150 to 300</td>
</tr>
<tr>
<td>(4)</td>
<td>Gram</td>
<td>150 to 180</td>
<td>75</td>
<td>15 to 20</td>
<td>150 to 300</td>
</tr>
<tr>
<td>(5)</td>
<td>Sugarcane</td>
<td>100 to 300</td>
<td>75</td>
<td>15 to 20</td>
<td>150 to 300</td>
</tr>
</tbody>
</table>

The values given are for reference purposes only.

### APPENDIX B
(Clause 2.1.2.1)
EXAMPLE FOR DETERMINATION OF QUANTITY OF WATER REQUIRED FOR IRRIGATION AND VOLUME RATE OF FLOW IN RELATION TO THE AREA TO BE IRRIGATED

B-1. The rate of discharge required for certain cropping pattern can be worked out by the following formula.

\[
Q = \frac{A 	imes L}{R 	imes T}
\]
where

\[ Q = \text{rate of discharge in } \ell/s, \]
\[ A = \text{area to be irrigated in hectares}, \]
\[ I = \text{intensity of irrigation in } \text{cm}, \]
\[ R = \text{rotation period in days}, \]
\[ T = \text{working hours of the pump-set per day}. \]

\[ \text{Example: } A = 3 \text{ hectares of wheat, } I = 7.5 \text{ cm, } R = 12 \text{ days and } T = 8 \text{ h/day} \]

\[ V = \frac{A \times I}{R \times T} = \frac{3 \times 7.5}{12 \times 8} = 0.70 \text{ cm/s} \]

\[ h_l = \frac{V^2}{2g} \]

TABLE 6 RESISTANCE COEFFICIENTS FOR VALVES AND FITTINGS

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Description of Valves and Fittings</th>
<th>Resistance Coefficient (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>i) Inlets or Reducers</td>
<td>1) Bell mouth</td>
<td>0.04 to 0.05</td>
</tr>
<tr>
<td></td>
<td>2) Square edged</td>
<td>0.47 to 0.56</td>
</tr>
<tr>
<td>ii) Elbows</td>
<td>1) Regular screwed 45° elbow</td>
<td>0.30 to 0.42</td>
</tr>
<tr>
<td></td>
<td>2) Regular screwed 90° elbow</td>
<td>0.55 to 1.00</td>
</tr>
<tr>
<td></td>
<td>3) Regular flanged 90° elbow</td>
<td>0.28 to 0.42</td>
</tr>
<tr>
<td></td>
<td>4) Long radius flanged 45° elbow</td>
<td>0.18 to 0.20</td>
</tr>
<tr>
<td></td>
<td>5) Long radius flanged 90° elbow</td>
<td>0.18 to 0.43</td>
</tr>
<tr>
<td></td>
<td>6) Long radius screwed 90° elbow</td>
<td>0.22 to 0.60</td>
</tr>
<tr>
<td>iii) Bends</td>
<td>1) Screwed return bend, close pattern</td>
<td>0.30 to 1.50</td>
</tr>
<tr>
<td></td>
<td>2) Flanged return bend, composed of two 90° flanged elbows</td>
<td>0.27 to 0.43</td>
</tr>
<tr>
<td></td>
<td>a) Regular</td>
<td>0.17 to 0.43</td>
</tr>
<tr>
<td></td>
<td>b) Long radius</td>
<td></td>
</tr>
<tr>
<td>iv) Inward Projecting Pipe</td>
<td>0.42 to 1.00</td>
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</tr>
</tbody>
</table>

(Continued)
### Table 5: Resistance Coefficients for Valves and Fittings - Contd.

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Description of Valve and Fitting</th>
<th>Resistance Coefficient (KC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1) Straight valve</td>
<td>0.3</td>
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<tr>
<td></td>
<td>a) Check valve</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>b) Check valve</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>c) Check valve</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>2) Globe valve</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>a) Globe valve</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>b) Globe valve</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>3) Gate valve</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>a) Gate valve</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>b) Gate valve</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>4) Angle valve</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>5) Y or blow-off valve</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>6) Foot valve</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>7) Standard Screwed Tee</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>1) Branch blanked off</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>2) Line blanked off</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>8) Long Radius Screwed Tee</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>1) Line blanked off</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>2) Flow from line to branch</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>3) Flow from branch to line</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>9) Couplings and Unions</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>1) Reducing Bushing and Coupling</td>
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</tr>
<tr>
<td></td>
<td>Used as Reducer</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Note: Use as normal loss is up to 40 percent more than that caused by a sudden enlargement for velocities near critical with disregard of pipe and branching of eddies.

---

### Appendix D

### INDIAN STANDARDS APPLICABLE TO AGRICULTURAL PUMPS

0.1 For...:

- IS 315 1978 Three-phase induction motors (fourth revision)
- IS 790-1984 Screw valves for water works purposes (90 to 300 mm size) (third revision)
- IS 1239 (Part 1) 1979 Mild-steel tubes, tubulars and other wrought steel fittings. Part 1 Mild-steel tubes (fourth revision)
- IS 1239 (Part 2) 1982 Mild-steel tubes, tubulars and other wrought steel fittings. Part 2 Mild-steel tubulars and other wrought steel pipe fittings (third revision)
- IS 1520-1980 Horizontal centrifugal pumps for clear, cold, fresh water (second revision)
- IS 1536-1976 Vertically cast iron pressure pipes for water, gas, and sewage (second revision)
- IS 1537-1976 Vertically cast iron pressure pipes for water, gas, and sewage (second revision)
- IS 1710-1972 Vertical turbine pumps for clear, cold, fresh water (first revision)
- IS 3589-1961 Electrically welded steel pipes for water, gas, and sewage (150 to 2000 mm nominal size) (first revision)
- IS 4038-1979 Foot valves for water works purposes (first revision)
- IS 4385-1981 Unplastic and PVC pipes for potable water supplies (first revision)
One crop a year based on annual rainfall is now almost a past history in India. Canal irrigation and pumping sub-soil water now enables Indian farmers to get almost three crops per annum in most of the States of the country.

The gravity flow canal water to the fields can be regulated easily to cover various types of crops requiring different quantities of water at different watering intervals. However, in case pumps are used for lifting water to the fields from rivers, canals, ponds, wells and underground streams, the rate of flow of the pump has to be determined before hand for selecting proper pumpset. The farmer has also to decide which type of pump, that is, horizontal, centrifugal, vertical turbine or submersible would be most suitable for economical use in his field.

This standard was first published in 1980 and on the basis of the experience gained, the Committee felt the need of revision of the standard. Major changes in this revision are:

- a) the conveyance losses have been reduced to 10 percent, and
- b) friction losses (C H for pipes have been taken as 140 and 150 for GI and RPVC pipes, and the resistance coefficients for valves and fittings modified.

This standard is issued in the following four parts for its easy reference:

- Part 1 Selection
- Part 2 Installation
- Part 3 Operation
- Part 4 Maintenance
APPENDIX ECP AGRI 2.5(b)

IS : 3694 (Part II) - 1980
(Reaffirmed 2001)
Edition 1.1
(1991-01)

CODE OF PRACTICE FOR THE SELECTION,
INSTALLATION, OPERATION AND MAINTENANCE
OF HORIZONTAL CENTRIFUGAL PUMPS FOR
AGRICULTURAL APPLICATIONS
PART II INSTALLATION
(Incorporating Amendment No. 1)

1. Scope — Lays down the general guidelines for the installation of horizontal centrifugal pumps for agricultural applications.

2. Shipment
2.1 Special conditions of delivery should be the subject matter of an agreement between the manufacturer and the user. It is important to mention that the pump equipment coming out of the factory should be fully equipped, ready for use, with stuffing box packing, coupling halves mounted or keys fitted on the shaft end; grease cups, if any, companion flanges with nuts and bolts.

2.2 Following are the suggested precautionary measures to be taken for protecting all the internal parts of the pump including the end-plates:
a) Bearings should be lubricated or protected by a film of oil;
b) Machined parts exposed to atmosphere should be protected against rusting by a protective film of liquid;
c) Opening of pipes, pipes, and nozzles should be protected suitably by plugs, covers or by screwed plugs, etc.

2.3 The shipment is usually carried out at the risk of the consignee. It is therefore important that the buyer carries out the following suggested verifications carefully:
a) Inspect and check the material to be delivered and verify to the carrier the damages, missing items, etc., if any;
b) Check the inventory of the equipment with the help of the dispatch notes and drawings; and
c) Make sure that all the accessories handed over for transport as well as the necessary tools are present and intact.

2.4 If the pump and its prime mover which are meant to be stored are prepared by the manufacturer, in agreement with the user in such a way that they retain their mechanical condition during and after storage time. The user will therefore make sure that the specified precautionary measures have been taken and they are still effective. If it is not so, or in case of delayed use of unprotected pumps, precautionary measures should be taken to protect the equipment. Following are the suggested precautionary measures:
a) The pumpset should be kept in a dry place which is not subject to vibrations;
b) The openings of the pipes and stuffing boxes should be effectively protected to prevent dust or any foreign particles getting into them; and

c) Bearings should be properly lubricated.

3. Installation — Many of the operating difficulties related to the pumps occur due to faulty installation. The following factors come into play in the installation of a pump:
a) Location,
b) Foundation,
c) Alignment,
d) Grouting, and
e) Piping

Adopted 17 December 1990 | © BIS 2003 | Price Group 3

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002
3.1 Location — Correct location of a pump is important for operating as well as for maintenance purposes. As far as possible, the pump should be located close to the source of water when suction lift is present. This in turn, will minimize the suction lift and permit the use of short direct suction piping. The pump should be placed in an accessible place, so that one can easily inspect the glands, bearings, etc., during operation. Centrifugal pumps require little attention but the attention required is very essential to the life of the pump. Sufficient headroom should be made available where there is a need to employ cranes, etc. Pumps should be generally located in a dry place.

3.1.1 In order to avoid the formation of air pockets and the risk of unpriming resulting there from, the suction pipe shall have a slope constantly rising to the pump. If the diameter of this pipe is greater than the pump suction branch size, the connection has to be made by means of an eccentric pipe.

The pump should be installed in a well ventilated pump house with enough space round about the pumpset for easy approach for inspection and maintenance.

If the pumping water level in the pit or open well or dug-cum-bored well is more than six metres, the pump may be installed in the well on a special platform created for such pump so as to keep the suction lift at minimum possible level. If the seasonal variations in pumping water levels are excessive, that is, more than 6.0 m, 2 or more platforms have to be created in the well so as to place the pump very near to the pumping water level in operating season.

3.2 Foundation

3.2.1 A rigid foundation into the ground is normally required for installing a pumpset, unless it is to be mounted on a rigid structured platform. It should be suitable to provide a permanent rigid support for the baseplate for taking the weight of the set, and should have enough mass to absorb any vibrations. The surface area of the foundation should be of sufficient dimension so as to leave adequate space of sufficient width, around the pumpbase when installed on it, to allow for grouting the foundation bolts, etc. The depth of the foundation depends on the nature of the soil in which it is to be laid.

1.2 Continuous contact should be done as far as possible for having the entire block of foundation, leaving provisions for grouting and pockets for locating foundation bolts in proper position. It should be provided with double reinforcements, which should not be less than 50 kg/m² of concrete. The minimum diameter of the bars should be 12 mm and the maximum spacing should be 200 mm in order to take care of shrinking in concrete. (See also IS : 2974-1968 Code of practice for design and construction of machine foundations — Part IV For Rotary type machines of low frequency).

3.3.3 The size and number of foundation bolts for each pumpset depend on its kW rating and type of prime mover used. For horizontal agricultural centrifugal pumpsets with prime movers of 1.5 kW to 11.0 kW, foundation bolt diameter normally varies from 12 to 20 mm and length from 150 to 150 mm.

3.4 Before placing the pumpset with its monoframe base (in case of monometal) or baseplate (in case of direct coupled sets) on the concrete foundation, it is recommended to chip off its upper surface for ensuring perfect adhesion of the grout. Moreover, water should be sprayed on the foundation before pouring the grout. The pumpset should be placed on the foundation with its foundation bolts in position, making it rest on shims and/or wedges placed at frequent intervals (close to foundation bolts position) between the baseplate and concrete block, to provide sufficient space for grouting.

3.2.5 When the pumpset is installed on a platform, constructed inside an open dug well for reducing pump suction lift or for some other reasons, it should be ensured that main supporting wooden beams or steel structures are of suitable size for the required span between their supports and rigid and strong enough to take the weight of the pumpset and two/three men, as also for absorbing vibrations, if any, likely to be caused by the running of the pumpset.

3.3 Grouting

3.3.1 Grouting prevents lateral movements of the pumpbase, increases its mass to reduce vibrations and fills in irregularities in the foundation. Normally, grout is composed of one part pure portland cement and two parts building sand, with sufficient water to flow freely under the base. In order to reduce settling, it is recommended to mix the grout and let it stand for a short period and then remix it thoroughly before use. If required, more water may be added.

3.3.2 Before starting grouting work, the pumpset should be levelled properly, with the help of a spirit level, by adjusting the thickness of the shims and/or positions of the wedges, on which it is resting on the concrete foundation block. After satisfactory levelling, foundation bolts should be tightened initially by hand. It is recommended that a frame work should be built around the pumpset base. Now the grout is poured until the entire space under the base is filled to the top of the under-side. A stiff wire should be used through the grout hole to work the grout in and release any air pockets.
3.1 Alignment (For Coupled Pumps)

3.1.1 Flexible type couplings are used for connecting the shafts of the pump and its prime mover and for transmission of power to the pump. The purpose of the flexible coupling is to compensate for temperature changes and to permit end movement of the shafts without interference with each other while transmitting power from the driver to the pump. A flexible coupling should not be used to compensate for misalignment of the pump and driver shafts. The following are the two types of misalignment between the pump shaft and the driver shaft:

1. Angular misalignment — Shafts with axes concentric but not parallel, and
2. Parallel misalignment — Shafts with axes parallel but not concentric.

3.1.2 The couplings are to be mounted on the pump shaft and prime mover shaft. The pump and the prime mover should be mounted on the baseplate in such a way that the faces of the couplings are parallel to each other and are spaced far enough so that the coupling ends cannot strike each other. The minimum dimension for the separation of the coupling used is usually specified by the manufacturer. This dimension may vary approximately from 6.0 to 6.0 mm. The tools for checking the alignment of flexible couplings are a straightedge or a set of feeler gauges. For accurate jobs dial gauge is also used.

3.1.3 A check for angular alignment is made by inserting the taper gauge or feelers at four points between the coupling faces and comparing the distance between the faces at four points spaced at 90 degree intervals around the coupling (see Fig. 1). The unit will be in angular alignment when the measurements show that the coupling faces are the same distance apart at all points.

3.1.4 A check for parallel alignment is made by placing a straightedge across both coupling rims at the top, bottom and at both sides (see Fig. 2). The unit will be in parallel alignment when the straightedge rests evenly on the coupling rim at all positions. Allowance may be necessary for coupling halves that are not of the same outside diameter. Care must be taken to have the straight edge parallel to the axis of the shafts.
3.1.5 Angular and parallel misalignment are corrected by means of shims under the motor mounting feet. After each change, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustments already made in another direction; it should not be necessary to change the shims under the pump. The permissible amount of misalignment will vary with the type of pump and driver. The manufacturer's recommendations should be obtained and followed.

3.1.6 Only after both the halves of the couplings are aligned by making their side faces exactly parallel to each other and their top circular faces in line with each other as mentioned above, the coupling bolts with their rubber bushes should be inserted in coupling bolt holes.

3.1.7 Care should be taken to ensure that faces of shaft ends do not project out of the half coupling faces, when the latter are fitted on to the pump and prime mover shaft extensions. Otherwise they may rub against each other and/or will not allow sufficient clearance for unhampered endwise movement of the shafts.

3.1.8 Even if the pump and its prime mover of a coupled set are properly aligned to each other at the manufacturer's works, the alignment gets invariably disturbed while handling during the transit of the set to the installation site. It is, therefore, always necessary to check up this alignment and make necessary adjustments for proper realignment, before the pumpset is placed on the foundation according to 3.2.4. This realignment should be rechecked once again after grouting has set on the foundation.

3.5 Piping

3.5.1 The suction and discharge piping should be connected only after ensuring that the grout is sufficiently set.

3.5.2 In order to have least possible friction head losses it is recommended to employ suction pipe as direct and short as possible. If a long suction line is unavoidable, the pipe size should be
1. The rotating parts such as couplings, fly wheel pulley, belts, etc, should be properly protected by guards.

2. Piping should be such that it does not impose excessive forces and moments on the pump casing to which it is connected, since it might spring the pump or pull it out of position. Piping things should be brought squarely together before the bolts are tightened. The suction and discharge point and all valves, strainer, etc, should be supported and anchored near to but independent of the pump, with no strain to be transmitted to the pump casing.

3. Final Installation — After the piping is over, alignment should be thoroughly checked and corrective action taken, if necessary. Now the nuts are finally tightened.

4. The rotating parts such as couplings, fly wheel pulley, belts, etc, should be properly protected by guards.

EXPLANATORY NOTE

Agricultural land is now irrigated according to the requirements with the help of pumps. To accomplish this, the following two points are considered:

1) Selection of a suitable type of pump to suit the requirements, and

2) Proper installation, operation and maintenance of the selected pump to ensure smooth functioning and prolonged life.

One of the important factors influencing successful operation and maintenance of pumps for agricultural purposes is its correct installation. Properly installed pumps remain in suitable alignment for longer periods, and vibrate less. An important gain which can be derived out of correct installation is the longer operating life of the pump with smooth functioning.

This part of the code has been prepared with an intention to provide sufficient guidelines to the farmers to enable them to take satisfactory services from the pumps by installing them correctly.

This standard is being issued in the following four parts for easy reference:

Part I Selection
Part II Installation
Part III Operation
Part IV Maintenance

1st edition 1.1 incorporates Amendment No. 1 (January 1991). Side bar indicates modification of the text as the result of incorporation of the amendment.
APPENDIX ECP AGRI 2.5(c)

Indran Standard

CODE OF PRACTICE FOR THE SELECTION, INSTALLATION, OPERATION AND MAINTENANCE OF HORIZONTAL CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS

PART III: OPERATION

1. Scope— These guidelines are for the operation of horizontal centrifugal pumps for agricultural applications.

2. Operation

2.1 Priming

2.1.1 Pumps should never be started until fully primed, i.e., until they have been filled with water and all the air contained in the leisure allowed to escape. Priming may be done manually or automatically.

2.1.2 When first put into service, the waterways of the pump are filled with air. If the suction supply is above atmospheric pressure, this air will be trapped in the pump and compressed when the suction valve is opened. Priming is accomplished by venting the entrapped air out of the pump through a pipe provided for this purpose. If the pump takes its suction from a supply located below the pump, it may be primed by providing a foot valve at the bottom of the suction pipe line or by filling the pump and suction line with water by opening the delivery valve or a bypass.

2.1.3 A foot valve does not always seat tightly, and occasionally the pump cannot be primed. However, the rate of leakage is generally very small and it is possible to restore the pump to service by filling and starting it promptly. This tendency to malfunction is increased if the water contains foreign particles such as sand.

2.1.4 The pump can be filled through a funnel attached to the priming connection from an overhead tank or any other source of water. If a check valve is used on the pump, it is required that the pipe leading from the supply be purged to remove all air before the pump is primed. Provisions should be made for filling all the waterways and for venting out the air.

2.2 Lubrication— It is recommended that before a pump is placed into service, its proper lubrication should be ensured.

2.3 Starting and Stopping Procedures— The following are the recommendations for starting and stopping the pump.

2.3.1 Precautions to be taken before operation:

a) Stuffing box— Make sure that the stuffing box has been properly packed according to 2.8. Above all, the gland has not been tightened firmly enough, otherwise, damage will occur to the packing and the shaft sleeve or shaft. It should be ensured that gland is tightened unevenly and does not rub on the shaft sleeve or shaft. The shaft should run freely, and it should be possible to turn it by hand easily.

b) Check the direction of rotation of prime mover with respect to pump.

2.3.2 Starting the pump:

a) Close the delivery valve and prime the pump. Ensure that priming of the pump is done as prescribed in the procedure laid down in 2.1;

b) Start the prime mover;

c) If the delivery pressure does not rise continuously as speed increases, stop the pumpset and prime the pump once more, carefully;

Adopted 17 December 1980

March 1981, IS1

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NEW DELHI 110078
d) Open the delivery valve gradually and observe that pump starts delivering water;

a) Check that pump operates smoothly without undue noise and vibrations;

f) Check that prime mover does not get overloaded. If motor is coupled to the pump, check the current drawn by the motor. If the pump is driven by an engine, check that the engine does not give out smoky exhaust; and

g) Check leakage through stuffing box. Set the gland slowly to allow steady desired leakage. Observe that the gland does not get heated up.

2.3.3 Stopping of pump:

i) Close the valve on delivery side; and

b) Stop the prime mover.

2.4 Restarting Motor Driven Pumps After Power Failure — If the pump is fitted with a check valve to protect it against reverse flow, it may be permitted to restart once power has been re-established. Automatic restart of the pump depends on the type of motor control used.

2.4.1 As pumps operating on a suction lift may lose their prime during the time the power is off, it is preferable to use starters with low load protection for such installations to prevent an automatic restart. This does not apply, of course, if the pumps are automatically primed or if some protection device is incorporated so that the pump cannot run unless it is primed.

2.5 Restarting a Pump after Long Idle Period (After Off Season Period)

a) Replace grease if necessary for bearings and stuffing box sealing, if grease sealing is provided;

b) Check pipe lines for any blockage;

c) Check foot valve flap for its proper function; and

d) Check the stuffing box packing and replace if necessary.

2.5.1 stuffing Box — Shelled graphite or asbestos packing rings should be used and instructions for proper installation of the packings inside stuffing box as given, should be followed:

i) The stuffing box and shaft or shaft sleeve surface must be thoroughly cleaned prior to insertion of the packing rings. Care should be taken to ensure that the working surfaces are perfectly clean (no rust or score). It is equally important that the journals and bearings are adequate to ensure that the packing will not extrude into the gaps under pressure.

b) The packings in spiral form should not be inserted.

c) Packings should be installed in individual rings. Rings should be cut carefully to the exact size by wrapping the packing around the shaft of a mandrel of equal diameter which should be protected by two layers of paper. For braided packings an oblique cut of not more than 30° angle or a straight cut to give a butt joint should be made without leaving any gap at the cut joint. To avoid any fraying of the cut ends of the packing, adhesive tape may be wrapped around the section before cutting.

d) To fit the packing rings, carefully open them radially until the ends are as wide apart as half the shaft diameter, then turn the ends apart in an axial direction until the rings slide over the shaft. Now carefully push each ring into the stuffing box inserting first the joint so that the ring sits squarely against the bottom of the stuffing box or against the previous ring. The joint of succeeding packing rings should be staggered.

a) Assemble the gland ring and tighten the nuts by hand or when using a spanner only tighten to give a slight nip, allowing the packing rings to adopt easily to the packing space.

b) With the pump in operation, tighten the nuts slightly and evenly, only one or two flats at a time, to reduce leakage to the desired minimum.

g) If the shaft temperature increases by any noticeable degree, the gland nuts should be slackened back a little when fluid leakage will provide a cooling affect. When the temperature has returned to ambient, the gland nuts can be slightly tightened to reduce the leakage.
EXPLANATORY NOTE

One of the most important factors influencing the trouble free working of a pumpset depends upon its proper operation.

Part III of the code gives the broad guidelines for the operation of the pumpset. It is felt that in case the procedures laid down in this part of the code are followed, the pumpsets will give fairly long trouble free service.

This standard is being issued in the following four parts for easy reference:

a) Part I Selection
b) Part II Installation
c) Part III Operation
d) Part IV Maintenance
APPENDIX ECP AGRI 2.5(d)

CODE OF PRACTICE FOR THE SELECTION, INSTALLATION, OPERATION AND MAINTENANCE OF HORIZONTAL CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS

PART IV: MAINTENANCE

1. Scope — Lays down the general principles for the maintenance of horizontal centrifugal pumps for agricultural applications.

2. Maintenance

2.1 Successful and efficient operation of centrifugal pumps depends greatly upon proper selection and installation. To ensure most efficient operation and least maintenance, it is recommended that complete data should be submitted to the pump manufacturer so that he properly suggest a pump capable of fulfilling the requirements.

2.2 Daily Observation of Pump Operation — Daily observation regarding general performance of the pumps should be made and any irregularity in the operation of a pump should be taken care of properly. This refers particularly to changes in sound of a running pump, stuffing box leakage, power consumption and abnormal temperature rise in the pump.

2.3 Annual Inspection and Complete Overhaul — It is very difficult to make general rules about the frequency of complete overhaul as it depends on the pump service, the pump construction and materials and economic evaluation of overhaul cost versus the cost of power losses resulting from increased clearances, or due to other factors.

2.3.1 A pump need not be opened for inspection unless either factual or circumstantial evidence indicates that overhaul is necessary. Factual evidence implies that either the pump performance has fallen off appreciably, or that noise and overloading of prime mover is in evidence. Circumstantial evidence refers to past experience with the pump in question.

2.4 Causes and Remedies for Faulty Operation — In operating a pump, apparently serious troubles may arise but close and careful inspection will normally reveal the fault to be due to some minor oversight; and investigation for irregular conditions of pump should be made.

2.4.1 A diagnostic analysis along with suggested remedies is given in Table 1.

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>No water being delivered</td>
<td>Pump may not be primed</td>
<td>Ensure proper priming by any suitable method.</td>
</tr>
<tr>
<td></td>
<td>Speed may be too low</td>
<td>Check whether the prime mover is working satisfactorily or not. In case of electric motor it may be due to low voltage also. If prime mover is not directly connected, it may be due to belt slip, etc., if employed.</td>
</tr>
<tr>
<td></td>
<td>Discharge head too high</td>
<td>Check operating conditions. See that pipe friction and suction and discharge heads are as specified.</td>
</tr>
<tr>
<td></td>
<td>Suction lift too high</td>
<td>Check it. Total suction lift should not exceed that recommended by the manufacturer.</td>
</tr>
<tr>
<td></td>
<td>Impeller or piping may be choked</td>
<td>Inspect. Clear/repair/replace the pipe, suction strainer, check valve and impeller.</td>
</tr>
<tr>
<td></td>
<td>Impeller may be rotating in wrong direction</td>
<td>Check and correct the direction of rotation of impeller. (Continued)</td>
</tr>
</tbody>
</table>

Adopted 17 December, 1980 | @ March 1981, ISI

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<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump works a while and then loses prime</td>
<td>May be a leak in the suction line</td>
<td>Check for air leakage and repair the pipe line.</td>
</tr>
<tr>
<td>Suction line too high for operating point</td>
<td>Air in the water</td>
<td>Vent suction back to source of supply.</td>
</tr>
<tr>
<td>Foot valve or suction opening may not be properly submerged</td>
<td>Speed too high</td>
<td>Suitably reduce the speed of impeller.</td>
</tr>
<tr>
<td>Mechanical defects such as a bent shaft</td>
<td>Wear in bearings may be binding</td>
<td>Provide means for removal of foreign matter.</td>
</tr>
<tr>
<td>Foreign matter in impeller</td>
<td>Misalignment</td>
<td>Re-align properly.</td>
</tr>
<tr>
<td>Shaft excessively bent</td>
<td>Rotor out of balance causing excessive vibration</td>
<td>Replace.</td>
</tr>
<tr>
<td>Excessive thrust caused by a mechanical failure inside the pump</td>
<td>Lack of lubrication</td>
<td>Balance the rotor.</td>
</tr>
<tr>
<td>Excessive oil in bearings</td>
<td>Excessive grease or oil in lubrication bearing housing or lack of cooling causing excessive bearing temperature</td>
<td>Suitably repair it.</td>
</tr>
<tr>
<td>Excessive cooling of water cooled bearing housing resulting in condensation of moisture from the atmosphere in the bearing housing</td>
<td>Decrease the flow rate of cooling water to prevent over cooling.</td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
TABLE 1 CAUSES AND REMEDIES FOR FAULTY OPERATION -- Contd
(Chapter 2.4.1)

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

AMENDMENT NO. 1 APRIL 1980

TO

IS 9694 (Part 4) : 1980 CODE OF PRACTICE FOR THE SELECTION, INSTALLATION, OPERATION AND MAINTENANCE OF HORIZONTAL CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS

PART 4 MAINTENANCE

( Page 2, Table 1, col heading 'Remedies')—Substitute the folloing:

(a) ‘Inspect and replace it by another tnt valve conforming to IS 1005: 1980.’

(b) ‘Inspect and replace it by another part valve conforming to IS 1005: 1980.’

(c) ‘For replace the existing valve of the prime mover or counter shaft, by another valve of compatible type.’

( Page 2, Table 1, col heading ‘Remedies’ )—Insert the following at the end in the sentence in column heading ‘Remedies’ against ‘Speed too high’:

‘For replace the existing valve of the prime mover or counter shaft, by another valve of compatible type.’

( Page 2, Table 1, col heading ‘Trouble’—Insert the folloing at the end against ‘T. 1. SK filter not used in suction line’:

‘For replace the existing valve of the prime mover or counter shaft, by another valve of compatible type.’

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PRINTED AT PRINCE OF PRINCE, V'CHAR, (India)

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and locating the causes

ments:

Part II Installation,
Part III Operation, and
Part IV Maintenance.
### Table 1 Causes and Remedies for Faulty Operation (Circle 241)

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump or shaft must cases</td>
<td>Pump not primed</td>
<td>Ensure correct priming.</td>
</tr>
<tr>
<td></td>
<td>Rotating part rubbing on stationary part</td>
<td>Prevent by suitable adjustment.</td>
</tr>
<tr>
<td></td>
<td>Bearing worn</td>
<td>Replace or install new.</td>
</tr>
<tr>
<td></td>
<td>Interference in bearings causing vibration</td>
<td>Properly realign the rotor.</td>
</tr>
<tr>
<td>Pump is noisy</td>
<td>Air leaks in suction</td>
<td>Replace or tighten joints and fittings.</td>
</tr>
<tr>
<td></td>
<td>Insufficient water supply</td>
<td>Ensure proper supply of water.</td>
</tr>
<tr>
<td></td>
<td>Bent drive shaft</td>
<td>Replace.</td>
</tr>
<tr>
<td></td>
<td>Misalignment or impeller not properly balanced</td>
<td>Par-align or balance the impeller properly.</td>
</tr>
<tr>
<td></td>
<td>Vibration due to non-rigidity of the foundation bolts loose</td>
<td>Tighten nuts and take corrective action.</td>
</tr>
<tr>
<td>Pump wears, rigidly</td>
<td>Pump runs dry</td>
<td>Take every precaution to prevent dry running of the pump.</td>
</tr>
<tr>
<td></td>
<td>Grit or dirt in water</td>
<td>Provide means to clear off dirt and grit from the water being handled.</td>
</tr>
<tr>
<td></td>
<td>Pipe strain on pump casing</td>
<td>Provide proper support to pipe, especially at suction and discharge ends.</td>
</tr>
</tbody>
</table>

### Explanatory Note

In order that pumpsets employed by farmers have longer operating life, it is necessary that the pumpsets are properly maintained. This part of the code has been formulated with the intention to provide sufficient guidelines to farmers for both maintenance of pumps and locating the causes of the trouble.

This standard is being issued in the following four parts for easy reference:

- **Part I** Selection,
- **Part II** Installation,
- **Part III** Operation, and
- **Part IV** Maintenance.
3.1 General

3.1.1 This ECP provides for measures to address environmental issues pertaining to soil and nutrient management in all agriculture related practices in AACP. The ECP covers key issues (i) agricultural practices in acidic soils ii) impacts on soil structure (iii) impacts due to erosion, and (iv) selection of appropriate (type and dosage) fertilisers based on the nutrient balance. The provisions of this ECP comply with the legal requirements and guidelines that govern the use of chemical and bio-fertilizers. The legal provisions include:

- Assam Agriculture Policy;
- The Fertiliser (Control) Order 1985;
- Biofertilisers Manual;
- ICAR Guidelines and,
- NABARD Guidelines.

3.2 Acidic soil management

3.2.1 The entire state of Assam is characterized by alluvial soils. On the basis of their genesis, the alluvial soils are divided into new alluvium and old alluvium. While the old alluvium soils\(^1\) are slightly acidic and rich in organic materials, the new alluvium soils\(^2\) are less acidic and not saline and are generally rich in phosphate, potash, calcium, nitrogenous material and organic substances.

3.2.2 A number of organic and inorganic materials are used as soil amendments\(^3\) for acidic soils. Strategies usually adopted for tackling problems of acidic soil: (i) Fertiliser management; (ii) Growing acid tolerant plants and (iii) Applying lime. The following factors are to be considered in selecting a soil amendment:

- Longevity,
- Soil texture,
- Soil salinity and plant sensitivities to salts, and
- Salt content and pH.

3.2.3 Liming is the most common amendment used for treating acidic soils. Appendix ECP Agri-3.1 presents materials used for liming and the procedure for estimation of quantities of lime required. The following principles shall be adhered to during application of lime:

- Application of lime done just prior to soil preparation is usually most appropriate.
- Caustic liming materials such as burned lime, hydrated lime shall not be applied onto actively growing plants.
- Lime shall be finely ground and thoroughly mixed to achieve the desired soil pH change

3.2.4 The DAO as well as Farm Management Committee shall provide farmers the information pertaining to (i) soil testing for acidic soils and (ii) methods for treating acidic soils.

---

\(^1\) Old alluvium is found in patches generally along the foothills in the Brahmaputra Valley there is a long patch of old alluvium along the Himalayan foothills from Kokrajhar District upto the river Subansiri of Lakhimpur district. The patch is however, criss-crossed by numerous rivers coming down from the hills. In Sonitpur district the patch of old alluvium occurs south along the middle of the north bank plain from Dikrai river upto about Gohpur. The other patch occurs at the southern and eastern margins of the south bank plain, along the foothills of Meghalaya in Dhubri, Goalpara, Kamrup and Marigadon districts, along the foothills of Karbi Anglong, in Nagaon and Golaghat districts, along the Nagaland foothills of Golaghat, Jorhat and Sibsagar districts and along the southern and eastern foothill margins of Tinsukia districts.

\(^2\) New alluvium is found all over the Brahmaputra and Barak Valleys except for the places mentioned above.

\(^3\) A soil amendment is any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. The goal is to provide a better environment for roots. To maintain an optimum soil pH for crop production, soil amendments are necessary so as to neutralize soil acidity.
3.3 Impacts on soil structure

3.3.1 Impacts on soil structure due to AACP intervention shall be compaction of topsoil\(^4\), due to mechanisation of agriculture. Towards minimising such impacts, the DAO and Farm Management Committee shall provide information to the farmers of practices to be followed to prevent compaction of soils (Refer Box 3-1).

<table>
<thead>
<tr>
<th>Box 3-1: PRACTICE AS TO MINIMISE SOIL COMPACTION....</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No tillage or zero tillage technique shall be adopted for ploughing or sub soiling as per ICAR guidelines.</td>
</tr>
<tr>
<td>- Whenever practicing deep cultivation, the farmers shall take account of soil conditions.</td>
</tr>
<tr>
<td>- Livestock shall not be allowed to graze when the land is too wet to avoid damage to soil structure.</td>
</tr>
<tr>
<td>- Regular cultivation shall be done on free draining soils</td>
</tr>
</tbody>
</table>

3.4 Erosion Impacts

3.4.1 The agricultural practices and activities adding to the problems of soil erosion other than rainfall are: i) Changes in cropping practice and management; ii) Agriculture mechanization and iii) poaching of land by grazing livestock.

3.4.2 The DAO, based on visits to individual fields shall identify the appropriate erosion control measure and provide information to the farmer on implementation of the same. The measures towards erosion control are presented in Table 3.1.

**Table 3.1: Measures to Control Soil Erosion**

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>DESCRIPTION OF MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain organic matter</td>
<td>Organic matter and microorganisms cement individual soil particles into larger aggregates. Soils high in organic matter have large, stable aggregates, which resist erosion.</td>
</tr>
<tr>
<td>Maintain crop residue cover</td>
<td>Protection of the soil surface with a cover of growing plants or crop residue will enable a control of erosion. Surface cover cushions the impact of rain due to which soil particles are not as easily dislodged and moved. It also slows the flow of water, giving the soil time to absorb more water and thereby reducing runoff and erosion</td>
</tr>
<tr>
<td>Reduce tillage</td>
<td>Reduced and minimum tillage systems leave a good crop residue cover to prevents erosion and conserves soil moisture.</td>
</tr>
<tr>
<td>Grow forages and use crop rotations</td>
<td>Forage cover protects the soil from erosion, and the fibrous roots hold the soil in place. Alternate forages with cereals and oilseeds or legumes can control erosion.</td>
</tr>
<tr>
<td>Grassed waterways</td>
<td>Gully erosion can be controlled through grassed waterway. A grassed waterway is a wide, shallow grassed channel that can carry a large volume of water quickly down a steep slope.</td>
</tr>
</tbody>
</table>

3.5 Selection of fertilizers

3.5.1 To determine nutrient requirements (i) Nutrient hunger signs on growing crops (deficiency symptoms presented in Table 3.1), (ii) Soil tests or analyses to determine the fertilizer nutrients and dosage needed (iii) Plant and/or plant tissue tests in the field need to be observed or conducted. The calculation of amount of nutrient requirement has been presented in Appendix ECP AGRI 3.2.

\(^4\) Compaction of topsoil can seriously damage soils structure and restrict root growth and reduce infiltration of water into soil. The biological activity and root growth is affected, as the entry of air gets restricted. This reduces the fertility of the soil and, more specifically, the availability of plant nutrients.
Table 3.2: Deficiency Symptoms of Plant/Crop Nutrients

<table>
<thead>
<tr>
<th>S.no</th>
<th>Nutrient Deficiency</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>S</th>
<th>Ca</th>
<th>B</th>
<th>Zn</th>
<th>Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stunted/Poor Plant Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Loss of Green Colour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Chlorosis(^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Necrosis(^6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lower Leaf die prematurely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Stunted growth of Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reddish Colour of Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Yellowish Upper Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Brown Spots on Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>White irregular spots on leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Olive green or Greyish Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Roots Malformed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Cavities in stems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Low Seed Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Small Size of Fruits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Bushy Shoots on Fruit trees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Delayed Crop Maturity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.5.2 The District Agriculture Officer (DAO) shall provide the farmers the know how of balanced fertiliser requirement to improve soil fertility. The farmers shall be encouraged to undertake soil tests after every cropping cycle to assess soil nutrient requirement. The different amounts of nutrients\(^7\) required by medium and good yields of some of the crops are given in Appendix ECP AGRI 3.3. In addition to plant nutrient needs at the respective yield levels, other factors to be considered in selection of fertilisers are:
- Soil nutrient reserves
- Possible unavailability of the applied nutrients to the plant roots due to fixation and leaching or other losses.

3.6 Selection of Application Techniques

3.6.1 The amount and timing\(^8\) of nutrient application depends upon i) crop variety ii) planting date iii) crop rotation iv) soil and weather conditions and v) method of application. All primary and secondary nutrients\(^9\) shall be incorporated immediately after application (as entire state is a high rainfall region) to avoid losses due to run-off and erosion. Application and handling of bio-fertilisers shall be in compliance with the Manual\(^11\) for Extension Workers - for Introducing Bio-fertilizers in North Eastern region. Additional nutrients may

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\(^5\) Chlorosis, i.e. a yellowish discoloration of leaves, indicates an affected formation of chlorophyll; chlorosis is reversible by application of the needed nutrient.

\(^6\) Necrosis, i.e. brownish discoloration of leaves or parts of leaves, indicates dead tissue. It is irreversible, i.e. it cannot be cured through nutrient application.

\(^7\) Different crops need different amounts of nutrients. Furthermore, the quantity of nutrients needed depends largely on the crop yield obtained (or expected). Different varieties of a crop will also differ in their nutrient requirements and their response to fertilizers.

\(^8\) This is particularly important for nitrogen fertilizer, which can easily be leached out of the soil profile. For optimum crop use efficiency and minimum potential for environmental pollution, the nutrients shall be applied as near to the time the crop needs them as is practical.

\(^9\) In the cases of urea and diammonium phosphate application, losses may occur through emission of ammonia to the air. Both these fertilizers must be incorporated into the soil immediately after application, if there is no immediate rainfall or irrigation to wash it into the soil.

\(^10\) The primary nutrients are N, P, and K, because they are most often limiting from a crop production standpoint. All of the other essential macronutrient elements (Ca, Mg, and S) are secondary nutrients because they are rarely limiting, and more rarely added to soils as fertilizers.

\(^11\) Regional Biofertilizer Development Centre, Department of Agriculture, Government of India, CAU campus, Iroisemba, Imphal-795001
be required after the application of Bio-fertilizers. The time and nature of nutrient requirement are presented in Box 3.2.

Rhizobium, which is applied in legume crops, then the first dose of NPK is given but the subsequent doses of N are not required.

In case of blue green algae biofertilizer, which is applied in rice, again the first dose of NPK is given but the subsequent doses of N are reduced by 50% or so depending upon the algal growth. In case of P solubilizing biofertilizer P is not applied. If we talk of green manure, the recommendation is to skip the first dose of N and the second dose of N is applied after 30 days.

3.6.2 During application of fertilizers, either by hand or equipments, the farmer shall take care to distribute nutrients uniformly at right dosage. District level training shall ensure that farmers are made aware of appropriate techniques of application. The equipment shall be well maintained. The techniques of application of fertilizers are given in Table 3.2.

| Fertilizer Application Techniques | Application Practice | Crop Type/Area
|----------------------------------|----------------------|-----------------
| Broadcasting                     | Application of fertilizer to the surface of the field and spreading should be as uniform as possible. | Dense crops not planted in rows or in dense rows (small grains) and on grassland.
| Row or Band Placement            | Fertilizer application only in selected places in field, the fertilizer is concentrated in specified parts of the soil during planting. | It is preferably used for:
|                                 |                                    | - row crops, such as maize, cotton, and sugar cane;
|                                 |                                    | - on soils with a tendency to phosphate and potassium fixation;
|                                 |                                    | - where relatively small amounts of fertilizer are used on soils with a low fertility level.
| Top Dressing                    | Broadcasting the fertilizer on a standing crop. Applying fertilizer for nitrogen requirement by top dressing and potassium requirement by Basal Dressing. | Mainly used for small and large grain crops and for crops such as forage.
| Side Dressing                   | Applying fertilizer as side-dressing is the practice of putting it to the side of widely spaced plants grown in rows. | Mainly Maize, Cotton and Sugar cane. Trees or other perennial crops also are normally side-dressed.
| Foliar Application              | Foliar application is the most efficient method of supplying micronutrients. Spraying shall preferably be done on cloudy days and in the early morning or late afternoon (to avoid an immediate drying of the droplets). | Can be applied for supplying small quantities of nutrients to any plants or crops.

The amount of fertilizer to be applied per hectare or on a given field shall be determined through the amount of nutrients needed and the types and grades of fertilizers available. The procedure for calculating the fertilizer requirement is presented in Box 3.3.

**Box 3-3: CALCULATION OF FERTILISER REQUIREMENT...**

Usually mineral fertilizers are delivered in 50-kg bags. Therefore, the farmer has to know the quantity of nutrients contained in a 50-kg bag. The easiest way to calculate the weight of nutrients in a 50-kg bag is to divide the number printed on the bag by 2.

**EXAMPLE:** How many bags of ammonium sulphate (AS) (with 21% N and 24% S) are needed to supply 60 kg/ha of N?

- 21 divided by 2 gives 10.5. Thus approximately six bags of AS are needed to give (a little more than) 60 kg/ha N. In addition, six bags of AS will supply 72 kg/ha of sulphur. If the area of the field is only 500 m² (square metres), the required amount of fertilizer would be one twentieth of that for one hectare: 1 hectare: 10 000 m² divided by 500 m² = 20, i.e. for an area of 500 m² 300/20=15 kg of ammonium sulphate are necessary to apply the amount of nitrogen corresponding to 60 kg/ha N.
3.7 Bio-Fertilisers

3.7.1 Bio-fertilisers are mainly live bacteria or fungi, which on application, help in fixing or solubilising the nutrients, present in air or soil, but do not contain any significant quantity of nutrient itself. Different bio-fertilisers available, which are of the three types namely i) Nitrogen Fixers, ii) Phosphate Mobilisers iii) Compost accelerators and enriches, are presented as Appendix ECP AGRI3.4

3.7.2 The DAO shall ensure that the farmers are educated about measures to be adopted by them to obtain desirable results from use of Bio-Fertilisers.

- Select right Bio-fertilisers and use it before expiry
- Use appropriate methods of application and use it at appropriate time
- For seed treatment use adequate adhesive for better results
- In problematic soils use correct methods like lime or gypsum pelleting of seeds or correction of soil pH by use of lime.
- Ensure supply of phosphorous and other nutrients

3.7.3 The precautions to be observed in Bio fertilizer use are:
- Store Biofertilizers packets in cool and dry place away from heat and direct sunlight
- Open the packets just before use and use all its content at a time.
- Bio fertilizers and treated seeds should not be mixed with chemical fertilizers, insecticides and pesticides.
- In case seeds are to be treated with fungicides, then treat the seeds first with fungicides such as Bevistan or Thiram and then with double the recommended dose of Biofertilizers.
- Seed treatment and Biofertilizers manure preparation to be done in shade.
- Always use specific Biofertilizers for specific crop and use the packet before the expiry specified on each packet.

3.7.4 Organic Manure application is beneficial both under irrigated and rain fed conditions. On an average 1 tonne of FYM will be equivalent to 4.4 kg fertilizer N+P+K in 2:1:1 ratio and the crop production efficiency of FYM-N will be 30%. However, this will vary depending upon the soil properties, FYM composition, temperature and moisture. The practices for application of organic manure shall be as follows:
- Animal Manure shall applied on soil 2 to 3 weeks before planting. Materials to be used are cow dung (10-15 tons per hectare) and Poultry manure (3 to 4 tons per hectare). Depending on the availability these can be applied individually or in combination.
- Rice Straw mulches can be placed in between rows in the standing crops generally from 5 to 8 tons per hectare on dry matter basis up to thickness of 2 to 4 cm above ground.
- Ploughing of the crop residue in the field immediately after the harvest of crops.
- Avoid planting same crop residues from identical crops.
- Green manure crops can be grown during fallow season. It can also be used as rotational crops. About 30 to 40 kg per hectare of seeds of a green manure is required for establishment.
- Compost can be prepared in the field and applied before planting the crop. Compost at the rate of 5 to 10 tons per hectare is sufficient.
Appendix ECP AGRI-3.1: Materials used for liming of soil

<table>
<thead>
<tr>
<th>Material</th>
<th>Relative Neutralizing value (%)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure CaCO&lt;sub&gt;3&lt;/sub&gt;</td>
<td>100</td>
<td>Not generally available</td>
</tr>
<tr>
<td>Calcitic agricultural lime, (calcium carbonate, CaCO&lt;sub&gt;3&lt;/sub&gt; +impurities)</td>
<td>90 - 100</td>
<td>Easily available</td>
</tr>
<tr>
<td>Dolomitic agricultural lime, CaCO&lt;sub&gt;3&lt;/sub&gt; + MgCO&lt;sub&gt;3&lt;/sub&gt;</td>
<td>95 - 108</td>
<td>Easily available; provides Mg</td>
</tr>
<tr>
<td>Seima chalk/marl, CaCO&lt;sub&gt;3&lt;/sub&gt; + clay</td>
<td>50 - 85</td>
<td>Contains clay; keep dry</td>
</tr>
<tr>
<td>Burned lime, CaO</td>
<td>150 - 175</td>
<td>Very caustic; don’t use</td>
</tr>
<tr>
<td>Hydrated lime or buildings’ lime, Ca(OH)&lt;sub&gt;2&lt;/sub&gt;</td>
<td>120 - 135</td>
<td>Caustic; use with caution; no Mg</td>
</tr>
<tr>
<td>Basic slag</td>
<td>50 - 70</td>
<td>Contains some P &amp; micronutrients; byproduct</td>
</tr>
<tr>
<td>By-products</td>
<td>Variable</td>
<td>Use as specified by manufacturer</td>
</tr>
<tr>
<td>Gypsum and/or ground drywall, CaSO&lt;sub&gt;4&lt;/sub&gt;</td>
<td>0</td>
<td>Not a Liming Material</td>
</tr>
</tbody>
</table>

**Liming Rate in kg per Hectare:**

Parameters for calculation of rate of liming required are:

1. Total Oxide content of Liming material—Information to be supplied by Trader during sale.
2. Liming requirement in kg oxides per acre can be recommended through soil testing.
3. Formulae for Conversion of lime application from kg oxides per acre to kg per acre

\[
\text{kg per acre} = \frac{(\text{kg oxides per acre})}{(\% \text{ of total oxides})}
\]

Example: A soil test analysis recommends the application of 1,000 kg oxides / acre. Liming material contains 29% CaO and 37% MgO. Find kg per acre of lime requirement

Total Oxides in percent = 29% CaO + 37% MgO = 66%

\[
= \frac{1000}{66} \times 100 = 1515 \text{ kg per acre}
\]

Therefore, the lime requirement 1500 kg per acre

**Appendix ECP- AGRI 3.2: How to Calculate the Nutrient Supply**

Among the various methods of formulating fertilizer recommendation, the one based on yield targeting has found popularity. This method not only indicates soil test based fertilizer dose but also the level of yield the farmer can hope to achieve if good agronomy is followed in raising the crop. It provides the scientific basis for balanced fertilization not only between the fertilizer nutrients themselves but also that with the soil available nutrients. The essential basic data required for formulating nutrient recommendation with this approach are nutrient requirement for a unit grain yield (NR), nutrient contribution from soil (INS) and the contribution from fertilizer (RE). Under the conventional procedure, these parameters are calculated as follows:

- **Nutrient requirement (NR, kg/t):**
  - Total uptake of the nutrient (kg/ha)
  - Grain yield of the crop (t/ha)

- **Total uptake of the nutrient in the control plot (kg/ha):**
  - Soil Nutrient Efficiency (SNE): 
  - Soil test value (STV) of the nutrient in control plot (kg/ha)

- **Fertilizer nutrient recover efficiency (RE):**
  - \( \frac{[\text{Total uptake in treated plot (kg/ha)}] - [\text{Soil test value in treated plot (kg/ha)}]}{[\text{Total uptake in control plot (kg/ha)}] \times \text{SNE}} \)

**Fertilizer requirement (F) for a target yield (Y, t/ha) is then calculated as:**

\[
F (\text{kg/ha}) = \frac{1}{RE} [NR(Y) - SNE \times STV]
\]

This equation serves as a basis for working out the fertilizer nutrient dose for a given soil test value and a specified yield target. Quantitative fertilizer adjustment equations based on soil tests have been formulated to calculate nutrient doses for a definite yield target.

**Appendix ECP AGRI-3.3: Nutrient Requirement by crops by kilograms per hectare**

<table>
<thead>
<tr>
<th>Crops By Type</th>
<th>Yield kg/ha</th>
<th>Nitrogen</th>
<th>Phosphorous</th>
<th>Potassium</th>
<th>Calcium</th>
<th>Magnesium</th>
<th>Sulphur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>3000</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Wheat</td>
<td>3000</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>140</td>
<td>140</td>
<td>240</td>
<td>240</td>
<td>340</td>
<td>540</td>
</tr>
<tr>
<td>Maize</td>
<td>3000</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>120</td>
<td>120</td>
<td>240</td>
<td>240</td>
<td>360</td>
<td>540</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>40000</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Seed oil</td>
<td>5000</td>
<td>140</td>
<td>140</td>
<td>240</td>
<td>240</td>
<td>360</td>
<td>540</td>
</tr>
</tbody>
</table>
APPENDIX-ECP AGRI-3.4: IMPORTANT Phospho BIO-FERTILISERS

BIOFERTILISERS

Nitrogen fixer
Symbiotic
Azospirillum
Azotobacter

Phosphate mobilizers
Free living
Azolla, Anabaena

Phosphate absorbers
VA Mycorhiza

Phosphate solubilizer
Bacillus
Pseudomonas

Compost accelerators and enrichers
Assocative
Blue green algae
Aspergillus
Penicillium

Compost accelerators
Cellulolytic
Trichoderma
C. fasciculatus
M. mycoides

Lignolytic
Arthrobacter
Humicola

Nitrogen enricher
Azotobacter

P enricher
A. actinomycetem
P. vivii
4.1 General

4.1.1 The ECP on Soil and Nutrient Management provides inputs towards selection of appropriate (type and dosage) fertilisers / pesticides based on the nutrient balance. This ECP addresses issues arising from the improper handling and storage of these chemicals. These guidelines and precautionary measures shall be applicable to handling and storage by (i) the traders dealing in fertilisers and pesticides and (ii) individual beneficiaries of the project.

4.2 Building a storage facility

4.2.1 The trader shall store fertilisers in a dry and secure location, so that impact on groundwater does not result. The fertilizers shall be stored away from activities that might rip open a bag or allow rain to enter the container. An impermeable (waterproof) floor, such as properly treated concrete shall prevent fertilizer from seeping into the ground and leaching to groundwater. This Secondary containment provides impermeable floor and walls around a fertilizer or chemical storage area that minimize the amount of fertilizer or chemical seeping into the ground from a spill or leak.

4.2.2 When building and maintaining a fertilizer-storage facility, the following precautionary measures shall be considered:

- The size of the storage facility should be adequate for holding the peak fertilizer requirement.
- Locate the dry-storage building or liquid secondary containment down slope and at least 15m away from the water body.
- The building foundation and secondary-containment floor shall be constructed from impermeable material & well drained and above the water table.
- Rainwater shall be diverted away from the fertilizer storage area.
- Fertilizer storage warehouses should be constructed of materials that protect the fertilizer from the natural elements.
- Fertilizer shall be stored in a manner to prevent contamination with other products. (i.e. seed, pesticides, grain, etc.) Store all dry fertilizer products under roof.
- The fertilizer bags shall not be stored on bare ground and shall be stored in dry place
- Display appropriate warning and hazard signs on storage facilities.

4.2.3 In addition, the siting of the storage facility, layout and construction of buildings shall be in conformance with the ECP Common 2: Building Activities.

4.3 Modifying an existing storage facility

4.3.1 The following precautionary principles shall be followed during the modification / expansion of an existing storage facility:

- The building foundation and secondary-containment, floor shall be constructed of impermeable material & well drained and above the water table. Drainage should be provided around the building
- Fertilizer shall be stored in a manner to prevent contamination with other products. (i.e. seed, pesticides, grain, etc.)
- If the storage facility is within 15m of a water body, the same shall be relocated.

1 Though the project does not envisage any interventions towards development of storage facilities for traders, the Department as Good Practices shall enforce upon these measures on the traders.
4.4 Recommendation for Safe Loading & Unloading

4.4.1 Loading and unloading facilities shall be designed to (i) reduce the risk of dry fertilizer escaping to the environment, and (ii) permit easy cleanup of any spilled fertilizer. The following measures for safe loading and unloading shall be adopted:

- Surface of the loading and unloading areas shall be constructed of an impervious material (i.e. concrete or asphalt).
- The area shall be larger than the vehicles being loaded and/or unloaded. The perimeter area shall be sloped away from the loading or unloading area to permit rainwater to drain away (to prevent puddles). Spilled fertilizer shall be swept up and re-blended in a dry useable form.
- Loading and unloading techniques shall prevent unnecessary spillage of the fertilizer.
- Bagged fertilizer must be handled in a manner to prevent fertilizer from escaping to the environment. Torn bags should be re-packaged immediately.
- Spills should be cleaned up immediately or at the end of the day to avoid the potential for soil and groundwater contamination.
- All dry fertilizer should be reused and wet fertilizer should be properly reused and recycled.

4.5 Handling and Storage of Pesticides

4.5.1 The detailed guidelines for handling and storage of pesticides developed by Assam Agriculture University are presented in Appendix ECP Agri. 4.1: Guidelines for use of Pesticides. In addition, the following measures shall be complied with:

- ALWAYS READ THE LABEL: Follow all safety precautions on the label. Wear protective clothing and use protective equipment according to instructions on the pesticide label.
- Be careful when handling pesticide spray materials to avoid spilling on skin or clothing. Should such an accident occur, wash immediately with soap and water.
- Avoid drift to non-target areas, which may endanger other plants or animals. Cover feed pans, troughs, and watering tanks in livestock areas.
- When selecting pesticides, keep in mind that the type of formulation and application equipment affects the potential for drift.
- Bathe or shower in hot, soapy water after applying pesticides.
- After applying pesticides, wash clothing, separate from other laundry, in hot, soapy water. Contaminated clothing must be handled with the same precautions as the pesticide itself.
- The washing of the containers of pesticides should not disposed off into any flowing water body or a water body used for drinking purpose.

4.6 Safety Measures for Personnel Handling Fertilizers and Pesticides

4.6.1 Towards ensuring adequate safety, personnel handling fertilizers / pesticides should use personal protective equipment, e.g. face shields or goggles, rubber aprons, long-sleeved shirts, rubber gloves and boots. In addition, the trader shall

- Adequately train all employees in the use of appropriate protective gear and equipment for handling products.
- Proper use of safety equipment and protective clothing for workers involved in handling and storage of fertilizers.
- Use closed mixing/transfer systems for pesticide handling safety.
- Do not mix pesticide-contaminated clothing with family clothing.
- Hang clothing outside in direct sunlight and wind to dry when possible.
- Use strong detergents and hot water for washing. Run empty washer with detergent and hot water cycle to clean after washing contaminated clothing.
- Provide and use appropriate personal protection device when loading and mixing pesticides.
- Provide office or non-storage areas with separate exit doors from pesticide storage rooms.
- Properly ventilate and lighted storage areas.
- Provide Information of first aid and antidote to personnel handling fertilizer or pesticides.

\[2\text{Publication Number:1407/05/02/1000, Assam Agriculture University.}\]
4.7 Guidelines for users of small quantities of pesticides

4.7.1 Avoiding pesticide dependence: Efforts shall be made by the Agriculture Department to reduce the dependence of farmers on chemical pesticides through training & demonstration programmes of IPM. Programmes that raise awareness of the hazards of pesticides encourage users to treat pesticides with care, minimize their use, and manage them and their waste products cautiously.

4.7.2 Buying pesticides: Through training and awareness programmes, the agriculture department shall ensure that only the appropriate pesticide is purchased to prevent accumulation of unwanted stocks. The farmers shall sought advise from agricultural extension officers, FMC, Agriculture Service Centres. The product selected should not only be effective against the pest but should also be of a formulation that is appropriate to the type of application equipment used by the buyer. Products should be bought only when they are in their original, sealed containers and not in repacked containers and complete product label attached. The label should be in a local language and be clearly legible. Buyers should resist pressure from pesticide vendors to buy larger quantities than are needed, even if cost reductions are offered. Pesticides intended for use in major crops should not be used on other crops such as vegetables, or for the control of domestic pests.

4.7.3 Storing pesticides: Owners and end users of pesticides have a responsibility to store them safely so that they do not cause harm. Badly stored pesticides are likely to deteriorate and become unusable or obsolete. The following conditions should be adhered to when pesticides are stored in homes or on farms:

- Pesticides should be kept in a secure place to which children, animals or unauthorized people do not have access.
- They should not be stored in living or sleeping quarters.
- They should be kept separately from all food, including animal feed, and away from water and water supplies.
- They should be kept dry and out of direct sunlight.
- They should be kept away from naked flames, e.g. fires or lamps.
- Storage places should be well ventilated.
- Pesticides should never be transferred into containers other than those in which they were supplied.
- Older products held in store should always be used before newly purchased products. Use-by dates on products should be strictly observed.

4.7.4 Empty containers: The containers should be cleaned out as completely as possible. For liquid (e.g. emulsifiable concentrate) or solid (e.g. wettable powder) formulations that are diluted before application, containers should be triple-rinsed and the washings used as part of the product diluant. Containers for dry application products should be emptied as completely as possible. Empty containers should not be used for any purpose other than storage of the pesticides that they originally contained. To prevent such misuses, schemes to collect empty containers by the traders to be insisted by the Agriculture department. Containers should be punctured to prevent reuse. Empty containers should not be burned or buried.

4.7.5 Unwanted pesticides: Unidentified or unusable pesticides should not be kept or used for any purpose. Neither should pesticides that are out of date or stored in damaged containers. Advice should be sought from pesticide suppliers/distributors. The department shall encourage pesticide suppliers/distributors to establish schemes for disposal.
Appendix ECP Agri - 4.1 : Guidelines for use of Pesticides
2

The soil is the bedrock of our agricultural system. Healthy soil is essential for growing healthy plants and producing healthy food. However, the soil can be damaged by improper use of fertilizers and pesticides.

Fertilizers are nutrients that help plants grow. They are essential for plant growth and can help improve soil health. Fertilizers can be applied in different forms, such as solid or liquid, and can be applied directly to the soil or mixed with the soil. Fertilizers can be purchased from local agricultural supply stores or online.

Pesticides are chemicals used to control pests, such as insects, weeds, and fungi. Pesticides can be applied in different forms, such as aerosols, sprays, and granules. Pesticides can be purchased from local agricultural supply stores or online.

It is important to handle and store fertilizers and pesticides safely to avoid harm to the environment and human health. The storage of fertilizers and pesticides should be in a cool, dry, and well-ventilated area.

Fertilizers and pesticides should be used as directed on the labels. Overuse of fertilizers and pesticides can harm the environment and human health. It is important to use fertilizers and pesticides in moderation and to rotate crops to avoid soil depletion.

In conclusion, fertilizers and pesticides are essential for plant growth and crop production. However, it is important to handle and store fertilizers and pesticides safely to avoid harm to the environment and human health. It is also important to use fertilizers and pesticides in moderation and to rotate crops to avoid soil depletion.
কৃষি কর্ম লগ্ন কৃষিপরিষদ লগ্ন উৎপাদ তালিকা মাঝো। এর দাঁড়ানো সত্ত্বেও কমবেলে দেখা যায়। এই কমবেলে চর্চা হওয়া দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই কমবেলে চর্চা হওয়া দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই কমবেলে চর্চা হওয়া দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই কমবেলে চর্চা হওয়া দেখা যায় সত্ত্বেও কমবেলে দেখা যায়।

রোগের সময় যে সংখ্যক দেখা যায় তাই এই দেখা যায়। এই দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই দেখা যায় সত্ত্বেও কমবেলে দেখা যায়। এই দেখা যায় সত্ত্বেও কমবেলে দেখা যায়।

বন্যার অবস্থা নথির মাঝে অন্তর্ভুক্ত হয়।

- তরল পদার্থ দেখা যায় ।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
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দামও দেখা যায় ।

- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
- তরল পদার্থ দেখা যায়।
ECP Agri. 4: Fertilizer & Pesticides - Handling & Storage

- Ensure all fertilizers and pesticides are stored in a well-ventilated, dry area.
- Keep fertilizers and pesticides separate from food and beverages.
- Store fertilizers and pesticides in their original containers.
- Do not mix different types of fertilizers or pesticides.
- Wear protective clothing when handling fertilizers and pesticides.

PPP

The content of this document focuses on the safe handling and storage of fertilizers and pesticides in agriculture. It highlights the importance of maintaining a clean and organized environment to prevent contamination and ensure the safety of workers.

In Bangladesh, the safe storage and handling of fertilizers and pesticides are crucial to prevent accidents and ensure the health of workers. The government provides training and guidelines to farmers and workers to follow these practices.

PPP

PPP
5.1 General

5.1.1 Land Development program aims at increasing cultivable areas through i) bringing temporarily water-logged area under cultivation ii) use LLP for assuring irrigation during the dry season. The major activities for land development are (i) removing water logging in agriculture field; (ii) Improving drainage channels; (iii) Clearing weeds or unwanted growth of plants in the channel; (iv) increase the width of channel and (v) Constructing new channel if the existing channel did not connect to the natural river system.

5.1.2 The environment consideration of the land development through improving the drainage channels involves (i) Water from Natural water bodies may also get drained; (ii) The bio diversity of the water logged area may be damaged; (iii) The drainage channel widening may involving land acquisition leading to social rehabilitation; (iv) The widening or construction of drainage channel shall involve encroachment on the common property resources or community places. Therefore it shall be the responsibility of the department to take up the land development exercise without causing damage to the natural and manmade habitat.

5.1.3 The ECP shall apply to land development in i) agriculture land which are waterlogged ii) marshy areas and iii) areas being developed which are categorised as "Low Impacts" based on the information provided in Project Information Document. (Appendix ECP AGRI 5.1)

PRECONSTRUCTION STAGE

5.2 Agricultural Land

5.2.1 It shall be the responsibility of the department to undertake topographic and hydrogeological studies of the area. Further it shall be the responsibility of the department to undertake following considerations:

- No Natural Water body or wetland shall be drained for the purpose of intervention
- The area selected for the land development shall not be in the radius of 7 km from the core of grade 1 wetland (Refer ECP Common 1- Biodiversity Management) or national parks or wild life sanctuary or forest area or any other ecological sensitive area.
- Existing channel shall be preferred for the drainage system else detailed EA shall be done. Minimum land cutting shall be done following the natural contours.
- Disposal of excavated earth shall not be done in the surrounding low lying of ecological sensitive areas.
- The drainage channel shall not pass through ecological sensitive area.
- The felling trees shall be avoided
- Construction in natural water channel shall not impede the migration of fished or other species

5.3 Marshes and Swamps

5.3.1 In addition to the environmental considerations in agriculture land it shall be the responsibility of the DAO to have an assessment of the Bio-Diversity of marshes and swamps identified for land development by a professionally qualified personnel. The assessment report\(^1\) along with recommendations shall be annexed to the Project Information Document. The information shall be used to categories projects. Projects with low Impacts which can be undertaken.

\(^1\) The Biodiversity Assessment Report shall also contain the list of species of Plants, birds and fishes that are found in the swamp.
5.4 Other Consideration

5.4.1 It shall be the responsibility of the DAO to undertake physical survey of the area involving study of land utilization pattern; encroachments; area requiring land acquisition or acquisition of the common property resources (CPR) or acquisition of community areas. Further it shall be the responsibility of the DAO to conduct consultation with the community directly or indirectly related to the with the help of Nodal NGO to incorporate the following considerations:

- No land acquisition shall be done for the purpose of the project else the department shall get the letter of consent from the community for donation of land.
- The development of drainage channel shall not lead to acquisition of CPR or community areas.
- One beneficiary shall not donate land more than 10% of his total land.

It shall be responsibility of the DAO to prepare detailed project report (i) detailing current condition of the area; (ii) Total area of the land; (iii) Length of the drainage channel; (iv) Length of channel encroached and nature of encroachment; (v) Length requiring land acquisition for widening; (vi) Length for which new channel has to be made; (vii) Length of channel passing through any ecological sensitive area. CONSTRUCTION STAGE

5.4.2 The DAO shall ensure that:

- Debris generated from excavation of drainage channel are not disposed at in any water body or are left along the channel.
- No un warranted destruction of flora and fauna occurs.

5.5 POST CONSTRUCTION STAGE

5.5.1 The DAO shall ensure that:

5.5.2 Vegetation is not allowed to grow in the drainage channel.

5.5.3 Desilting of drainage channels take place periodically,

5.5.4 Fresh encroachments shall not be allowed.
ECP Agri. 4: Fertilizer & Pesticides - Handling & Storage

APPENDIX ECP AGRI 5.1: PROJECT INFORMATION DOCUMENT
Land Development

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td><strong>BRIEF PROFILE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Area to be Developed in km²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D Length of Drainage Channel (km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E Major Water Channel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Items for Evaluation**                                            |     |    |
| **Physical Consideration**                                          |     |    |
| 1 Is the profile of drainage channel prepared and finalise?         |     |    |
| i If yes, then what is the available clear width of the channel?    |     |    |
| ii What is the length to which the encroachment has occurred?       |     |    |
| iii What are the nature of encroachments?                          |     |    |
| iv What is the total land required for the widening of the channel?|     |    |
| **Environment Considerations**                                      |     |    |
| 1 What is the period of water logging after rainy season? (in days)  |     |    |
| 2 Is there any wetland in the proximity of the area?                |     |    |
| i If yes, what is the distance from the area?                       |     |    |
| ii If the distance is less than 7km, whether bio-diversity of wetland has been assessed? |     |    |
| iii Are Community consultations being carried out in surrounding area of wetlands? |     |    |
| 3 Are there any National Park/Wildlife Sanctuary in the proximity of area? |     |    |
| i If yes, what is the distance from the area?                       |     |    |
| 4 Does natural Habitat exists along the area?                       |     |    |

0 0 0 0 0
S Items for Evaluation

1 Drainage Channel?
   If yes, what is the length of channel passing through the natural habitat? 
   \[ \square \] m²

   ii Is natural habitat management plan prepared?
   Yes \[ \square \] No \[ \square \]

   Attach the plan

5 Are trees being cut by the land development project?
   If yes, What are the number of trees felled?
   
   ii Is clearance from the forest department obtained?
   Yes \[ \square \] No \[ \square \]

   Attach the certificate

6 Is any forest land being diverted for the project?
   If yes, is clearance from forest department obtained?
   
   Attach the certificate

7 Is plan prepared for disposal of excavated earth?
   
   Attach the copy of plan

C Social Considerations

1 Is land is required for widening of drainage channel?
   
   I Are consultation conducted with community before finalization of the project?
   Yes \[ \square \] No \[ \square \]

   Attach the Detail of Consultation

   ii Is Consent of land owners towards voluntary land donation received?
   Yes \[ \square \] No \[ \square \]

   Attach the Gift deed/MoU

   iii What the average land donation by the individual beneficiary?

   Attach the Beneficiary total land details

2 Is project involves acquisition of common property resources?
   
   Attach the Details
ECP Fishery 1. Beel (Open Water) Fishery Management

1.1 General

1.1.1 This ECP establishes procedures for management of open water fisheries, i.e. to carry out open water fishery activities in a manner to minimise the environmental implications on these ecosystems. The ECP is applicable to all Open Water fisheries and interventions in Beels categorised as "Low Impact" by the Environment cum Technical Officer (ETO) except those within 1km of National Parks, Sanctuaries, Ramsar Sites, Grade I Beels, Biosphere Reserve, Classified forest.

1.1.2 This ECP covers the following (i) Criteria for selection of beels for open water fisheries (ii) Procedures for minimizing adverse environmental impacts including management of weeds, economic and social consequences resulting from water extraction, land use, discharge of effluents, use of pesticides etc and (iii) Institutional Arrangements including training requirements for enhancing awareness of the communities towards sustainable beel management practices.

1.2 Institution & Legislations in India

1.2.1 To regulate and organise the fish seed industry and ensure quality fish seeds the Government of Assam has formulated, Fish Seed rules 2002 which is yet to be enacted. Other legislations such as Assam Fishery Rules, 1953 (related to beels and rivers), Assam private fisheries protection act, 1935 (related to private ponds and tanks) govern the fisheries activities in the state. ARIASP has developed legal literacy campaign for educating the communities on the rights and duties of the community in open water (beel) fishery.

1.2.2 India is a signatory to the Ramsar Convention on Wetlands, an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It came into force in 1975, and it is the only global environmental treaty that deals with a particular ecosystem.

1.3 Selection of beels

1.3.1 The District Fishery Development Officer (DFDO) shall identify beels for taking up for inland fisheries based on the following key considerations (i) Biodiversity; (ii) Physical, chemical and biological parameters; (iii) Primary productivity and (iv) Stock assessment. Beels which shall not be taken up in AACP are presented in Box 1-1.

1.3.2 The issues pertaining to biodiversity of beels is presented in ECP Common 1 Biodiversity Management.

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1 The beneficiary shall provide information in the Project Information Document provided as Appendix ECP Fishery 1.1.

2 It was adopted in the Iranian city of Ramsar in 1971. The signatories shall formulate and implement their planning so as to promote the conservation of the wetlands. The salient features of the convention are:

- Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.
  - Waterfowl are birds ecologically dependent on wetlands.
  - Wetlands should be selected in terms of their international significance in terms of ecology, botany, zoology, limnology or hydrology.

3 The grading criteria beels are presented in ECP Common 1: Biodiversity Management.
1.3.3 **Physico-chemical parameters:** Water and bottom soils basically control overall beel environment, which supports aquatic life. To assess the aquatic productivity, the Department shall assess the quality of certain physico-chemical parameters as per the standard practices developed by Central Inland Fisheries Research Institute (CIFRI). These would include:

- Water parameters such as temperature, water pH, turbidity, Dissolved oxygen, Alkalinity, Total hardness, Specific conductivity, Biological oxygen demand, chloride, calcium and magnesium.
- Soil parameters such as texture, soil pH, organic carbon and status of soil nutrient (Nitrogen, Phosphorus and Potassium).

1.3.4 **Primary productivity of beel or wetland:** Towards understanding the trophic status of the beel ecosystem, the DFDO shall carry out a measurement of primary productivity through photosynthesis. The daily and seasonal carbon production of a system can be used to assess the trophic status and fish production potential of any water body. While assessing the aquatic productivity, the role of nitrogen and phosphorus is also equally important.

1.3.5 **Stock Assessment:** The DFDO, shall study issues related to growth of fish populations, their size (Length and weight) and age structure, recruitment and mortality, estimation of stock, optimum yield etc. are to be studied before taking up any developmental activities in a particular beel. The AACP shall develop a right type of stock assessment model, which can be utilised, to carry out stock assessment in the project.

1.4 Management of Aquatic Weeds

1.4.1 Management of macrophytes is essential as excessive growth of macrophytes poses threat to fish production, healthy environment and fishing. Periodical removal of excessive growth of macrophyte or aquatic vegetation shall improve plankton production (primary food producer) and shall help improve the water quality of beel. Management practices for controlling aquatic weeds are presented in Box 1.2.

- A maximum cover of 20 - 25% macrophyte in a particular beel shall be allowed.
- Selective removal of excessive growth of submerged aquatic weed;
- Complete eradication of floating macrophytes;
- A particular portion of the weed-infested beel may be transformed into a fish habitat to conserve the fish biodiversity.

1.4.2 The DFDO shall encourage manual and cost effective means of periodic removal of floating weeds like water hyacinth, using boat, net or bamboo hook.

1.5 **Desiltation**

1.5.1 Community surrounding the wetland shall be discouraged, through information dissemination campaigns, to drain or fill portion of the wetlands to secure land for development or farming. At such location, alternative sources of livelihood such as animal husbandry shall be propagated.

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*Estimation of chloride is important to evaluate the pollution level, as it is a good index of eutrophication and pollution caused by cattle, sewage and other waste materials.*

*Soil nitrogen above 250mg/kg and soil phosphorus above 30mg/kg are said to be indicators for good productivity. Chemical fertilizers when used in paddy field, which contain phosphates and nitrates, can leach into waterways, destroying the natural habitat by causing algal blooms. These blooms reduce oxygen availability in the water and alter the biodiversity in the waterway.*

*Dissolved inorganic nitrogen in the range of 0.2-0.5 mg/l and phosphorus between 0.05 & 0.20 mg/l, are said to be favourable for fish productivity.*

*Through studies by experts several models of fish stock assessment are known.*

*Macrophytes are the characteristics feature of beel ecosystem. They play a definitive role in the stabilization of beel ecosystem.*
1.5.2 In the event of the connecting channel or opening to river getting blocked due to heavy siltation, the productivity of the Beel shall be adversely affected. In such cases desiltation would be required. The DFDO shall ensure that the community is actively involved in desiltation. To some extent, silt may be removed manually to prepare smaller earthen nursery or rearing tanks along the periphery of the beel for stocking fish seeds.

1.6 Stocking of Beels

1.6.1 The department shall ensure that stocks are replenished only by indigenous fish species. No Exotic Species shall be introduced in beels under any condition. Release of fry into rearing tanks shall be done under the supervision of DFDO or a Fishery expert only under favourable conditions.

1.7 Sustainable Beel Management Practices

Three major issues of environmental concerns viz. (i) Water Quality, (ii) Restoration of Habitats and (iii) Legislation Enforcement are important to any wetland development.

DFDO along with the Beel Development Committee shall prepare a Beel Management Plan for all beels that would be taken up for development of Fisheries activities in AACP. The basic strategies and management measures have been detailed in ECP Common 1: Bio-diversity Management.

1.7.1 For development programs around the beels, the department shall assess impacts of such activities, which would have adverse impacts on the sustainability of the beels e.g. use of chemicals and pesticide, development activities. The department of fishery shall sensitise other line departments such as district administration, forest department, department of agriculture etc.

1.8 Socio-Economic Issues surrounding the beels

1.8.1 To assess the profile of the local inhabitants and to identify problems and issues and priorities for further development, The fisheries department shall use an efficient tool, either Rapid Rural Appraisal (RRA) or Participatory Rural Appraisal (PRA). For fisheries based income generation activities, initially selected groups in the project area shall be given some type of revolving fund. Training on small-scale enterprise for both men and women shall be provided for income generation activities during the lean period where there is no or restricted fishing activities.

1.8.2 The project shall ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments (Ref: CCRF Article 9.1.4). Towards these, the fisheries department shall ensure the following: (i) Access to fishing grounds shall be guaranteed and, where necessary, regulated for the mutual benefit of fisheries, culture-based fisheries and aquaculture. (ii) Agreements shall be fostered between aqua farmers and fisher folk, to avoid conflicts over access to shared resources such as water, space and living aquatic resources.

1.8.3 Initiate small-scale fish rearing business and live-stock farming as income generating activities & for their livelihood. For effective implementation and monitoring a team shall be constituted with experts drawn from field of Fisheries& Aquaculture, social science, and engineering etc.
ECP Fishery 1: Beei (Open Water) Fishery Management

### Clause 1.3.2
**Biodiversity Assessment**

### Clause 1.3.3
**Physico-chemical characteristics**

### Clause 1.3.4
**Primary Productivity**

### Clause 1.3.5
**Stock Assessment**

### Clause 1.6
**Strategies for Sustainable Management**

### Clause 1.7
**Guidelines for Community Involvement**

### Clause 1.4
**Guidelines for Deweeding**

### Clause 1.5.1 & 1.5.2
**Guidelines for Desiltation**

### Clause 1.5.3
**Guidelines for Artificial Stocking**
ANNEXURE ECP Fishery 1.1 PROJECT INFORMATION DOCUMENT
Beel (Open Water) Fishery Management

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<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Block</th>
<th>Area</th>
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</thead>
</table>

1. Has bio-Diversity Assessment been carried out? *(attach documents detailing species etc)*

2. What is the Grade of the beels?

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
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</thead>
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2. Distance of the Facility from:

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (m)</th>
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<tr>
<td>Sensitive Location National parks</td>
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<td>NA</td>
</tr>
<tr>
<td>Sanctuaries,</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Ramsar sites,</td>
<td></td>
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</tr>
<tr>
<td>Grade I Beels,</td>
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</tr>
<tr>
<td>Biosphere reserves,</td>
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<td>Classified Forests</td>
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<tr>
<td>Habitation</td>
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</tr>
<tr>
<td>Water Channel</td>
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</tr>
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</table>

3. Nature of Operation

<table>
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<tr>
<th>Nature of Operation</th>
<th>Physical Parameters</th>
<th>Chemical Parameters</th>
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<tbody>
<tr>
<td>i) Is there any plans for artificial stocking?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ii) Name of species likely to be introduced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii) Has assessment of physico-chemical parameters of the Beel been carried out? <em>(write values of each parameters)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Water parameters</td>
<td>a. pH</td>
<td>b. Turbidity</td>
</tr>
<tr>
<td>C. Primary productivity <em>(attach relevant Documents)</em></td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

D. Stock Assessment

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Is there requirement of removal of weeds</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5. Is desilting of beels required</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7. Has a socio economic profile of the community surrounding beel carried out?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

8. Has an assessment of the socio-economic assessment of community been carried? *(attach relevant documents)*

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ECP Fishery 2. Community Tank & Farmers Ponds

2.1 General

2.1.1 AACP interventions for aquaculture include development of farmer ponds and community tank for fisheries. This ECP provides guidelines for carrying out fish farming in an environmentally sustainable manner in the community and farmers ponds to achieve the envisaged objectives of both food and economic security for the beneficiaries. Also, this code presents the guidelines to be followed by the Department during selection and development of these tanks and ponds for fisheries.

2.1.2 The ECP is applicable to all Community Tank and farmers pond categorised\(^1\) as “Low Impact” by the ETO, based on information provided by the beneficiary in the Project Information Document (Refer Appendix ECP Fishery 2.1), except those within 1km of National Parks, Sanctuaries, Ramsar Sites, Grade I Beels, Biosphere Reserve, Classified forest.

2.2 Legislation and its Implication

2.2.1 The legislations and their relevant provisions including the set of regulation for pond fish production by the Department of Fisheries are provided below:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Legislation</th>
<th>Relevant provisions</th>
</tr>
</thead>
</table>
| 1    | Assam Private Fisheries Protection Act, 1935 | Rule 7: Clearing of weeds in water bodies under private ownership  
Rule 8: Filling of Water Body with area above 0.07ha  
Rule 11: Issue of license of producers and renewal of license  
Rule 12: Power of licensing authority to refuse to grant or renew license  
Rule 14: Suspension and Cancellation of License |

Interventions can occur in existing tanks or new tanks or ponds constructed for the purpose. The Codes of practice lays guidelines for designing construction, stocking and maintenance of tanks.

2.3 Construction of New Tanks

2.3.1 Site Selection: Lands not suitable for paddy cultivation or other important crop, low lying areas etc. shall be utilized for construction of fishponds. The department shall discourage the conversion of paddy fields to fishponds. Important considerations for selection of a water body for aquaculture are i) Topography ii) Soil\(^2\) iii) Water supply and iv) Water quality\(^3\).

2.3.2 Designing & Construction: The pond design and construction shall be in accordance with the guidelines for pond construction available as standard packages of CIFRI. The Department shall carry out wide dissemination through an effective extension system of these CIFRI guidelines. This shall include:
- Time of Preparation: Ideal time in Assam is Dec- Jan.
- Preparation of Site
- Pond Excavation & Construction of embankment

---

\(^1\) The beneficiary shall provide information in the Project Information Document provided as Appendix ECP Fishery 2.1.
\(^2\) Soil should have good water retention capacity, optimum level of nutrient and should be of alluvial type.
\(^3\) No fecal coliform and other disease-causing pathogens should be present in the water. Fecal coliform contamination may occur due to dumping of garbage, municipal waste, unrestricted livestock access to waterways and pollution from farm runoff. Mechanisms for improvements to water quality are already known to improve the quality of water: 1) Control livestock access to waterways. 2) Encourage the improvement of manure management practices through better composting and reduction of runoff.
2.3.3 The beneficiary shall be responsible for obtaining approval from the Fishery Department before starting construction. Information of the nature and scale of operations (in the Project Information Document) shall be provided to the ETO for assessment of environment impacts.

2.4 Renovation of Existing Ponds:

2.4.1 Standard practices have been developed by Central Inland Fisheries Research Institute (CIFRI) towards i) Deweeding ii) Dewatering & Drying and iii) Desilting shall be followed for these activities.

2.5 Reclamation of Derelict Water bodies

2.5.1 Derelict water bodies shall be reclaimed through deweeding and excavating part of the area for fish farming activities.

2.6 Stocking of Ponds

Stocking of ponds shall be carried out only with quality seeds certified by the Department of Fisheries.

2.6.1 Fish Species Suitable for Culture Fishes: The fish species suitable for culture are native major carps (Rohu, Catla & Mrigal) and minor carp (L.calbasu, L.gonius etc.) fishes, local fish species like Magur, Singhi, Murrels, Chital and Koi. However, the culture practices of these species have not gained importance probably due to non-availability of adequate quantity of seeds and proper feed.

2.6.2 Introduction of exotic species: The department shall ensure that farmers only grow fish species compatible to each other in community tanks and farmers ponds for its growth and maturation. In Assam, more attention should be paid towards the seed quality-the basic input of pond fish farming. The introduction of exotic species requires detailed evaluation.

In addition to the native fish species other exotic varieties such as Chinese carps viz. Silver, Grass carp and Common carp can also be cultured in confined water. They normally show good growth rate under culture condition. Utmost care shall taken to prevent the escape of such exotic species in to natural waters during the flood or monsoon season.

The farmer engaged in culture of exotic species shall be held responsible for any escape of fishes into natural ecosystem. The precautions required for introduction of exotic species in culture system are:

- The beneficiary shall ensure that ponds shall be bound by nets during the monsoon to prevent fish to escape into natural environment.
- Silver Carps and grass carps may be introduced in Farmers pond and Community Tanks.
- Common carps shall not be introduced instead mrigal shall be used as alternate species in the poly-culture system.
- The probability of an escape from the culture system to natural water,
- Survival of the organism if it does escape,
- The organism's reproductive capability in the wild, both with itself and with other species,
- The ability of specific genes from the species to be transferred to native species.

The fishes utilize the ecological niches of the water body and initially feed primarily on the minute fish food organisms present in the water body. In semi-intensive fish farming artificial feeds and fertilizers are used for enhancement of fish growth and overall productivity.

Common carps shall not be introduced until the study on “Impacts of Introduction of Common Carps” proposed as part of AACP is complete and it recommendations internalized in the package of practices.

Ponds and tanks in areas prone to submergence of water shall be protected by nets to prevented any escape.

In case of grass carps sterile strains of grass carps can be used. Common carps are prolific breeders and have been reported to establish in natural water bodies.

---

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5 Common carps shall not be introduced until the study on “Impacts of Introduction of Common Carps” proposed as part of AACP is complete and it recommendations internalized in the package of practices.

6 Ponds and tanks in areas prone to submergence of water shall be protected by nets to prevented any escape.

7 In case of grass carps sterile strains of grass carps can be used. Common carps are prolific breeders and have been reported to establish in natural water bodies.
2.6.3 Culture of exotic species such as Big head carps, Tilapia and Thai magur and any hybrid fish species shall not be taken up for production strict monitoring is required to check their entry into the water bodies of the state. The department shall ensure action against the producers of banned species (Refer Box 1-1).

<table>
<thead>
<tr>
<th>Box 1-1: Criteria for Selection of Fish Species for culture are ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Grows fast in confined environment</td>
</tr>
<tr>
<td>• Matures fast.</td>
</tr>
<tr>
<td>• Accept artificial feed.</td>
</tr>
<tr>
<td>• Seeds of the fish species are locally available.</td>
</tr>
<tr>
<td>• Compatible with other fish species in the same environment.</td>
</tr>
<tr>
<td>• Has good market demand.</td>
</tr>
</tbody>
</table>

2.6.4 The District Fishery Development Officer (DFDO) would undertake awareness campaign involving the market committees and NGOs to raise the awareness of consumers about the adverse environmental impacts of these exotic species. Special stress would be given to identification of these species. If possible display boards may be put up in front of the markets for educating the consumers.

2.6.5 Stocking density shall depend on type of culture method, whether extensive, semi-intensive or intensive fish farming. Based on the culture method, species ratio and density standard practices are by developed CIFRI. The department shall ensure dissemination of this information through the Field Officers and nodal NGOs. However, in case of seasonal ponds and homestead pond used for aquaculture, small-scale aquaculture shall be promoted by the Department of Fisheries.

2.6.6 The Department shall educate farmers about selection and use of correct inputs for fish farming (Refer Box 1-2)

<table>
<thead>
<tr>
<th>Box 1-2: Criteria for Selection &amp; Procurement of Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Seeds: Shall be pure strain of cultivable species. The quality of the seed should not be compromised. Ideal size of the seed is more than 5.0 cm.</td>
</tr>
<tr>
<td>• Feed: Low-cost effective feeds shall be prepared utilizing local ingredients. It should have recommended protein, carbohydrate and lipid percentage. Information on nutrient requirement of different stages of fish is already available.</td>
</tr>
<tr>
<td>• Fertilizers: Major thrust shall be given on use of manures. In semi intensive fish farming cattle and poultry manures can be very safely applied at the recommended dose. Chemical fertilizers may be recommended after case-by-case analysis.</td>
</tr>
<tr>
<td>• Pesticide: Chemical pesticides shall be discouraged. Instead organic pesticides and herbal medicines such as mahaua oil cake, soap and oil emulsion etc shall be used</td>
</tr>
</tbody>
</table>

2.7 Use of Bio resources in Fish Farming

2.7.1 The department shall propagate, in seasonal pond, aquaculture combined along with agriculture or animal husbandry for maximizing profit. Use of Bio resource\(^\text{a}\) shall be encouraged especially in farmers’ ponds and community tanks.

2.8 Management of Environment Hazards

2.8.1 The Department would train the fish farmers to tackle environmental hazards. Some of these are presented below:

- **Deficiency\(^{\text{b}}\) of Dissolved Oxygen:** The department shall undertake efforts to disseminate information about measures to avoid oxygen deficiency, through the extension machinery of the state.

---

\(a\) biological resources that are available in a particular area. During the PRA exercise the bioresource map of a village can be drawn and the resources can be tapped for mutual benefits.

\(b\) Causes and remedies of oxygen depletion in pond water are already known.
Appearance of algal Bloom: Algal bloom in fish ponds deteriorates the water quality and the aquatic environment. Some algal species can also produce toxins harmful to aquatic fauna. Algal bloom may appear due to i) eutrophication ii) High dose of fertilizers and feeds (Refer Box 1-3).

**Box 1-3: Some of The Strategies to Control Algal Bloom Are....**

- Application of fertilizers and feeds should be temporarily suspended.
- Surface bloom can be removed by dragging a small-mesh sized net.
- Chemicals such as CuSO₄, Diuron, H₂SO₄, Potash etc. can be applied to control bloom.
- The best way to control bloom is through biological means, i.e. through introduction of Silver carp fishes, which primarily feed on phytoplankton.

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**CLause 2.3.1 & 2.3.2**
Guidelines for Site Selection & Construction

**Clause 2.4**
Practices for Renovations

**Clause 2.5**
Practices for reclaiming derelict water bodies

**Clause 2.6**
Provision for providing License to fish farmers

**Clause 2.7.1**
Fish Species suitable for Cultivation

**Clause 2.7.2 & 2.7.3**
Provisions for culture of exotic species

**Clause 2.7.6**
Provisions of stocking Density

**Clause 2.7.7**
Criteria for selection of inputs

**Clause 2.8 & 2.9**
Uses of Bio Resources & Management of Env Hazards
# ANNEXURE ECP Fishery 2.1: PROJECT INFORMATION DOCUMENT

Farmers Pond and Community Tank Management

### Name of Individual/Committee

<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Block</th>
<th>Area</th>
</tr>
</thead>
</table>

1. Is the Pond a natural Waterbody or man-made tank  
   - Yes  
   - No

2. Will the operation include  
   - Construction of New tank  
   - Renovation of Existing Tank  
   - Renovation of Derelict Water body

3. In case of man made tank what was the original land use  
   - Low Lying Paddy field  
   - Others

4. Distance of the Facility from:  
   - i) Sensitive Location National parks,  
     - _____ m  
     - NA
   - Sanctuaries,  
     - _____ m  
     - NA
   - Ramsar sites,  
     - _____ m  
     - NA
   - Grade I Beels,  
     - _____ m  
     - NA
   - Biosphere reserves,  
     - _____ m  
     - NA
   - Classified Forests  
     - _____ m  
     - NA
   - Habitation  
     - _____ m  
     - NA
   - Water Channel  
     - _____ m  
     - NA

5. What are the fish species being stocked in the tank?  

6. Is exotic species being introduced in the tank?  
   - Yes  
   - No

7. What are precautionary measures being taken to avoid fish escape?(attach measures to be taken to prevent fish escape)

8. What is the source of the fish seed(Name, address and registration number of the Producer)

9. What are the feed that would be used?
ECP Fishery 3. Fish Seed Production Management

3.1 General

3.1.1 Quality fish seed is the basic input for aquaculture. Assam produced 2245.57 million fry during the year 1997-98 (Anon, 1998). Currently, more than 120 hatcheries are in operation in the state. However, one of the major constraints experienced in expanding aquaculture industry in the State is the non-availability of quality fish seeds. The urgent need therefore is to educate the fish seed producers on a planned breeding programme that produces quality fish seed rather than large quantities of unhealthy fish seeds (Das, 1997). This code of practice provides measures for quality fish seed production and management.

3.1.2 The ECP shall be applicable to all hatcheries requiring less than 40 kgs of brood fish and producing 10 million eggs in one batch, or else are categorised as projects with “Low Impacts” by the Environment cum Technical Officer. The categorisation of projects shall be based on information provided in the Project Information Document (Appendix ECP Fishery 3.1).

3.2 Legislations

3.2.1 The State Fisheries department, Govt. of Assam has recently adopted a policy of fish seed production industry. Based on this Fish Seed Rules, 2002 has been prepared. The legislation is basically to regulate the quality of the seeds produced at the hatcheries of the state. It has been prepared taking into consideration of the biodiversity and conservation issues.

3.3 Key Considerations in Fish Seed Production

The addressal of the concerns about Genetic deterioration, Large-scale mortality during the early stages, Use of Chemicals, Breeding of Nuisance Species calls in for an efficient planning and design of the fish seed production units, which is explained in the following sections.

3.3.1 The major components of a fish seed production unit are stocking ponds, brood fishpond, nursery tanks, actual hatchery unit, water supply system etc. The Fisheries Department based on the resources available and requirement of fish seeds shall carry out the choice of hatchery models for breeding of carps. For pond construction, engineering aspects such as slope, water system, and drainage needs to be considered.

3.3.2 Actual Hatchery Unit: Circular large-scale concrete hatchery model is the most commonly seen hatchery in Assam. This requires heavy investment and infrastructure as the capacity to breed fish in those hatchery is about 80-100 kg in one batch. The Fishery Department shall popularize small-scale hatchery model for the benefit of marginal fish farmers. The small-scale hatchery can be operated with less number of brood fish economically and this will further help in avoiding gene pool contamination. One such model is already available in Assam (Das, 2003).

1 Of late many developed & developing countries have become deeply concerned about the deteriorating quality of the hatchery produced fish seeds and are adopting stringent measures to improve the quality and to conserve the pure strains of indigenous fish species. Should the seed quality of the hatcheries get degraded beyond certain limits, the situation may go out of control which may not only adversely affect the aquaculture production but the entire aquatic ecosystem may be thrown out of gear and may head towards a severe ecological imbalance. Thorough investigation on the hatchery-produced seeds is the need of the hour to not only protect the native species and boost the aquaculture production but also to sustain the fish seed production industry in the state.

2 The Department of Fisheries, Govt. of Assam, in their recent report.

3 The act is yet to be implemented fully. Effectiveness will be known only after the department officials implement it.
3.3.3 Breeding Ponds: Breeding ponds are a component of a circular hatchery. The large-scale breeding pool size is about 6-8 meters in diameter and can be 1.0 mt deep. The tank shall have facilities to create artificial rain and river flow.

3.3.4 Rearing Tanks: The standard sizes of rearing and nursery tanks are already known. With consultation of fishery experts and engineers, the right type of earthen rearing or nursery tanks shall be constructed based on the requirement and resources available.

3.4 Planning of Breeding Program

3.4.1 Brood Stock: For production of quality fish seeds, the most important prerequisite is the proper size of brood fish. They require special care. They are stocked at low density and fed with high protein diet.

<table>
<thead>
<tr>
<th>Species</th>
<th>Recom. Wt. (in gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rohu</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Mrigal</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Catla</td>
<td>&gt;3000</td>
</tr>
<tr>
<td>Gonius</td>
<td>&gt;500</td>
</tr>
<tr>
<td>Silver Carp</td>
<td>&gt;1500</td>
</tr>
<tr>
<td>Grass Carp</td>
<td>&gt;2000</td>
</tr>
</tbody>
</table>

Individual selection of brood stock shall be on the basis of:
- Origin of Population
- Performance of the given strain (Refer Appendix ECP Fishery 3.2)
- Typical external characteristics of the species.

3.4.2 Apart from inbreeding, the other serious issues associated with the quality fish seed production and causing deterioration in the seed quality are:
- *Mixed spawning of fish practiced by the most seed producers:* If this continues, conservation of the native fish species shall be extremely difficult.
- *Induced breeding of undersized matured fish:* This is a very common practice in most hatcheries. This needs to be stopped to preserve the quality of fish seeds.
- Poor brood stock management and unplanned cross-breeding of different species.

Strategies to control deterioration of quality of fish seeds:
- Through massive awareness camps, the seed producers are to be educated.
- Local network to be formed to exchange brood stocks among the farmers members.
- Fish farmers should be motivated and educated to culture only the pure varieties of a particular fish species, say: Rohu, Mrigal, catla, Silver, Grass and Common carps. This practice initially shall be taken up by the department at one center, equipped with a good number of fishponds and hatchery. The institute at Amranga can be upgraded to a training and research center in quality fish seed production. The quality fish seed produced at the government farm shall be reared to the size of advanced fingerling for distribution to the farmer seed producers at a reasonable price, who will raise the stock for future brood fish.

3.4.3 The selective breeding programme shall involve raising of brood stock species wise collected from different rivers. This programme requires heavy investment and competent persons in the field of fish breeding & genetics.

3.4.4 The concerned personnel of the department of Fisheries shall be trained at CIFA before taking up such planned breeding project. Since the project needs heavy investment and infrastructures, from the conservation point of view, Indian major carps specially Rohu and Catla be selected for the selective breeding programme in the first phase. The fingerling/ brood fish shall be collected from rivers Brahmaputra, Ganges, and any other wild sources.

---

4 The leading institute, CIFA of ICAR, Bhubaneswar which has already developed a high yield variety of Rohu through selective breeding and other institutes working on ex-situ conservation of fish germplasm such as the NBFR, ICAR, Lucknow, CIFE, ICAR, Mumbai shall be consulted.
The samples of Rohu developed by the CIFA shall also be procured for breeding programme in Assam.

3.4.5 **Tagging and Marking:** Species collected from different sources will have to be marked and tagged (e.g.: fin clipping, M- procian blue dye, PIT tags etc) for identification. The marked fishes can be reared along with the farmed stock in a communal pond. The recommended stocking density of marked fingerling for raising as brood stock is about 1500kg /ha.

3.4.6 Approach for reduction of inbreeding and production of quality fish seed is already known. The system requires the formation of two or more distinct breeding lines. Brood stock generations are advanced by a systematic mating scheme in which females of each line are mated to males of different lines. Eggs for hatchery production shall be obtained from matings either within a single line or between lines. An opportunity for improving the breeding population is provided through selection of individual fish to be used in the production of the next brood stock generation.

3.5 **Operation & Maintenance**

3.5.1 Develop a team of dedicated departmental staff to be engaged in quality fish seed production and training of trainers. Regular maintenance of record on planned breeding programme is very much required for any stock improvement studies.

3.6 **Seed production of commercially important indigenous food fish species** There is a growing demand for supply of some of the commercially important native food fishes such as Chital, Magur, Singhi, Mystus etc. Although their breeding behaviour and the techniques of seed productions are known, yet farmer–proven commercial techniques are not available in the state. More research projects shall be funded to develop protocols for commercial breeding of these fishes under captive condition.

3.7 **Seed production of commercially important indigenous ornamental fish species**

3.7.1 The Department of Fisheries shall organise potential entrepreneurs to be trained on ornamental fish breeding for taking up this enterprise for livelihood.
Problems of Fish Seed Infrastructure and Breeding Aspect

Clause 3.3
Genetic deterioration due to negative selection of brood stock

Fish Seed Production Component and Design

Clause 3.4.1
Components of Fish seed production; Engineering Aspect of Pond Construction

Clause 3.4.2
Existing Hatchery Models are cost intensive; Introduction of Cost Effective Models

Clause 3.4.3
Components of Breeding Ponds and Facilities Provision

Clause 3.4.4
Standard sizes of Rearing Tank and Engineers & Fishery Expert inputs for innovations

Planning of Breeding Program and Operation of Production

Clause 3.5.1
Planning of Breeding Programs

Clause 3.5.2.1
Selective breeding programmes for quality brood stock with input from competent experts

Clause 3.5.2.2
Strategies to prevent deterioration of quality of fish seeds.
# APPENDIX ECP Fishery 3.1 PROJECT INFORMATION DOCUMENT

## Fish Seed Production Management

<table>
<thead>
<tr>
<th>Name of Individual/Committee</th>
<th>District</th>
<th>Block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Village</td>
<td>Area</td>
</tr>
</tbody>
</table>

Provide a location map of the area showing important landmarks and sensitive features.

1. **Size of Hatchery**
   - 1a. What is the number of eggs which can be produced in one batch
   - 1b. What is the number of brood stock in that is available
   - 1c. Number & types of ponds with size (sq.mt)

2. **Distance of the Facility from:**
   - i) Sensitive Location National parks,
   - ii) Sanctuaries,
   - iii) Ramsar sites,
   - iv) Grade I Beels,
   - v) Bio sphere reserves,
   - vi) Classified Forests
   - vii) Habitation
   - viii) Water Channel

3. Indicate fish species that are induced bred in your hatchery?

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>选中</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rohu</td>
<td>☐</td>
</tr>
<tr>
<td>Silver Carp</td>
<td>☐</td>
</tr>
<tr>
<td>Mrigal</td>
<td>☐</td>
</tr>
<tr>
<td>Common carp</td>
<td>☐</td>
</tr>
<tr>
<td>Catla</td>
<td>☐</td>
</tr>
<tr>
<td>Grass Carp</td>
<td>☐</td>
</tr>
<tr>
<td>Gonius</td>
<td>☐</td>
</tr>
<tr>
<td>Big head carp</td>
<td>☐</td>
</tr>
<tr>
<td>Clarias gariepinus (Thai sutchi magur)</td>
<td>☐</td>
</tr>
<tr>
<td>Pangasius</td>
<td>☐</td>
</tr>
<tr>
<td>Tilapia</td>
<td>☐</td>
</tr>
<tr>
<td>Other Species (Specify)</td>
<td>☐</td>
</tr>
</tbody>
</table>

4. **Acquiring Brood stock**
   - 4a. What is the amount of stock that would be acquired
   - 4b. What are the sources of brood stock collection (Attach details, Name of natural water/hatchery/farmer/organization with postal address, registration number (if any))

5. **Designing of Infrastructure**
   - 5a. What is the diameter of the spawning pool? (ft/m)
   - 5b. What is the source of the fish seed (Name, address and registration number of the Producer)
APPENDIX ECP FISHERY 3.2: ACTIONS TO ASSESS PERFORMANCE OF THE GIVEN STRAIN

The basic input for quality seed production in a hatchery is healthy brood fish. Initially, different strains of a fish should be collected from various source of origin. The fish seed produced form different strains at a hatchery should be marked and reared to the size of fingerling. Detailed study must be conducted on FCR (Food Conversion Ratio), growth, quantitative and qualitative characters etc. before selecting them to be reared as brood fish. (Figure 1.Performance Testing of Different strains)

Figure 1: Performance Testing of Different Strains

In a hatchery to maintain commercial fish population, two lines “A” & “B” would be ideal to keep simultaneously in closed groups with strict selection in each generation. Females can be selected from line “A” and males from Line “B” for providing brood fish to produce good quality seeds for commercial fish production. (Figure 3: Practical Approaches to overcome Inbreeding)

* Fish Seed: Quantity vs Quality – A practical Approach to Quality Fish Seed Production; S K Das, College of Fisheries, Assam Agriculture University, Raha, Nagoan, Assam, India;
Figure 2: Practical Approaches to overcome Inbreeding

**PARENTAL STOCK**

<table>
<thead>
<tr>
<th>Maternal line</th>
<th>Paternal line</th>
<th>For Hatchery operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>Select female from (A) and male from (B) for commercial seed production</td>
</tr>
</tbody>
</table>

I. 

<table>
<thead>
<tr>
<th>0+ 0'</th>
<th>0+ 0'</th>
<th>A+ x B</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>0+ 0'</td>
<td>0+ 0'</td>
<td>AB</td>
</tr>
</tbody>
</table>

II. 

<table>
<thead>
<tr>
<th>Pure line</th>
<th>Pure lines</th>
<th>Keep only male fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>To maintain pure lines keep only female fish by crossing among 30-40 individuals</td>
<td>Keep only male fish</td>
<td></td>
</tr>
</tbody>
</table>

Note: When we select females we have to make strict selection considering the following characters:
1. Largest individuals.
2. No abnormalities.
3. Hardness of fins.

(Never select brood fish from this stock)

1.1 General

1.1.1 As part of AACP, the Animal Husbandry and Veterinary Department proposes to (i) Strengthen Artificial Insemination activities, (ii) Improve the Institute of Veterinary Biological (iii) Improve Animal Health Care facilities and iv) encourage animal husbandry such as poultry, piggery and duckery. Wastes generated from Veterinary activities are hazardous and toxic and have a high potential for transmissions of diseases. These wastes comprise infections, and bio-medical waste materials include sharps (hypodermic needles, syringes). These constitute contamination risks and health hazards if allowed to mix with municipal wastes without proper treatment.

Animal husbandry such as poultry, piggery shall be encouraged. Waste generated form such facility shall have to be managed to prevent adverse impacts.

1.1.2 The Codes of practice shall be applicable to Veterinary facilities treating less than 3000 animals per annum and located more than 1km from National parks, Sanctuaries, Ramsar sites, grade I Beels, Bio sphere reserves, Classified Forests. Poultry activities with less than 1000 birds not located within National parks, Sanctuaries, Ramsar sites, grade I Beels, Bio sphere reserves, Classified Forests shall comply to the provision in this codes of practice. It shall also be applicable to facilities categorized as having "Low Impacts (L)" as per the information provided in the PID (Appendix ECP AH&VS 1.1)

1.1.3 This Code deals with Waste Management aspects in three parts namely,

- Part I Bio Medical Waste Management
- Part II Solid Waste Management
- Part III Liquid Waste Management

PART I: BIO MEDICAL WASTE MANAGEMENT

1.2 Regulations

1.2.1 The Ministry of Environment & Forests under Section 3 of the Environment Protection Act 1986 has promulgated the Bio-Medical Waste (Management and Handling) Rules, 1998. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form.

1.2.2 Wastes generated from Veterinary facilities are categorized as Bio-Medical Wastes under the Bio-Medical Waste (Management and Handling) Rules, 1998 that also provides guidelines for handling and management of these special categories of waste. The relevant Provisions of the Act are presented below.

<table>
<thead>
<tr>
<th>Bio-Medical Waste (Management and Handling) Rules, 1998</th>
<th>Sections 4 &amp; 5 : The Department or any other agency running the facility generating hazardous waste would be responsible to ensure that the hazardous wastes are handled, stored, managed and disposed without any adverse impacts.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Section 6 : The bio-medical waste would be segregated, packed, transported and stored as per the details provided.</td>
</tr>
<tr>
<td></td>
<td>Section 8 : The Department or any other agency would apply for authorization of handling such waste from the Pollution Control Board.</td>
</tr>
<tr>
<td></td>
<td>Section 12 : The Department or any other agency operating any of the facility should report to the Pollution Control board any accident due the collection handling and transportation.</td>
</tr>
</tbody>
</table>
1.3 Waste Categories

1.3.1 Biomedical Wastes have been classified under Schedule I of the Bio-Medical Waste (Management and Handling) Rules; 1998. Categories and disposal methods are described in Appendix ECP AH&VS 1.2.

1.4 Siting of Animal Veterinary Centre

1.4.1 Siting of the veterinary facilities shall be done as per the norms suggested in ECP Common 2: Building Activities.

1.5 Composition of Bio–Medical Wastes in Animal Husbandry

1.5.1 Components of bio-medical wastes generated by Veterinary Hospitals, Laboratories and Artificial Insemination Centres are:

- Animal tissues / organs, body parts
- Laboratory cultures, micro-organisms, toxins
- Sharps such as hypodermic needles, syringes, scalpels, broken glass
- Discarded medicines
- Dressings, bandages, plaster casts
- Tubes, catheters

1.6 Principles of Management of Bio–Medical Wastes

1.6.1 Management of bio-medical wastes requires special efforts and skills. Following are the necessary steps involved.

1. Segregation and labeling of different types of wastes in different categories as specified in the Schedules I and II (Refer Appendix ECP AH&VS 1.2 & 1.3) of the Bio-Medical Waste (Management and Handling) Rules 1998

2. Transportation of the segregated material for final treatment and disposal (Appendix ECP AH&VS 1.3)

3. Processing of different categories of wastes as per treatment options provided in Schedule I (Appendix ECP AH&VS 1.2)

1.7 Methods of Treatment and Disposal

1.7.1 Treatment and disposal of bio-medical wastes have been elaborated in Schedule I of the “Bio-Medical Waste (Management and handling) Rules 1998”. No single technology, can take care of all categories of bio-medical wastes. Following are some treatment options. (These are briefly described in Appendix ECP AH&VS 1.4: Treatment methods for Bio-Medical wastes)

(i) Autoclave treatment
(ii) Hydroclave treatment
(iii) Microwave treatment
(iv) Chemical disinfection and,
(v) Sanitary and secure land filling

Standards for treatment and disposal of bio-medical wastes by the above methods are provided in Appendix ECP AH&VS 1.5

1.7.2 Treatment of bio-medical wastes is expensive and it may be better to combine it with a common treatment facility for Bio-Medical Waste. However as no common facility exists, the Bio-medical wastes need to be disinfected as per the process in SCHEDULE I of Bio-Medical Waste (Management and handling) Rules 1998 and then disposed off with the Municipal Solid Waste. It may be noted that use of such common facility will be limited to final disposal only as these can not be mixed with municipal wastes without first converting them to non-hazardous state. The generator of the waste shall take steps as to avoid littering of waste and; delivery of the waste to the municipal collection system.
1.7.3 Non bio-degradable Bio-medical wastes such as sharps, hypodermic syringes, gloves, Al sheath etc shall be disinfected, shredded and then buried in Municipal Land fills. These may also be disposed in the pits for Compensatory afforestation program.

PART II: SOLID WASTE MANAGEMENT

1.8 Objectives

1.8.1 Non – hazardous solids wastes are also generated from on farm activities and are mainly organic in nature. Some quantities of inorganic material are also generated in minor quantity. The objective of solid waste management is to reduce the quantity of solid wastes disposed off on land by recovery of materials and energy from solid waste. The management has two aspects namely,

- Segregation of solid waste and
- Biodegradation of organic waste

1.8.2 The objective is also to provide treatment to solid wastes to such an extent, which will stabilize the decomposable organic matter and would not contaminate the surface and ground water. The issue is more pertinent in the context of terrains which have underground waters at shallow depths and which have steep slopes quickly draining storm waters in to rivers.

1.9 Legislations

1.9.1 Handling of solid wastes falls under the purview of “The Municipal Solid Waste (Management and Handling) Rules 2000 under notification dated 25th September 2000 by MoEF.

1.10 Wastes and its Constituents

1.10.1 Constituents of waste generated from on farm activities are presented in Table 1.2.

Table 1.2: Constituents of solid wastes expected from different units

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type of unit</th>
<th>Product / Activity</th>
<th>Constituents of wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pig Breeding Farms</td>
<td>Pigs for slaughtering</td>
<td>Pig excretions, fodder and rags</td>
</tr>
<tr>
<td>2.</td>
<td>Duckeries and Poultries</td>
<td>Raising of birds</td>
<td>Bird droppings, bird food and feathers</td>
</tr>
<tr>
<td>3.</td>
<td>Artificial Insemination Centres</td>
<td>Artificial insemination of animals</td>
<td>Glassware, syringes, needles, medical gloves and straws</td>
</tr>
</tbody>
</table>

In addition waste fodder, plastic bags and rags are expected to be generated.

1.11 Management Mechanisms

1.11.1 An effective Waste management system involves (a) Collection and segregation of raw solid wastes, (b) Transportation and, (c) Treatment including resource recovery through processing.

1.11.2 Constituents of wastes generated from farm activities are both organic and inorganic in nature. In addition, some wastes are also under the hazardous category which has already been discussed above. The first steps therefore consist of segregation of waste.

1.11.3 Segregation of waste: The objective of solid waste management is to reduce the quantity of solid waste by recovery of materials and energy from solid waste. It shall be the responsibility of the beneficiary operating such farm to recover maximum quantities of inorganic matter for the purpose of recycling. Plastic materials, polythene bags, glass, and packing materials of paper and other items, which can be recycled, shall be segregated, by sorting and sent for recycling.

1.11.4 Handling of Organic matter: For organic matters present in the wastes, controlled decomposition under aerobic or anaerobic conditions is one of the commonly adopted methods. Depending upon the situations wastes could also be disposed of through landfills.
1.11.5 Composting and Landfills are the common method of treatment depending upon the constituents of wastes from different processing units. There are however new processing technologies, which are becoming popular. In the context of units under ARIASP, it should be noted that one or more types of wastes may be produced from one unit. For example, some waste may be obtained from a veterinary hospital, with constituents similar to slaughter house. It will be appropriate to first (a) segregate wastes in each individual unit, (b) combine segregated wastes of same nature from different units of same nature and, (c) provide treatment. Following are the methods commonly adopted for treatment and disposal.

1.12 Composting

1.12.1 Animal husbandry facilities under ARIASP are generating wastes suitable for disposal by way of composting. Pig breeding farms produce wastes, which are decomposable under natural conditions.

1.12.2 Windrow composting which is done in open paved spaces under aerobic conditions can be adopted for decomposition of waste. As the bio degradable waste generation from these activities are of small quantity, composting is only viable option for waste disposal. These process is discussed briefly in Appendix ECP AH&VS 1.6.

PART III: LIQUID WASTES

1.13 Liquid Wastes from Pig Farms

1.13.1 Rural pig breeding farms also fall in the same category as cattle farms except that they are smaller in numbers. However wastewaters are generally not generated mainly because traditionally, pigs are not kept proper sheds like those for cattle.

1.13.2 In the urban sector however, maintenance of pig farms is more organized and quantities of wastewaters is not small. Collection and disposal therefore is a necessity.

1.14 Veterinary Hospitals

1.14.1 Normal activities in veterinary centres include delivery of calves and treatments of various ailments for animals. Presently most of these are carried out in the farm itself. Animals are brought to veterinary hospitals only for treatment of major ailments requiring surgeries or indoor treatment.

1.14.2 Small quantities of liquid wastes are generated during veterinary activities. Veterinary hospitals located in town areas discharge effluents into municipal wastewater disposal system. As surgeries are done in such hospitals wastewater may be hazardous and requires pre-treatment before disposal. It shall be the responsibility of the veterinary officer in charge of the Centre to ensure waste-water discharged from surgeries are disinfected before discharge into the Municipal Sewer. Veterinary activities carried out in villages are scattered and are at local farm level. Wastewaters generated during these activities do not pose major problems of disposal due to the reasons that (a) they are obtained once in a while (b) their volumes are small and (c) activity is scattered.

1.15 Veterinary laboratories

1.15.1 Veterinary laboratories involved in production of vaccines are located in urban centres. Waste water is generated mainly from cleaning, housekeeping and disinfecting activities washing of apparatus. Wastewater may also contain some chemicals due to washing of apparatus.

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* Decomposition and stabilisation of organic waste matter is a natural phenomenon. Composting is an organised method of producing compost manure through decomposition.
1.16 Artificial Insemination Centres

1.16.1 The scope of Artificial Insemination Centres (AIC) is also limited to both urban and rural areas. Artificial insemination is usually carried out by the staff visiting these farms. In the urban AIC, activity is concentrated at few places where animals are brought for the purpose. There is a likelihood of increase in this activity in the urban AICs. Insemination is a process, which does not involve much use of water except for washing purposes. Not much wastewater is therefore generated from the activity and the same when carried out in individual households; small quantity of wastewater is disposed off with other wastewaters. At the AIC, the quantity may be slightly higher due to concentration of the activity. Quality of wastewaters from AIC centres is similar to those from veterinary hospitals.

1.17 Treatment and disposal of Wastewaters

1.17.1 Wastewaters from animal farms and related establishments are usually mild and not very offensive\(^2\). These wastewaters have lower strengths as compared to municipal sewage as they contain animal excretions only. The BOD\(_5\) \(20^\circ\) C may vary between 120 to 150 mg/l. For wastewaters from facilities in urban centres no special treatments are required and they could be disposed off in the municipal disposal system. In the absence of municipal sewerage system, treatment will have to be provided to an extent which will render it suitable for discharge into rivers. Since the BOD of raw sewage is not high (up to 150), simple treatment method with medium efficiency such as oxidation ponds may be sufficient.

1.17.2 Wastewaters from laboratories may contain small quantities of chemicals and before disposal in to the sewerage system, pre-treatment should be provided as specified in Schedule I of Bio-medical Waste (Management and Handling) Rules 1998 of the Government of India as described in Part I. It shall be the responsibility of the District Veterinary Officer or Veterinary Officer in charge of the facility to ensure that waste water is disposed as per guidelines suggested above.

---

\(^2\) Wastewaters from veterinary hospitals, AIC centers and laboratories do not have high contents of organic matter and consequently the BOD may be less as compared to municipal sewage. This is subject to collection and removal of animal tissues and organs before they enter the sewerage system.
## ANNEXURE ECP AH&VS 1.1 PROJECT INFORMATION DOCUMENT
VETERINARY HOSPITAL/DISPENSARY/ARTIFICIAL INSEMINATION CENTRE

<table>
<thead>
<tr>
<th>District</th>
<th>Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village</td>
<td></td>
</tr>
</tbody>
</table>

### 1. Type of Facility
- Veterinary Hospital
- A I Centre
- Veterinary Laboratory
- Poultry Farm
- Piggery Farm

### 2. Distance of the Facility from:

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (m)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>National parks,</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Sanctuaries,</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Ramsar sites,</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Grade I Beels,</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Bio sphere reserves,</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Classified Forests</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Habitation</td>
<td>m</td>
<td>NA</td>
</tr>
<tr>
<td>Water Channel</td>
<td>m</td>
<td>NA</td>
</tr>
</tbody>
</table>

### 3. Scale of Operation

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Veterinary Hospital &amp; Artificial Insemination centre</td>
<td>nos of animals per annum</td>
</tr>
<tr>
<td>ii) Veterinary Laboratory</td>
<td>nos of vaccines produced</td>
</tr>
<tr>
<td>iii) Poultry Farm</td>
<td>nos of birds</td>
</tr>
<tr>
<td>iv) Piggery Farm</td>
<td>nos of animals</td>
</tr>
</tbody>
</table>

### 4. Area of the Facility

<table>
<thead>
<tr>
<th>Area in sqm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

### 5. Area for Waste storage identified

<table>
<thead>
<tr>
<th>Area in sqm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

### 6. Distance from the nearest water channel from waste storage facility

<table>
<thead>
<tr>
<th>Distance in m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

### 7. In case of Poultry Activity

#### i) Direction of the Settlement in relation to the proposed site

<table>
<thead>
<tr>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>NE</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>SE</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>SW</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>NW</td>
</tr>
</tbody>
</table>

#### ii) Normal direction of the wind

<table>
<thead>
<tr>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>NE</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>SE</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>SW</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>NW</td>
</tr>
</tbody>
</table>

#### iii) Direction of the wind during winter season

<table>
<thead>
<tr>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>NE</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>SE</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>SW</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>NW</td>
</tr>
</tbody>
</table>
## APPENDIX ECP AH&VS 1.2: CATEGORY WISE DISPOSAL METHODS OF BIO-MEDICAL WASTES

<table>
<thead>
<tr>
<th>Options</th>
<th>Waste Categories</th>
<th>Treatment and Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category No. 2</td>
<td>Animal Waste: Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood, experimental animals used in research, waste generated by veterinary hospitals, colleges, discharges from hospitals and animal houses</td>
<td>Incineration (without any chemical pretreatment) or deep burial</td>
</tr>
<tr>
<td>Category No. 3</td>
<td>Microbiology and Biotechnology waste: Wastes from laboratory cultures, stocks or specimens of microorganisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer cultures</td>
<td>Local autoclaving or Micro-waving or Incineration (without any chemical pretreatment)</td>
</tr>
<tr>
<td>Category No. 4</td>
<td>Waste Sharps: Needles, syringes, scalpels, blades, glass that may cause puncture and cuts. This includes both used and unused sharps</td>
<td>Disinfection by chemical treatment, Autoclaving, Microwaving and Mutilation shredding</td>
</tr>
<tr>
<td>Category No. 5</td>
<td>Discarded Medicines and Cytotoxic drugs: Wastes comprising of outdated, contaminated and discarded medicines</td>
<td>Incineration (without any chemical pretreatment) or Destruction and drugs disposal in secured landfills</td>
</tr>
<tr>
<td>Category No. 6</td>
<td>Solid Wastes: Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts and lines</td>
<td>Incineration (without any chemical pretreatment) or Autoclaving or Micro-waving</td>
</tr>
<tr>
<td>Category No. 7</td>
<td>Solid Wastes: Wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets</td>
<td>Disinfection by chemical treatment, Autoclaving, Micro-waving and Mutilation shredding</td>
</tr>
<tr>
<td>Category No. 8</td>
<td>Liquid Wastes: Wastes generated from laboratory washings, cleaning, housekeeping and disinfecting activities</td>
<td>Disinfection by chemical treatment (using 1% hypochlorite solution or equivalent reagent ensuring disinfection) and discharge in to drainage system</td>
</tr>
<tr>
<td>Category No. 9</td>
<td>Incinerator Ash: Ash from incinerator of bio-medical waste</td>
<td>Disposal in municipal landfill</td>
</tr>
<tr>
<td>Category No. 10</td>
<td>Chemical Waste: Chemicals used in production of biologicals and disinfections such as insecticides</td>
<td>Chemical treatment (using 1% hypochlorite solution or equivalent reagent ensuring disinfection) and discharge in to drains for liquids and landfills for solids</td>
</tr>
</tbody>
</table>
Appendix ECP AH&VS 1.3 LABEL FOR BIO-MEDICAL WASTE CONTAINERS/BAGS & TRANSPORT
SCHEDULE III
(see Rule 6)

Note: Label shall be non-washable and prominently visible.
SCHEDULE IV
(see Rule 6)
LABEL FOR TRANSPORT OF BIO-MEDICAL WASTE CONTAINERS/BAGS

Day .......... Month ..............
Year ..........
Date of generation ..............

Waste category No ........
Waste class
Waste description

Sender's Name & Address
Phone No ........
Telex No ....
Fax No ............
Contact Person ........

Receiver's Name & Address
Phone No ..............
Telex No ..............
Fax No ..............
Contact Person ........

In case of emergency please contact
Name & Address :

Phone No.

Note :
Label shall be non-washable and prominently visible.
APPENDIX ECP AH&VS 1.4-MANAGEMENT OF BIO-MEDICAL WASTE

(a) Autoclave treatment: This is a process of steam sterilization under pressure. In this process steam is brought in to direct contact with the waste material for duration sufficient for disinfections.

(b) Hydroclave treatment: This is also a steam sterilization process and an innovation over the autoclave. The equipment consists of a double walled container and the steam is injected into the outer chamber. The material is contained in the inner chamber and due to heat from steam, moisture content evaporates. Puddles inside slowly rotate material against steam heated walls and loses moisture. The treated material can then be shredded up.

(c) Microwave treatment: This is also a wet thermal disinfections system with the difference that instead of heating the entire chamber, microwave heats the targeted material from inside out, and provides a high level of disinfections.

(d) Chemical disinfections: This treatment is recommended for waste sharps, solid wastes and chemical wastes. Chemical treatment involves use of at least 1% hypochlorite solution or other equivalent chemical reagents with a minimum contact period of 30 minutes. Pre-shredding is recommended for better contact with the waste materials.

(e) Sanitary and secured land filling: Sanitary and secured land filling should be done under following circumstances.
   (i) Deep burial of animal parts where incineration is not available.
   (ii) Animal excretions
   (iii) Disposal of autoclaved wastes
   (iv) Disposal of incinerated ash
   (v) Disposal of sharps such as needles and syringes
Appendix ECP AH&VS 1.5: STANDARDS FOR TREATMENT AND DISPOSAL OF BIO-MEDICAL WASTES

SCHEDULE V

(see Rule 5 and Schedule 1)

1. STANDARDS FOR WASTE AUTOCLAVING:

The autoclave should be dedicated for the purposes of disinfecting and treating bio-medical waste,

(I) When operating a gravity flow autoclave, medical waste shall be subjected to:

(i) a temperature of not less than 121 °C and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or

(ii) a temperature of not less than 135 °C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or

(iii) a temperature of not less than 149 °C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

(II) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one pre-vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following:

(i) a temperature of not less than 121 °C and pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or

(ii) a temperature of not less than 135 °C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes;

(III) Medical waste shall not be considered properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature and pressure were reached during the autoclave process. If for any reasons, time temperature or pressure indicator indicates that the required temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

(IV) Recording of operational parameters

Each autoclave shall have graphic or computer recording devices, which will automatically, and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.

(V) Validation test

Spore testing:

The autoclave should completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be
Bacillus stearothermophilus spores using vials or spore Strips; with at least $1 \times 10^4$ spores per millilitre. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, regardless of temperature and pressure, a temperature less than 121°C or a pressure less than 15 psi.

(VI) Routine Test
A chemical indicator strip/tape the changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste package at different location to ensure that the inner content of the package has been adequately autoclaved

2. STANDARDS OF MICROWAVING
1 Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal car casses, body parts and large metal items.
2. The microwave system shall comply with the efficacy test/routine tests and a performance guarantee may be provided by the supplier before operation of the limit.
3. The microwave should completely and consistently kill the bacteria and other pathogenic organisms that is ensured by approved biological indicator at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be Bacillus Subtilis spores using vials or spore strips with at least $1 \times 10^4$ spores per millilitier.

3. STANDARDS FOR DEEP BURIAL
1. A pit or trench should he dug about 2 meters deep. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.
2. It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron/wire meshes may be used.
3. On each occasion, when wastes are added to the pit, a layer of 10 cm of soil shall be added to cover the wastes.
4. Burial must be performed under close and dedicated supervision.
5. The deep burial site should be relatively impermeable and no shallow well should be close to the site.
6. The pits should be distant from habitation, and sited so as to ensure that no contamination occurs of any surface water or ground water. The area should not be prone to flooding or erosion.
7. The location of the deep burial site will be authorised by the prescribed authority.
8. The institution shall maintain a record of all pits for deep burial.
APPENDIX ECP AH&VS 1.6-MANAGEMENT OF SOLID WASTE

(a) Vermi - composting
Vermi - composting involves stabilization of organic solid waste through earthworm consumption which converts the material into worm castings. It is a result of combined activity of microorganisms and earthworms. Microbial decomposition of biodegradable matter occurs through primary decomposition, whereas secondary decomposition occurs in the earthworm tract.

(b) Biogas from solid wastes
During the anaerobic decomposition of organic matter in the solid waste, a gaseous mixture of Methane and Carbon Dioxide known as biogas could be produced. The system is becoming popular in rural areas and more and more household or community level biogas plants are being installed. There are some drawbacks as well. These are described below:
- Emission of methane takes place from the waste storage
- Emission of gas takes place in the form of leaks from plant
- Contamination occurs from the disposal of digested matter
- Harmful emissions from burning of gas
- There are risks of fire and accidents
- There is the nuisance of flies and mosquitoes

(c) Conversion of solid wastes to protein
Experiments have established that under aerobic conditions, it is possible to convert the insoluble cellulose present in municipal solid waste to cellulytic bacteria. These bacteria are then harvested for use as protein. The process involves size reduction followed by a mild alkaline oxidation treatment before aerobic oxidation.
ECP Dairy 1. On Farm Waste Management

1.1 General

1.1.1 Rural farm project activities encourage formation of Diary Co-operatives and self help groups for increasing milk productions. During the activities, liquid waste, solid wastes and some quantities of Bio-medical wastes are generated. Current practices of waste disposal are unorganised resulting in environmental degradation of surface water bodies. This Code lays emphasis of proper practices of waste management and consists of two parts namely,

- Part I: Solid Waste Management
- Part II: Bio-Medical Waste Management

1.1.2 The ECP shall apply to all dairy farmers and professionals except for those having more than 15 hybrid animal or are located within 1 km of National Park, Sanctuaries, Ramsar sites and Reserved or classified forests. In addition, projects classified as having "Medium Impacts" based on the information furnished in the Project Information Document presented as Appendix Dairy 1.1.

PART I: SOLID WASTE MANAGEMENT

1.2 Siting of Dairy & Waste management Facility

1.2.1 The siting guidelines for dairy farm are presented in ECP Common2: Building Activities.

1.3 Waste & its Constituents

1.3.1 Constituents of Waste generated from on farm activities are Animal excretions, fodder, plastic bags etc. Animal excretion is a major constituent of the waste and other components are only generated in small quantity.

1.4 Waste Management System

1.4.1 An effective Waste management system involves (a) Collection of raw solid wastes, (b) Biodegradation of organic waste

1.5 Collection of Solid Waste

1.5.1 The beneficiary shall ensure that maximum quantity of solid waste is collected and stored in an area that it does not flow into any drainage channel or water body.

In case of large dairy¹ to estimate capacity of the solid waste storage facility was required is presented in Box 1-1.

Box 1-1: Sizing a Dairy Waste Storage Facility...

i) Multiply the suggested² daily excretion per animal by the number of animals on the farm to determine daily waste storage volume required.

ii) Multiply the total daily storage volume by the required storage duration (90 to 120 days) to obtain the total storage capacity required. This calculation is shown in Example below.

EXAMPLE

Assumptions: 15 milking cow herd producing 200 kg waste per day, waste storage facility to be roofed desire 4 months (120 days) storage

¹ Dairy with less than 5 cattle head will be considered as small dairy. Dairy with 5-15 cattle head shall be considered as medium dairy, large dairy have more than 15 cattle head
On Farm Waste Management

(Daily Waste Production) x Storage Period = Total Waste Production Requiring Storage
200kg/day x 120 days = 24000 kg
Converting to Imperial units (24000 kg x 35.3 ft$^3$)/(1000kg) = 850 ft$^3$ say 850 cubic feet

1.5.2 A management measures required for storage of waste in areas where rainfall is more than 800 mm or water table is below 20 m precautions are as follows:
- Long term storage by stockpiling wastes on direct ground is not recommended
- located at least 20 m from any surface water body or any drinking water source;
- covered during the monsoon season/rains to prevent runoffs

1.5.3 It is recommended for small and medium dairy earthen storage structure while for large dairy concrete storage structures shall be used for storage. The details of each of the structure are presented in Box 1-2.

**Box 1-2: Storage of Waste from Farm...**

*Earthen Storages.* Earthen storages are for semi-solid manure storage should in addition to the criteria specified in Clause 1.6.2 the following criteria should be:
- Structurally sound
- have an impervious floor
- be lined with an impervious material.

*Concrete Storages.* Storages built with concrete structure should in addition to the criteria in Clause 1.6.2:
- structurally sound
- have reinforced concrete walls;
- have a concrete floor which is sealed to the walls;
- be constructed entirely above ground to minimize seepage of groundwater into the structure;
- be roofed to keep out rain; and
- be well ventilated

1.5.4 Odour Control: To control offensive odour the following measures shall be adopted:
- Handle solid Manure in as dry state as possible
- Remove wet manure and feed from dairy building as soon as possible
- Water from floor washing should not be allowed to stagnate.

1.6 Technique of Disposal of Waste

1.6.1 The matrix below presents area required for different treatment methods for different categories of dairy farmers. The Details of the methods of treatment of waste are presented as Appendix ECP Dairy 1.3

<table>
<thead>
<tr>
<th>Type of Cow</th>
<th>Area Per Cow (sq m)</th>
<th>Area (ha)</th>
<th>Area Required (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>70</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Medium</td>
<td>70-200</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Large</td>
<td>200-400</td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

1.7 Storage and Disposal of Waste in Peri-urban³ Dairies

1.7.1 Peri-Urban dairies can be classified as large dairies. Shortage of space is common in almost all peri-urban dairies. The premise accommodates the stalls for cattle, storage areas for feeds and also housing quarters for the proprietor, workers and family. Waste generated is dumped

---

² As per the standards for a farm unit of 3 cattle heads 40 kg of solid waste is generated per day.
³ Dairies located in the periphery of Class I towns and Class II towns as decided by the respective urban authority or development authority.
into sewer lines. Pre-requisites for inclusion of large and medium peri-urban dairies are presented in BOX 1.3

- Shall not be located upwind to any settlement
- Shall not be located in low lying area
- Shall be located at least 50 m from any natural water body or any drainage channel or drinking water source
- Shall have adequate space for housing of cattle
- Shall construct concrete waste storage of appropriate capacity as described above
- Shall have designated storage area for storage of feed and fodder away from milking area or the residential area.
- Shall have adequate supply of clean drinking water.
- Shall have separate storage area for feed, animals.
- Residential quarters shall not be used as storage facilities and shall be at a minimum distance of 15 from any of the facility.
- Shall have adequate access facility.

**PART II: BIO-MEDICAL SOLID WASTE MANAGEMENT**

1.8 General

1.8.1 Bio – Medical Wastes from the on farm activities are generated during Veterinary activities carried out at the farm level. Visits of Veterinary Doctors to cattle farms and small dairy farms in rural areas for treatment of minor ailments of animals are common. Artificial insemination is also carried out at the farm and straws etc generated are disposed along with ordinary refuse at the farm. Placenta obtained as a result of calf delivery at farm itself is also buried nearby. Animal treatments result in generation of wastes consisting of viols, syringes etc which are usually dumped in the backyard along with other refuse. Present practice of primary treatment of waste at farm is not sufficient.

1.9 Legislations

1.9.1 The Ministry of Environment & Forest under Section 3 of the Environment Protection Act 1986 has promulgated the Bio-Medical Waste (Management and Handling) Rules, 1998. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form. The relevant Provisions of the Act are presented in Box 1-5.

**Box 1-5: Bio-Medical Waste (Management and Handling) Rules, 1998**

*Sections 4 & 5: The Department or any other agency running the facility generating hazardous waste would be responsible to ensure that the hazardous wastes are handled, stored, managed and disposed without any adverse impacts.*

*Section 6: The bio-medical waste would be segregated, packed, transported and stored as per the details provided.*

*Section 8: The Department or any other agency would apply for authorization of the handling such waste from the Pollution Control Board.*

*Section 12: The Department or any other agency operating any of the facility should report to the Pollution Control board any accident due the collection handling and transportation.*

1.10 Waste Categories

1.10.1 Biomedical Wastes have been classified under Schedule I of the Bio-Medical Waste (Management and Handling) Rules; 1998. Categories and disposal methods are Appendix ECP Dairy 1.2
1.10.2 Components of bio-medical wastes generated by on farm activities include, (i) Placenta, (ii) Sharps such as hypodermic needles, syringes, scalpels and broken glass, (iii) Viols of used and discarded medicines and, (iv) Dressings, bandages and plaster casts.

1.11 Methods of Treatment and Disposal

1.11.1 Wastes generated on farms are of two categories namely (i) Decomposable matter such as placenta, body parts and organs of animals and (ii) Non-biodegradable wastes like needles, syringes etc.

- Decomposable wastes are to be treated in 1% hypo chlorite solution and buried on site as per the Schedule V of Bio medical waste handling rules 1998.
- The non-biodegradable wastes can be disinfected on site and disposed. Alternatively, it can be carried to the AI center and disposed off at the common disposal point as per Schedule I of Bio Medical waste and handling rules 1998

1.11.2 Segregation of Waste: The beneficiary shall ensure Segregation and labelling of different types of wastes in different categories as specified in the Schedules I and II of the Bio-Medical Waste (Management and Handling) Rules 1998

1.11.3 Treatment of Waste: For on farm dairy producers, incineration of farm medical waste is not possible. The farmers or AI officers shall consider the following:

- The placenta of the animals shall be disposed on site through a deep burial by disinfecting it in 1% hypochlorite solution.
- The Sharps such as hypodermic needles, syringes, scalpels and broken glass shall be disinfected and reduced in surface area through shredding. The waste is then disposed on site by the farmers or shall be carried by the AI officers to the AI centres and disposed at common disposal point. The disinfected and shredded material can be put in the pit of the plant during the afforestation programs.
- The farmers shall dispose viols of used and discarded medicines after disinfecting. If the quantum of the discarded medicines and viols is more than 20-25kg per month the AI officers shall suggest the assistance for the appropriate and safe disposal.

1.11.4 The dressings, bandages and plaster casts generated on farm shall be disinfected and then disposed.

- The Directorate of Dairy Development and Department of Animal Husbandry and Veterinary Sciences shall educate farmers on about the adverse impacts of present system and the benefits of the proposed systems. The users are also to be informed about: that adopting the disposal system with biogas production would attract subsidy from the Government of India.
- Methods of disinfecting and disposing bio-medical waste.
APPENDIX ECP DAIRY 1.1 PROJECT INFORMATION DOCUMENT
DAIRY FARM AND WASTE MANAGEMENT

Name of Individual/Committee

<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Block</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provide a location map of the area showing important landmarks and sensitive features.

1. **Size of Hatchery**
   1a. Number of Hybrid Cattle
   1b. Number of local breed cattle?
   1c. Area of the Dairy farm?

2. **Distance of the Facility from:**
   i) Sensitive Location National parks, Sanctuaries, Ramsar sites, Grade I Beels, Bio sphere reserves, Classified Forests, Habitation, Water Channel, Natural Water body

<table>
<thead>
<tr>
<th>Distance</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m</td>
</tr>
<tr>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

**Prevalent Wind Direction**

<table>
<thead>
<tr>
<th>Direction of the Settlement in relation to the proposed site</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Normal direction of the wind**

<table>
<thead>
<tr>
<th>Direction of the wind during winter season</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Distance of waste storage facility from natural waterbody**

<table>
<thead>
<tr>
<th>Discharge point of liquid waste generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>River/ stream</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX ECP DAIRY 1.2: CATEGORY WISE DISPOSAL METHODS OF BIO-MEDICAL WASTES

<table>
<thead>
<tr>
<th>Options</th>
<th>Waste Categories</th>
<th>Treatment and Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category No. 2</td>
<td>Animal Waste: Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood, experimental animals used in research, waste generated by veterinary hospitals, colleges, discharges from hospitals and animal houses</td>
<td>Incineration (without any chemical pretreatment) or deep burial</td>
</tr>
<tr>
<td>Category No. 4</td>
<td>Waste Sharps: Needles, syringes, scalpels, blades, glass that may cause puncture and cuts. This includes both used and unused sharps</td>
<td>Disinfection by chemical treatment, Autoclaving, Microwaving and Mutilation shredding</td>
</tr>
<tr>
<td>Category No. 5</td>
<td>Discarded Medicines and Cytotoxic drugs: Wastes comprising of outdated, contaminated and discarded medicines</td>
<td>Incineration (without any chemical pretreatment) or Destruction and drugs disposal in secured landfills</td>
</tr>
<tr>
<td>Category No. 6</td>
<td>Solid Wastes: Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts and lines</td>
<td>Incineration (without any chemical pretreatment) or Autoclaving or Microwaving</td>
</tr>
<tr>
<td>Category No. 7</td>
<td>Solid Wastes: Wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets</td>
<td>Disinfection by chemical treatment, Autoclaving, Microwaving and Mutilation shredding</td>
</tr>
</tbody>
</table>
Appendix ECP Dairy 1.3: Methods of Treatment of Solid Waste

**Composting:** The compost can be prepared in the concrete or earthen tank. The size of tank shall be 3ft wide, 2.0-3.0ft high and 5ft in length (length is a variable parameter and can vary depending upon availability of raw materials) (Figure 1-1). The methods of preparation of compost are as follows:

- The available bio wastes are to be collected in the storage tank and allowed to decompose in the aerobic conditions by rotating it 2 to 3 times a day.
- Sprinkling of water should be done as and when necessary to maintain 70-80% moisture content.
- Provision of a shed is essential to prevent entry of rain water and direct sunshine.
- Sprinkling of water should be stopped when 80-90 per cent bio wastes is decomposed. Maturity could be judged visually by observing the formation of granular structure of the compost at the surface of tank.

**Vermicomposting:** The compost can be prepared in concrete tank. The size of the tank should be 3ft wide, 1.5-2.0ft high and 5ft in length. Figure 1-2 shows the plan and section of the compost site and compost pit. The methods for preparation of compost are as follows:

- The available bio wastes are to be collected and heaped under sun for about 7 to 10 days and chopped if necessary.
- Sprinkling of cow dung slurry to the heap may also be done.
- A thin layer of surface soil/sand (1-2 inch) is to be placed at the bottom of the tank.
- Fine bedding material such as partially decomposed cow dung/ dried leaves etc are to be placed over the soil or sand layer.
- Place the chopped weed biomass and partially decomposed cow dung layer wise (10-20 cm thickness) in the tank. The bio waste and cow dung ratio should be 60:40 on dry weight basis.
- Release about 2-3kg earthworms of efficient species like eisenia foetida, Amyanthes diffringens, Eurdillus eugineae etc over the mixture.
- Dry straw or thatch is to be placed over the compost
- Sprinkling of water should be done as and when necessary to maintain 70-80% moisture content.
- Provision of a shed is essential to prevent entry of rain water and direct sunshine.
- Sprinkling of water should be stopped when 80-90 per cent bio wastes is decomposed. Maturity could be judged visually by observing the formation of granular structure of the compost at the surface of tank.

**Bio-Gas:** Organic matter, such as cow dung, crop residue and kitchen waste is fermented in the absence of oxygen, biogas is generated which contains combustible methane (around 60% ) along with carbon dioxide, and traces of other gases. The slurry of biogas plant after the gas is produced, can be used as an organic manure in the fields to augment soil fertility. Thus, biogas technology produces fuel as well as fertilizer, while only one of these is possible if dung is used in its original form.

Biogas production is a chemical process occurring in stages during which different bacteria act upon the organic matter resulting in the formation of methane and acids. The main factors that influence biogas production are:

- **pH** (level of acidity) of the feedstock: It is well established that a biogas plant works optimally at pH level of 7 or just above (neutral solution)
- **temperature**: a temperature of around 35° C. In low temperatures, bacteria activity slows down resulting in substantial decrease in gas generation, ceasing completely below 10°C.
Carbon-nitrogen ratio of the feed material: should be in the range of 20:1 to 30:1. Cowdung has a C-N ratio of 25:1 and is considered ideal for maximum gas production.

**Solid concentration in the feed material** is also crucial to ensure sufficient gas production, as well as easy mixing and handling; 8-10% of total solids is the normal value required.

Cowdung has a solid concentration of about 20% and therefore, it is recommended that dung and water are mixed in a 1:1 ratio to attain the desired level of solids. One kilogram of dung produces about 40 litres of biogas. A family size biogas plant (two cubic meters) requires 50 kg of dung and equal amount of water to produce 2000 litre of gas per day.

**Hydraulic Retention time (HRT)** is the most important factor governing the size of the Bio-Gas Plant. In India, the different HRTs are recommended for three different temperature zones.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Average ambient temperature</th>
<th>HRT (days)</th>
<th>Approximate regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&gt;20°C</td>
<td>30</td>
<td>Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu, Pondicherry and Andaman &amp; Nicobar Islands</td>
</tr>
<tr>
<td>II</td>
<td>15-20°C</td>
<td>40</td>
<td>Bihar, Gujrat, Haryana, Jammu region of J&amp;K, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal</td>
</tr>
<tr>
<td>III</td>
<td>&lt;15°C</td>
<td>55</td>
<td>Himachal Pradesh, North-eastern states, Sikkim, Kashmir region of J&amp;K, and hill districts of UP</td>
</tr>
</tbody>
</table>

*the number of days the feed material is required to remain in the digester to begin gas production is defined as the Hydraulic Retention time, which in turn determines the cost of the plant; the larger the retention period, higher the construction cost.
2.1 General

2.1.1 The Directorate of Dairy Development envisages implementation of following projects as part of AACP, (i) Organization of Self Help Groups/District Co-operative Societies for dairy farming in the most potential districts of Assam, (ii) Strengthening of milk testing laboratories, processing and marketing of milk and, (iii) Capacity building through increased awareness, information dissemination, training to officers and implementation of a Management Information System. There are adverse impacts from the proposed projects due to the activities such as processing of dairy products, slaughtering and processing of meat. This code of practice shall provide information on the methods of treatment and disposal of wastes from these processing plants. It shall also provide inputs on the selection of the appropriate treatment methods. Detailed designs for the same however shall have to be done on a case-to-case basis.

PART I: LIQUID WASTE MANAGEMENT

2.2 Legislations

2.2.1 Provision of the Legislations and Government orders that are applicable to the processing plants are detailed in table 2.1.

Table 2.1: Relevant Legislations for Processing Plants

<table>
<thead>
<tr>
<th>Relevant Acts</th>
<th>Briefs of Provisions in Acts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (Prevention &amp; Control of Pollution) Act, 1974</td>
<td>Section 25 &amp; 26: Provisions for obtaining consent to establish and operate</td>
</tr>
<tr>
<td>Air (Prevention and control of pollution) Act 1981</td>
<td>Section 22: Provisions for obtaining consent to establish and operate any unit emitting air pollutants</td>
</tr>
<tr>
<td>The Environment (Protection) Act 1986</td>
<td>Section 7: Person or industry carrying out operation shall not allow emission or discharge of environmental pollutant in excess of the standards</td>
</tr>
<tr>
<td>Bio-medical Wastes (Management &amp; Handling) Rules 1998</td>
<td>Section 8: Person handling hazardous substances to comply with procedural safeguards</td>
</tr>
<tr>
<td></td>
<td>Section 8: The operator of the meat processing plant will obtain consent for operation</td>
</tr>
</tbody>
</table>

2.3 Standards of Discharge

2.3.1 Process effluents must be treated according to the standards as specified in Schedule II of the Environment Protection Rules 1986. The effluent standards are shown in Table 2.2.
Table 2.2: Effluent Standards for Dairy and Meat Processing Facilities as per Environment Protection Act 1986

<table>
<thead>
<tr>
<th>Industry</th>
<th>Parameter</th>
<th>Standard (mg/l)</th>
<th>Quantum per product Processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>pH</td>
<td>6.5-8.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOD (_{1}^1) at 20° C</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suspended Solids(_{2}^2)</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil &amp; Grease</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waste Water</td>
<td>-</td>
<td>3 m(^3) per KL of milk</td>
</tr>
</tbody>
</table>

**Meat Processing**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Parameter</th>
<th>Standard (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Meat form</td>
<td>BOD (_{1}^1) at 20° C</td>
<td>30</td>
</tr>
<tr>
<td>Slaughter House</td>
<td>Suspended Solids(_{2}^2)</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Oil &amp; Grease</td>
<td>10</td>
</tr>
</tbody>
</table>

2.4 Wastewaters and their Constituents

2.4.1 Liquid wastes in dairy processing result from (a) rinsing and washing of cans, tanks or drums, equipment, pipelines and floors and, (b) overflows, spillage and leakages from pumps and equipment. Effluents obtained from washing are sometimes alkaline due to use of washing soda or detergents.

2.4.2 Quantities of effluent generated vary\(^3\) depending on the process adopted for treating and packaging milk. The effluents are high in dissolved organic matter, mainly protein fat and lactose that are not easily digested. Strengths of these wastes depend upon types of processing and method of collection. Grease and fats are generated in the form of wastes but they are usually collected in traps inside the dairy plant only and used for other purposes.

Milk processing units may have a high concentration of wastes with pH of 7.5, BOD 1000, COD 2500, total solids 2000 and suspended solids up to 700.

2.4.3 Abattoirs and meat processing units generate effluents from washing of (i) livestock (ii) trucks carrying live animal and carcass, (iii) carcasses, (iv) equipment and process areas. Rate of water consumption could vary from 2000 to 15000 litres per tonne of live carcass weight. Abattoir effluents contain high levels of organic matter due to presence of manure, blood and fat. The most significant contributor to organic load is blood followed by fat.

Sometimes small quantities of effluents may also be obtained from boiler houses, water softening plants or cooling plants. Processing plants generate wastes of different strengths. Strength ranges of these are indicated in Table 2.3.

---

1. BOD may be made stringent upto 30 mg/l if the recipient fresh water body is a source of drinking water supply. BOD shall be upto 350 mg/l for chilling plant for applying on land provided land is designed and operated as a secondary treatment with suitable monitoring facilities. Drainage water from land after secondary treatment has to satisfy a limit of 30 mg/l of BOD and 10 mg/l of nitrates expressed as 'N'. The net addition to ground water quality should not be than 3 mg/l of BOD and 3 mg/l of nitrate expressed as 'N'. This limit for applying on land is allowed subject to availability of adequate land for discharge under control of industry. BOD value is relaxable upto 350 mg/l, provided waste water is discharged into town sewer leading to secondary treatment of sewage.

2. Suspended solid limit is relaxable upto 450 mg/l, provided the waste water is discharged into town sewer leading to secondary treatment of the sewage.

3. Quantities of effluents from dairies in India vary from about 6 to 10 litres per litre of milk processed depending upon process used, though in efficiently run plants abroad, these quantities are known to be smaller (1.3 to 2.5 litres / kg of milk intake).
Table 2.3: Strengths of Waste Water from Processing Plants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mixed Species Dairy Processing</th>
<th>Abattoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD (mg/l)</td>
<td>1000 - 3000</td>
<td>2500</td>
</tr>
<tr>
<td>Suspended Solids (mg/l)</td>
<td>400 - 800</td>
<td>700</td>
</tr>
<tr>
<td>Total Nitrogen (mg/l)</td>
<td>&lt;300</td>
<td>100</td>
</tr>
<tr>
<td>Total Phosphorous (mg/l)</td>
<td>&lt;10</td>
<td>30</td>
</tr>
<tr>
<td>Oil &amp; Grease (fat) (mg/I)</td>
<td>&lt;350</td>
<td>150</td>
</tr>
<tr>
<td>PH</td>
<td>7 - 8.5</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Source: Cleaner Production Assessment in Meat Processing, Cleaner Production Assessment in Dairy Processing, UNEP.

2.5 Inventorization of Wastes

2.5.1 For planning a wastewater disposal system, initially an inventory of effluent characteristics and topographic information is required.

**Effluent Characteristics:** Quantities of wastewater and variations of flow shall be required. Projections of flow quantities shall have to be made for the design period. In case of existing units samples of effluents from various units shall have to be collected and analysed. Separate and composite samples during lean and peak flows shall be required for this purpose to correctly determine the organic and other loads.

**Topographical Information:** These include collection of topographical hydraulic and other information. Topographical surveys need to be carried out for determining appropriate location of the plant which would also decide whether wastewaters from different units will flow in to the treatment plant by gravity or pumping. These surveys will also help in identification of the route and point of ultimate disposal of treated effluent.

2.6 Options of Treatment

2.6.1 Options of treatment of wastewaters from dairy or meat processing plant are limited because strengths of these are high and discharge standards are stringent. The choice narrows down further in Assam, as possibility of disposal of effluents on land after treatment is rare. The reasons are, (i) rainfall occurs for almost for 8 months during which treated effluent can not be utilized for irrigation and, (ii) existence of large number of streams which will wash away any treated effluents disposed off on land and quickly pass these to the rivers. In all probabilities therefore, treated effluents are likely to flow in to the rivers. Thus application of the effluents on land shall not be feasible. Treatment therefore must be provided to meet discharge standards specified above.

2.7 Consent to Establish and Operate

2.7.1 The operator of the plant shall obtain consent to establish and operate the effluent treatment plant under the provisions of Water (Prevention & Control of Pollution) Act, 1974. Forms for applying for Consents under the Water (prevention and Control of Pollution ) Act 1974 is presented as Appendix ECP Dairy 2.1)

2.8 Selection of treatment method

2.8.1 Selection of effluent treatment system shall be undertaken by a technically qualified person e.g environment engineer.

2.8.2 Wastewaters obtained from dairy or meat-processing units shall require primary and secondary treatments. These wastes do not contain toxic and heavy metals and compounds and as such tertiary treatment for their removal is not required. Operations and functions of different units during the treatment operations are summarized in Table 2.4.
Table 2.4: Unit Processes and devices for Treatment of Wastewaters

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Operations</th>
<th>Units</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Treatments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Screening</td>
<td>Screens</td>
<td>Removal of floating and suspended matter</td>
</tr>
<tr>
<td>2.</td>
<td>Grit removal</td>
<td>Grit chamber</td>
<td>Removal of inorganic suspended solids</td>
</tr>
<tr>
<td>3.</td>
<td>Primary Sedimentations</td>
<td>Primary Sedimentation Tanks</td>
<td>Removal of organic and inorganic settleable solids</td>
</tr>
<tr>
<td><strong>Secondary Treatments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (a)</td>
<td>Aerobic biological suspended growth processes</td>
<td>Activated sludge process units, waste stabilization ponds, aerated lagoons</td>
<td>Conversion of colloidal, dissolved and residual suspended organic matter in to settleable biofloc and stable inorganics</td>
</tr>
<tr>
<td>4 (b)</td>
<td>Aerobic biological attached growth processes</td>
<td>Trickling filter, rotating biological contactor</td>
<td>Conversion of colloidal, dissolved and residual suspended organic matter in to settleable biofloc and stable inorganics</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic biological growth processes</td>
<td>Anaerobic filters and reactors, fluid bed submerged media, upflow anaerobic sludge blanket reactor, anaerobic rotating biological contactor</td>
<td>Conversion of colloidal, dissolved and residual suspended organic matter in to settleable biofloc and stable inorganics</td>
</tr>
<tr>
<td>6</td>
<td>Anaerobic stabilization of organic sludges</td>
<td>Anaerobic digesters</td>
<td>Conversion of colloidal, dissolved and residual suspended organic matter in to settleable biofloc and stable inorganics</td>
</tr>
</tbody>
</table>

2.8.3 Wastewaters from dairy or meat processing units can be treated by any of the processes based upon (a) Conventional Activated Sludge Process, (b) Extended Aeration Process, (c) Trickling Filters, (d) Stabilization Ponds (e) Aerated Lagoons and (f) Upflow Anaerobic Sludge Blanket Process. Details of each of these methods are presented in Appendix ECP Dairy 2.2. However options for treatment shall not be restricted exclusively only to the following systems, other cost effective methods shall also be analysed.

Selection of the type of treatment of waste has to be very carefully made considering all factors. Discharge standards must be adhered to very strictly for safeguarding the interests of population living downstream. The selection of treatment methods shall be influenced factors presented in Box 2.1.

**Box 2.1: Selection of treatment methods**

1. Strength of raw effluent: The first and foremost step would be to get the wastewater analyzed for different quality parameters
2. Efficiency of treatment
3. Standards of effluent discharge
4. Availability of sewerage system
5. Capital, Operation & Maintenance costs of treatment plants: For the selected options, land costs, capital costs of plants including all civil, electrical and mechanical works should be taken in to account. Expenditure on power, staff, operation and maintenance should be capitalized over a period of 15 years to arrive at the most economic alternative
6. Power requirement

Because of the high strength of process effluent, treatment process will have to be highly efficient. While making a selection out of the available processes, Capital and O & M costs will also have to be given due weighatges. Operational costs are substantially influenced by consumption of power. Efficiencies of different types of treatment are presented in Table 2.5.
Table 2.5: Efficiencies of different types of treatment processes

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Types of treatment</th>
<th>Efficiency</th>
<th>Coliform removal (%)</th>
<th>Helminth removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BOD&lt;sub&gt;5&lt;/sub&gt; 20&lt;sup&gt;0&lt;/sup&gt; C removal (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Activated Sludge process</td>
<td>85 – 92</td>
<td>60 – 90</td>
<td>No</td>
</tr>
<tr>
<td>2.</td>
<td>Extended aeration</td>
<td>95 – 98</td>
<td>60 – 90</td>
<td>No</td>
</tr>
<tr>
<td>3.</td>
<td>Trickling filters</td>
<td>80 – 90</td>
<td>60 – 90</td>
<td>No</td>
</tr>
<tr>
<td>4.</td>
<td>Oxidation ponds</td>
<td>75 – 85</td>
<td>60 – 99.9</td>
<td>Yes</td>
</tr>
<tr>
<td>5.</td>
<td>Aerated lagoons</td>
<td>75 – 85</td>
<td>60 – 90</td>
<td>No</td>
</tr>
<tr>
<td>6.</td>
<td>UASBs</td>
<td>75 – 85</td>
<td>60 – 90</td>
<td>Yes</td>
</tr>
</tbody>
</table>

2.8.4 Treatment systems have to be tailor made for each processing plant. Box 2.2 presents criteria for selection of treatment process.

- Quality parameters: The first and foremost step would be to get the wastewater analyzed for different quality parameters.
- End use of treated effluent: Simultaneously, mode of end use of treated effluent should be decided. These two factors would narrow down the choice to a few types of treatment.
- Costs: For the selected options, land costs, capital costs of plants including all civil, electrical and mechanical works should be taken into account. Expenditure on power, staff, operation and maintenance should be capitalized over a period of 15 years to arrive at the most economic alternative.

2.9 Siting Criteria for processing plants

2.9.1 Dairy and meat processing and abattoirs are a nuisance to the humans in terms of sight and odour. Odour can be a serious problem in meat processing if by-products and effluent streams are not managed properly. These units must be located sufficiently away from habitation and in the downwind direction of the predominant wind direction.

Manoeuvring of trucks delivering livestock and removing by-products cause nuisance. Therefore, it is also necessary that such units should not be located along common road networks. Another important criteria is availability of proper sites for treatment and disposal of liquid and solid wastes. These potential problems therefore should be taken into consideration when determining plant location.

2.10 Siting criteria for treatment plants

2.10.1 There are several factors, which are taken into consideration while deciding the location of treatment plant. Some of the important considerations include the following.

- Distances from the waste discharging units: While keeping a minimum distance between the point of waste disposal from the unit and the treatment plant will be preferred, nuisance value of the plant has to be kept in mind.
- Elevation of ground: Location of a treatment plant should be decided keeping in view that it should neither be high so as to warrant pumping, nor low involving lifting of treated effluent. Too much depth has a bearing on the cost of civil structures also.
- Area not susceptible to flooding: While location of treatment plant at lower points will be preferred to facilitate gravity system, land area should be chosen carefully and areas prone to flooding during rainy season shall be avoided.
- Proximity to land available for irrigation: If end use of treated effluent is proposed to be land irrigation, proximity of agricultural land will always be preferable.
- Proximity to water body such as river or lake: Proximity of the treatment plant to a water body will lead to discharge of treated effluent directly into that body. Ideally, the plant should be
located at such point which will allow treated effluent to be applied for land irrigation and surplus quantity shall be passed in to the water body.

- **Safe distance from human population**: All treatment plants, irrespective of type of treatment process, have some nuisance value. Foul odours and fly breeding are some of the common problems near treatment plants and therefore these should be located sufficiently away from human settlements.

- **Ground water conditions**: Aeration tanks, primary and final settling units are usually 3.5 to 4 metres deep. Treatment plants should therefore be avoided at locations where water table is above the bed levels of units of treatment plants.

## 2.11 Minimization of Wastes

### 2.11.1 Capacities of treatment plants are based on hydraulic and biological loads received from the processing plants. Increased quantities of these loads mean increased capacities of the treatment processes. The increased capacities result in increased capital costs and additional operation and maintenance costs. Every effort should therefore be made to reduce quantities of wastes from the processing units.

In dairy and meat processing units, water is used principally for cleaning equipment and work areas to maintain hygienic conditions.

- Consumption of water in dairy processing depends upon whether the plant operates on batch process or continuous process. Effluents from dairy processing result from tanker washing, cleaning and milk spills.

- In case of abattoirs, it is estimated that more than 2 % of the carcass weight is unaccounted for and is lost to the effluent resulting in increase in hydraulic and organic loads. As such it is necessary that such by products are not allowed to pass with effluents. They shall rather be collected and used for alternate purposes. Some of the by products and their alternate uses are, edible offal could be used for human consumption, blood for pharmaceuticals and food additives, inedible fats for industrial products such as tyres, lubricants.

### 2.11.2 Thus it is paramount that quantity of water used in processing is optimised. There are several steps possible for reducing quantities of wastewaters in Dairy and meat processing units and abattoirs. Every effort should be made for reuse and recycling of wash water. Some of the important options for reducing wastewaters are presented in Box 2.3.

<table>
<thead>
<tr>
<th>Box 2.3: Methods of reducing wastes from Dairy Processing and Meat Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use continuous rather than batch processing as far as possible</td>
</tr>
<tr>
<td>Use water for cleaning purposes at high pressure rather than high volume for cleaning</td>
</tr>
<tr>
<td>Reuse relatively clean wastewaters (such as from final rinses) for other cleaning in non critical applications.</td>
</tr>
<tr>
<td>Recirculate water used in non critical applications</td>
</tr>
<tr>
<td>Use compressed air instead of water where appropriate</td>
</tr>
<tr>
<td>Fix leaks promptly</td>
</tr>
<tr>
<td>Dry clean floors before washing</td>
</tr>
<tr>
<td>Ensure that vessels and pipes are drained completely and use implements to remove residues before washing</td>
</tr>
<tr>
<td>Spilled solid products should be collected for reprocessing or animal feeds.</td>
</tr>
<tr>
<td>Product spillage should be avoided at the time of disconnecting pipes and hoses. It should be ensured that the lines are empty when disconnecting hoses.</td>
</tr>
<tr>
<td>Appropriate facilities for collecting spills should be provided.</td>
</tr>
<tr>
<td>Tanks should be equipped with levels to prevent overflows.</td>
</tr>
<tr>
<td>Concentrated milky wastewater could be collected for reprocessing or supply to farmers for animal feeds.</td>
</tr>
<tr>
<td>Fit drains with screens or traps to prevent solid materials entering effluent system</td>
</tr>
</tbody>
</table>

---

4 Efficiently run dairy plants can use 1.3 to 2.5 litres of water per kg of milk intake.
2.12 Designing of treatment systems

2.12.1 A short description of the key considerations for the design of various units is presented in Appendix ECP Dairy 2.3. Moreover proposed solution for wastewater disposal from Animal Husbandry units in Guwahati and other smaller towns are presented in Appendix ECP Dairy 2.4.

2.13 Construction and Maintenance

2.13.1 Wastewater treatment plants comprise construction of civil structures, installation of mechanical equipment such as bar screens, grit lifting pumps, gears, aeration, sludge scrapers, sludge pumps and electrical motors and switchgears. For detailed guidelines, Codes of Practices for civil works, mechanical and electrical installations shall be referred.

2.14 Guidelines for Construction for Civil Works

2.14.1 These sections have been detailed in ECP Common 2: Codes of Practice for Building Activities.

2.15 Guidelines for erection of Mechanical and Electrical equipment

2.15.1 These sections have been detailed in ECP Common 2: Codes of Practice for Building Activities.

2.16 Guidelines for Maintenance

2.16.1 Maintenance of treatment plant mainly implies that all mechanical and electrical installations shall be maintained by taking appropriate steps in advance, to prevent breakdown before a major damage is caused. This would avoid wastage of time, production loss and prolong the life of machine. It also maintains better efficiency in the system and economizes the running cost. Maintenance could be preventive or corrective depending upon whether it is done prior or after the damage.

2.16.2 It should be borne in mind that primary aim of effluent treatment plant operation is its working and maintenance efficiently and economically so that treated effluent meets the prescribed standards. The basic requirements of successful operation and maintenance of effluent treatment plants are presented in Box 2.4.

**Box 2.4: Basic requirements O&M**

- A thorough knowledge of plant and machinery provided and their functions
- A thorough knowledge of process
- Availability of proper and adequate tools, spare parts and chemicals
- Clear assignment of responsibilities to operating staff
- Systematic inspections
- Staff adequately trained in operations and maintenance
- Observation of safety precautions

2.16.3 Monitoring of raw effluents, air, recirculated sludge and treated effluent are necessary for efficient running of the plant. Proper recording of data is also essential. Current trends are that routine operation is entrusted to private agencies on contract agencies. The operating agency whether governmental or private, has to carryout certain routine operations as:
- **Maintenance of performance records:** The data sheets for recording performance should be designed to enable evaluation of same with the objective of improving performance and reduction in operating costs by saving in energy, if possible.

- **Manuals of operation:** Manuals of operation are generally supplied by the plant designers and builders. They must include all aspects namely (i) Operational procedures and testing schedules, (ii) Preventive maintenance aspects and (iii) Maintenance of records.

- **Control Laboratory:** The laboratory plays a key role in plant operation for control of quality. It is also necessary that representative sampling is done from properly located points on a regular basis. Procedures described in "Standard methods for examination of water and wastewater" or "Manual of methods for examination of water, effluent and industrial wastes" should be followed. Care should be taken to avoid entry of extraneous materials such as silt or floating materials.

- Physical tests are carried out on raw effluent to determine total suspended and dissolved solids. Chemical tests are performed to determine pH, BOD, COD, nitrogen and phosphates. From primary sedimentation tanks, influent and effluent are analyzed for SS, settleable solids, BOD and COD. Primary sludge is analyzed for percent solids, organic content and specific gravity. Influent and effluent BOD, COD, DO, MLSS, SVI are determined from samples from aeration tanks. Effluents are also analyzed from secondary settling tanks for SS, settleable solids, filtered and unfiltered BOD, COD, DO, alkalinity and nitrates.

2.17 Training

2.17.1 Proper training for all categories of staff is vital for efficient performance of the plant. Each category of staff has different duties and accordingly they should (i) understand their specific roles regarding waste management (ii) comply with the policy decisions taken by management and (iii) contribute to the success of overall waste management plan in their establishment. Training modules should be developed for the following category of personnel.

- Operators of electrical and Mechanical machinery
- Laboratory staff monitoring influent and effluent qualities
- Cleaning staff for removal of screened materials and grit
- Administrative and management staff

2.17.2 For plant operators and laboratory personnel, the training capsule should include:

- Discussion regarding existing standards supply of copies to each individual
- Review of impacts of improper management
- Discussion regarding policy of the establishment
- Detailed description of each step involved
- Measures for accidents and emergency situations
- Comments and suggestions for subsequent inclusion for betterment of system

2.17.3 For sweepers, cleaning staff and guards, sustained awareness generation is essential. The management of the establishment should organize awareness programmes especially for the auxiliary staff. The capsule should include:

- Awareness generation about possibilities of infectious wastes and diseases caused
- Brief introduction of rules governing handling of wastes
- Providing simple charts of responsibilities and cautioning against pit falls
- Educating them how to cope up with accidents
- Maintaining personal hygiene in the environment, importance of use of protective gear
- How to cooperate with management in the matter
PART II: SOLID WASTE MANAGEMENT

2.18 General

2.18.1 Solid waste generated in processing plant from the receiving of material and thereafter at every step in the process. The objective of solid waste management is to (i) reduce the quantity of solid waste generated (ii) segregate & recycle of materials recovered from solid waste, (iii) dispose off on land as per the methods of disposing municipal solid waste. The objective is also to provide treatment to solid wastes to such an extent which will stabilize the decomposable organic matter and would not contaminate the surface and ground water. The issue is more pertinent in the context of terrains which have underground waters at shallow depths and which have steep slopes quickly draining storm waters into rivers.

2.19 Legislations


2.20 Wastes and its Constituents

2.20.1 Under the AACP, following types of wastes are expected to be generated.
  - **Industrial wastes:** Such as wastes from milk processing plants.
  - **Thermal plants wastes:** Such as wastes from boilers.
  - **Other wastes:** Such as garbage and rubbish from plant complex.

2.20.2 General categories of solid wastes are those which are organic and inorganic in nature and which could be treated and disposed off by normal processes. Different types of wastes, which are to be generated from various units under the Dairy Department, are presented in Table 2.6.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type of unit</th>
<th>Product / Activity</th>
<th>Constituents of wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk Processing</td>
<td>Pasteurized Milk, yogurt, cheese, paneer</td>
<td>Plastic bags, rags, grease, detergents, grit and sand</td>
</tr>
<tr>
<td>Units</td>
<td>Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Slaughter Houses</td>
<td>Varieties of meat</td>
<td>Animal excretions, blood, hair, paunch manure, flesh, grease and offal</td>
</tr>
</tbody>
</table>

2.21 Management Of Wastes

2.21.1 An effective waste management system shall include one or more of the following options and shall be environmentally and economically sustainable. The options for Disposal of the solid waste generated are:
  - Segregation and recycling
  - Disposal of waste along with the Municipal Collection System

2.21.2 **Segregation and recycling:** The operator of the plant shall ensure that wastes are sorted at source to recover most of recyclable materials for reuse. Following are some of the guidelines for sorting for material recovery.
  - Sorting of waste at the source must be accorded the highest priority. For this purpose the existing system of Kabaroes shall be promoted.
  - Horticulture waste from parks and gardens may be composted at the site.
2.21.3 **Disposal of waste along with the Municipal Collection System:** The residual waste shall be stored to avoid littering of the neighbouring areas and disposed along with the municipal solid waste system. In case of absence of such system the operator along with the local body shall promote a collection & disposal system for the municipal waste generated from the facility.

**PART III: BIO-MEDICAL WASTE MANAGEMENT**

2.22 **General**

2.22.1 Wastes generated from slaughter houses are hazardous and toxic and have a high potential for diseases transmissions. The wastes generated out of these facilities are categorised as Bio-Medical Waste under the Bio-Medical Waste (Management and Handling) Rules, 1998. The codes provide a system for handling and management of these special categories of waste.

2.23 **Legislations**

2.23.1 The Ministry of Environment & Forest under Section 3 of the Environment Protection Act 1986 had promulgated the Bio-Medical Waste (Management and Handling) Rules, 1998. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form. The relevant Provisions of the Act are presented below.

<table>
<thead>
<tr>
<th>Bio-Medical Waste (Management and Handling) Rules, 1998</th>
<th>Section 4 &amp; 5: The department or any other agency running the facility generating hazardous waste would be responsible to ensure that the hazardous wastes are handled, stored, managed &amp; disposed without any adverse impacts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 6: The bio-medical waste would be segregated, packed, transported and stored as per the details provided</td>
<td></td>
</tr>
<tr>
<td>Section 8: The department or any other agency would apply for authorization of the handling such waste from the Pollution Control Board.</td>
<td></td>
</tr>
<tr>
<td>Section 12: The department or any other agency operating any of the facility should report to the Pollution Control board any accident due the collection, handling &amp; transportation</td>
<td></td>
</tr>
</tbody>
</table>

2.24 **Categories of Wastes**

2.24.1 The Biomedical Wastes have been classified under Schedule I of the Bio-Medical Waste (Management and Handling) Rules, 1998. Various types of Bio – Medical Wastes. The relevant details in Appendix ECP DAIRY 2.5.

2.25 **Treatment of Slaughter House Wastes**

2.25.1 The solution to safe disposal of slaughterhouse waste does not lie only in treatment. Measures such as collection of blood, improved methods of dressing, evisceration could reduce the magnitude of treatment. Slaughtering of animals generates wastes such as non-edible offal namely the intestines, tissues organs and body parts. Stomach and intestinal contents and dung are also received as liquid wastes. All these types of wastes are required to be disposed off by methods such as rendering, deep burial, composting and anaerobic digestion. Methods of treatment of Slaughter house wastes are described in

**Table 2-1: Treatment of Slaughter house waste.**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type of Slaughterhouse Waste</th>
<th>Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Waste consisting of inedible offals, animal tissues, organs, body parts, carcasses</td>
<td>Rendering or land fill</td>
</tr>
<tr>
<td>2.</td>
<td>Stomach or Intestinal contents, dungs</td>
<td>Composting, Land filling</td>
</tr>
<tr>
<td>3.</td>
<td>Sludge from waste water treatment systems</td>
<td>Composting, Landfill</td>
</tr>
</tbody>
</table>
The methods of treatment of landfill operation for slaughter house waste is provided as Appendix ECP Dairy 2.6.

2.25.2 Illegal slaughtering also needs to be curbed as the problem is much widespread. All slaughtering should be confined to slaughterhouses only. Following is the schedule IV attached with the Environment Protection Act 1986 containing guidelines for disposal of solid wastes from slaughterhouses.

2.25.3 Utilization of by products received during slaughtering also helps in reduction of wastes. There are a few other Guidelines available relating to slaughterhouses. The IS Code 8895: 1978 specifies requirements for handling, storage and transport of slaughterhouse by products (refer Appendix ECP Dairy 2.6).

<table>
<thead>
<tr>
<th>Clause 2.5</th>
<th>Surveys &amp; Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 2.6, 2.8, 2.9, 2.10</td>
<td>Criteria for Selection of treatment Methodology &amp; Location of ETP</td>
</tr>
<tr>
<td>Clause 2.7</td>
<td>Consent to Establish</td>
</tr>
<tr>
<td>Clause 2.9</td>
<td>Sitting of Plant</td>
</tr>
<tr>
<td>Clause 2.10.2</td>
<td>Minimization of Waste</td>
</tr>
<tr>
<td>Clause 2.12</td>
<td>Description of Designs</td>
</tr>
<tr>
<td>Clause 2.13, 2.14, 2.15</td>
<td>Guidelines for Construction of Civil &amp; Electrical Equipments</td>
</tr>
<tr>
<td>Clause 2.16</td>
<td>Guidelines for Maintenance</td>
</tr>
<tr>
<td>Clause 2.17</td>
<td>Treatment of Waste</td>
</tr>
<tr>
<td>Clause 2.21.2</td>
<td>Segregation &amp; Recycling</td>
</tr>
<tr>
<td>Clause 2.21.3</td>
<td>Disposal along with MSW</td>
</tr>
<tr>
<td>Clause 2.25</td>
<td>Treatment of Waste</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Clause 2.22</th>
<th>Consent to Establish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 2.23</td>
<td>Consent to Operate</td>
</tr>
<tr>
<td>Clause 2.24</td>
<td>Treatment of Waste</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Clause 2.11</th>
<th>Consent from Pollution Control Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 2.18</td>
<td>Treatment of Waste</td>
</tr>
<tr>
<td>Clause 2.19</td>
<td>Disposal along with MSW</td>
</tr>
<tr>
<td>Clause 2.20</td>
<td>Treatment of Waste</td>
</tr>
</tbody>
</table>
Appendix ECP 2.1: Application for Consent to Establish and Operate

\textbf{FORM XIII}

Application for consent for establishing or taking any steps for establishment of Industry operation process or any treatment disposal system for discharge, continuation of discharge under section 25 or section 26 of the Water (Prevention and Control of Pollution) Act, 1974.

(See Rule 32)

Date __________________________

From

________________________________________

________________________________________

To

The Member Secretary,

Central Pollution Control Board.

Sir,

I/We hereby apply for Consent/Renewal of Consent under section 25 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) for establishing or taking any steps for establishment of Industry/operation process or ally treatment/disposal system to bring into use any new/changed outlet for discharge of *sewage/trade effluent* to continue to discharge* sewage/trade effluent* from land/premises owned by ________________.

The other relevant details are below:

I. Full Name of the applicant __________________________

II. Nationality of the applicant __________________________

III. (a) Individual

(b) Proprietary concern

(c) Partnership firm

(whether registered or unregistered)

(d) Joint family concern

(e) Private Limited Company

(f) Public Limited Company

(g) Government Company

(1) State Government

(2) Central Government

(3) Union Territory

(h) Foreign Company

(if a foreign company, the details of registration, incorporation, etc.).

(i) Any other Association or Body
4. Name, Address and Telephone Nos. of Applicant.

(b) Licence Annual Capacity of the Factory/Industry.


12. (a) State the daily maximum quantity of effluents quantity and mode of disposal (sewer or drains or river). Also attach analysis report of the effluents. Type of effluent quantity in kilolitres Mode of disposal.

(i) Domestic

(ii) Industrial.

(b) Quality of effluent currently being the discharged or expected to be discharged.

(c) What monitoring arrangement is currently there or proposed.

13. Slate whether you have any treatment plant for industrial? domestic or combined effluents.

Yes/No

If yes attach the description of the process of treatment in brief. Attach information on the quality of treated effluent vis-a-vis the standards.


Description ............. Quantity ............. Method ............. Method of disposal

15. I/We further declare that the information furnished above is correct to the best of my/our knowledge.

16. I/We hereby submit that in case of change either of the point of discharge or the quantity of discharge or its quality a fresh application for CONSENT shall be made and until such CONSENT is granted no change shall be made.

17. I/We hereby agree to submit to the Central Board an application for renewal of consent one month in advance of the date of expiry of the consented period for outlet/discharge if to be continued thereafter.

18. I/We, undertake to furnish any other information within one month or its being called by the Central Board.

19. I/We, enclose herewith cash receipt No./bank draft No. ............. dated ......... for Rs. .................. Rupee .................. (in favour of the Central Pollution Control Board, New Delhi, as fees payable under section 25 of the Act.

Yours faithfully,

Signature of the applicant

Note: * Strike out which is not relevant.
Annexure ECP Dairy 2.2: Description of Treatment Methods

A. Conventional Activated Sludge Process

The Activated Sludge Process (ASP) is widely used in wastewater treatment. After screening and grit removal, suspended organic matter is allowed to settle in a primary settler which removes about 30% to 35% BOD. It is then passed to aeration tanks where biological aeration takes place and the dissolved organic matter is converted into settleable form. The settleable solids are removed by settling in the final settling tank placed next. The aerated sludge is called "Activated" part of which is pumped back into the aeration tank. Remaining sludge is withdrawn and mixed with sludge from the primary settler, thickened and sent to anaerobic sludge digester for further stabilization. The digested sludge is dried on drying beds. The process though has a high efficiency but may not be successful where raw effluent BOD is very high and treated effluent has to meet river standards. The process flow diagram is given in figure 1.

![Figure 1: Process Flow Diagram](image)

B. Extended Aeration Process

The Extended Aeration Process is a modification of the Activated Sludge Process (ASP). The process does not have primary settler and the raw effluent is passed directly to aeration tanks. There is no anaerobic sludge digester as well. The simplification implies longer aeration time and hence named as extended aeration. The consequent power consumption is therefore higher. The process has a high BOD removal efficiency and suitable for treatment of wastes with high strengths. The process flow diagram is given in figure 2.

![Figure 2: Process Flow Diagram](image)

C. Trickling Filters

Aeration tanks in an Activated Sludge Process could be replaced by trickling filters, which provide aerobic biological process with attached growth. The applied effluent trickles through the filter medium, which gets coated with a zoogical film. Suspended solids are removed through filtration and colloidal matter is adsorbed. Since air is present, aerobic bacteria work upon the suspended, colloidal and dissolved organic matter and brings about a reduction in BOD. The process does not have a high efficiency and may not be successful where raw effluent BOD is very high and treated effluent has to meet river standards. A typical section of a trickling filter is shown in figure 3.

![Figure 3: Trickling Filter Diagram](image)
D. Waste Stabilization Ponds

Treatment through Waste stabilization ponds is one of the simplest methods. The stabilization takes place in shallow (1 to 1.5 m deep) algal ponds. Wastewater is allowed to stand for several days depending upon temperature and climatic conditions under which algae can flourish and provide oxygen through photosynthesis. Algal growth is therefore important for meeting the oxygen demand and it depends on surface area, which becomes an important design parameter. Therefore the pond requires large land area. The process has a low BOD removal efficiency. A typical cross section of an oxidation pond is given in figure 4.

E. Mechanically Aerated Lagoons

Aerated lagoons fall in the category of stabilization ponds in which oxygen is also supplied through mechanical or pneumatic aeration. Such ponds may have greater depths (3 to 5 m) consequently reducing land area. However Power requirement is more or less within the same range as that in ASP. The process has a low BOD removal efficiency. Sometimes combination of lagoons and ponds could also be made depending upon way of handling solids. Types of aerated lagoons could be classified as (a) Facultative, (b) aerobic and (c) aerobic with recycling of solids. The way solids are handled, there will be an effect on efficiency, power consumption, detention time and sludge disposal. The system with recycling of solids requires maximum power but also has a slightly higher efficiency of BOD removal as compared to oxidation ponds.
F. Upflow Anaerobic Sludge Blanket Process

Flow in an Upflow Anaerobic Sludge Blanket process (UASB) is passed in to a distribution inlet from which several vertical pipes take the flow down to the UASB reactor with a depth of 4.5 to 5 metres and release it uniformly to the lower part. This is allowed to rise at the desired velocity up to outlet placed at the upper periphery. The upflowing effluent forms small granules of sludge which are held in suspension and provide a large surface area on which organic matter can attach and undergo biodegradation. The gas could be collected at top. The unit does not require mixers or aerators and thus power consumption is low. The process does not have a high efficiency and may not be successful where raw effluent BOD is very high and treated effluent has to meet river standards. A typical cross section of a UASB plant is given in figure 5.
Annexure ECP Dairy 2.3: Criterion for designing of treatment plants

Cost is one of the prime considerations in selection of the treatment method. It should include the capital cost of installation, capitalized cost of maintenance and operation taking in to account interest charges and period of amortization. Other factors that may also influence are, ease of construction and maintenance, benefits that accrue from better environmental sanitation, location, topography and availability of land. Designs of various units should be carried out in following manner.

(a) **Screens**: Sizes of the screens should be provided which would pass effluent flows in all conditions. Principal function is to prevent entry of floating matter like logs, timber, carcasses, rags or plastic bags brought in by flowing effluent. Bar screens are composed of vertical or inclined bars spaced at equal intervals across the channel through which effluent flows. Screens are comprised of coarse, medium and fine screens placed in series. Cleaning may be manually operated although mechanically cleaned racks are also used. Spacing of bars in screens is decided on the criteria of velocity of flow and head loss. Screened materials are disposed off by burial or composting. Such disposal could also be by way of mixing with municipal refuse.

(b) **Grit Removal**: Grit in effluent consists of coarse particles of sand, ash, and many inorganic inert materials. Quantities and qualities of grit depend upon types of surfaces cleaned, climatic conditions, amount of storm water entering, sewer slopes, industrial wastes and social habits. Specific gravity of grit is between 2.4 to 2.6 and hence it is possible to separate gritty material from organic solids by differential sedimentation in a grit chamber or channel. Cleaning of settled grit may be manual or mechanical. Grit contents may vary between 0.05 to 0.15 m³/m³ and quantity may increase 3 to 4 times during peak flows. Size of a grit channel is determined by way of reducing the velocity of flow sufficient enough to allow particles of 0.22 to 0.15 mm to settle. A loss of head of about 0.6 m occurs in the grit channel. As settled grit consist of inorganic matter, disposal may be by way of landfill or burial.

(c) **Primary settling**: The purpose of primary settling is to separate the settleable solids from wastewater so that when discharged in to water courses or on land, decomposition does not take place. Primary settling also reduces organic load on secondary units. Primary settling tanks are designed for average flow conditions and factors such as flow variations, solids concentration, solid loading, area, detention time and overflow rate influence the designs. Parameters usually adopted are given in the table.

<table>
<thead>
<tr>
<th>Type of settling</th>
<th>Overflow rate</th>
<th>Detention time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m³/m²d</td>
<td></td>
</tr>
<tr>
<td>Primary settling only</td>
<td>Average 25 : 50 Peak 50 : 60</td>
<td>Depth 2.5 : 3.5 Hours 2.0 : 2.5</td>
</tr>
<tr>
<td>Primary followed by secondary settling</td>
<td>Average 35 : 50 Peak 80 : 120</td>
<td>Depth 2.5 : 3.5 --</td>
</tr>
<tr>
<td>Primary with activated sludge return</td>
<td>Average 25 : 35 Peak 50 : 60</td>
<td>Depth 3.5 : 4.5 --</td>
</tr>
</tbody>
</table>

Weir loading rates of 125 m³/d.m for average flow are recommended. Sludge is usually removed hydrostatically or mechanically. To facilitate this hopper bottom tanks are provided with mechanical sludge scrapping.

(d) **Aeration Tank**: In all aerobic suspended growth systems, aeration tanks containing microorganisms in suspension are provided in which the reaction takes place and oxygen is transferred. The design consideration for activated sludge process or other aerobic treatment plants are based on the aeration tank capacity, dimensions, aeration facility, secondary settling and recycled and excess sludge wasting. Aeration tank capacity is designed from Food : Microorganism ratio (F/M), Mixed Liquor Suspended Solids concentration (MLSS), Hydraulic Retention time (HRT) and Oxygen required in kg per kg of BOD removed. These are shown in the table II for both the conventional as well as extended Aeration process.

<table>
<thead>
<tr>
<th>Process Type</th>
<th>MLSS mg/l</th>
<th>F/M BOD/kg MLSS</th>
<th>HRT</th>
<th>Kg O₂/kg BOD removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>1500 : 3000</td>
<td>0.3 : 0.4</td>
<td>4.6</td>
<td>0.8 : 1.0</td>
</tr>
<tr>
<td>Extended Aeration</td>
<td>3000 : 5000</td>
<td>0.1 : 0.18</td>
<td>12 : 24</td>
<td>1.0 : 1.2</td>
</tr>
</tbody>
</table>

Supply of oxygen could be by introduction of compressed air or surface aerators.
(e) **Secondary Settling**: The Secondary Settling Tank has the function similar to the primary settling tank. The unit however, is an important and integral part of treatment process, as it facilitates efficient separation of biological sludge not only for ensuring final effluent quality, but also for return of sludge for maintaining MLSS level in the aeration tank. Since secondary settling tank is sensitive to fluctuations in the flow rates, it will be desirable to design it not only for average flows but also for peak flows.

(f) **Return Sludge pumping and Excess sludge wasting**: The MLSS concentration in aeration tank is controlled by sludge recirculation rate, sludge settleability and thickening. Pumping rates of sludge may therefore vary and pumping rates should be split in order to satisfy different rates. For the purpose of maintaining MLSS in the system, excess sludge has to be wasted. The excess sludge is pumped on to sludge drying beds where sludge after drying could be disposed off in the form of cakes.

Annexure ECP Dairy 2.4: Proposed solution for wastewater disposal from Animal Husbandry units in Guwahati and other smaller towns

It has been noticed that the milk processing plant and other units of the Animal Husbandry Department at Guwahati, lack proper collection and treatment facilities for waste water. As has already been discussed earlier, it would be preferable to connect waste waters from all units to the sewerage system after treating it to standards suitable for discharge in to sewers. Sewerage system does not exist in Guwahati or other places where such Animal Husbandry units are situated. This is a typical situation due to the following reasons.

(a) Waste waters are being generated from most of the units in small or large quantities.

(b) System for proper treatment and safe disposal does not exist at present, as required under the Control of Water Pollution Act. Providing treatment as required under the Act would not only be expensive, successful operation and maintenance of treatment plants will be difficult.

(c) It is not possible to discharge these waste waters in to a municipal sewerage system which does not exist.

(d) New sewerage system is not foreseen in near future. It can not be denied that improper waste treatment and disposal systems are not only causing insanitary conditions, they are sources of health hazard to workers and humans living and working within the premises. A solution therefore has to be found which could address the present problems, is viable and economical and which could dovetail with the ultimate system as and when it is developed. Following approach is recommended.

(e) Instead of providing separate treatment arrangements for different units such as dairy, laboratory, pig farm and slaughter house, a common treatment plant should be provided at an appropriate location. It should be noted that costs of small and scattered units of treatment plants are higher than a combined and properly located plant. It also saves cost on staff. If there are single units existing, as may be the case in some other towns, treatment units will have to be provided for those individual units.

(f) The different units in Guwahati should be made to connect waste water discharges to the common plant through piped sewers and not open drains. As far as possible, gravity sewers should be laid but if unavoidable, pumping could be resorted. To facilitate gravity flow, even if the level of treatment plant has to be lowered slightly, it would be appropriate as effluent pumping is always a difficult installation to operate and maintain.

(g) So far as question of selecting treatment process is concerned, it will be possible to do so only after basic data is made available. The data should include daily flow measurements and results of analysis of effluent samples. An assessment of quality of waste, costs, availability of lands and possibilities of location points of final disposal should be decided. Simultaneously, end use of treated effluent has also to be decided.

(h) For milk processing units, usual practice is to provide treatment based on Conventional Activated Sludge Process. However in this particular case since the treated effluent is to be discharged in to river, Extended Aeration process may have to be adopted due to its high efficiency. This process is simpler and easier to operate as compared to conventional ASP, but has high power consumption. Thus installation of plant based on EA would mean lower initial costs and easier maintenance to which the Department should agree. Life of mechanical and electrical units in such plants is no more than 10 years and the Department should plan to abandon the system in about 10 years when it will be possible to connect it to a sewerage system after primary treatment.
The above could be summarized as follows.

(a) Collect wastewaters from all the units at one place. (The slaughterhouse under construction already has a provision for providing a conventional ASP plant. If levels permit, all wastes could be brought to this location).

(b) Provide a common treatment plant, preferably based on extended aeration.

(c) Operate it till the time sewerage system is developed.

(d) Provide bypass so as to connect it to a sewerage system in future.
### APPENDIX ECP AH&VS 2.5: CATEGORY WISE DISPOSAL METHODS OF BIO-MEDICAL WASTES

<table>
<thead>
<tr>
<th>Options</th>
<th>Waste Categories</th>
<th>Treatment and Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category No. 2</td>
<td><strong>Animal Waste</strong>: Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood, experimental animals used in research, waste generated by veterinary hospitals, colleges, discharges from hospitals and animal houses</td>
<td>Incineration (without any chemical pretreatment) or deep burial</td>
</tr>
<tr>
<td>Category No. 6</td>
<td><strong>Solid Wastes</strong>: Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts and lines</td>
<td>Incineration (without any chemical pretreatment) or Autoclaving or Microwaving</td>
</tr>
<tr>
<td>Category No. 8</td>
<td><strong>Liquid Wastes</strong>: Wastes generated from laboratory washings, cleaning, housekeeping and disinfecting activities</td>
<td>Disinfection by chemical treatment (using 1% hypochlorite solution or equivalent reagent ensuring disinfection) and discharge in to drainage system</td>
</tr>
</tbody>
</table>
Appendix ECP Dairy 2.6: Guidelines for Landfill Operation of Slaughter House Waste.

The following procedures should be followed when disposing of slaughterhouse remains or by-products at a landfill:

- The Operator of the meat processing plant shall obtain permission from the Municipal authority to dump the specified quantity of waste, outline disposal procedures and schedules of disposal in a predestinated area.
- A pit must be excavated in a dedicated area of the landfill separate from the working face. The area should not be accessible to the public.
- The waste should be placed in the pit and immediately covered after each disposition with sufficient soil to discourage odours, flies and vermin. Lime may be spread on the waste before covering to discourage vermin. When filled, the pit should be compacted and capped.
- Special permission to bury slaughterhouse remains or byproducts at the working face may be requested under the landfill operating permit if daily covering takes place. Waste must be accepted by appointment after the landfill is closed to the public. The waste must be immediately covered and compacted at the toe of the working face.
- Shall be fenced to prevent entry of stray animals and unauthorized entry.
INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>metre</td>
<td>m</td>
</tr>
<tr>
<td>Mass</td>
<td>kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Time</td>
<td>second</td>
<td>s</td>
</tr>
<tr>
<td>Electric current</td>
<td>ampere</td>
<td>A</td>
</tr>
<tr>
<td>Thermodynamic temperature</td>
<td>kelvin</td>
<td>K</td>
</tr>
<tr>
<td>Luminous intensity</td>
<td>candela</td>
<td>cd</td>
</tr>
<tr>
<td>Amount of substance</td>
<td>mole</td>
<td>mol</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplementary Units</th>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane angle</td>
<td>radian</td>
<td>rad</td>
</tr>
<tr>
<td>Solid angle</td>
<td>steradian</td>
<td>sr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Derived Units</th>
<th>Unit</th>
<th>Symbol</th>
<th>Constants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force</td>
<td>newton</td>
<td>N</td>
<td>1 N = 0.0015999996 slugs (slug)</td>
</tr>
<tr>
<td>Energy</td>
<td>joule</td>
<td>J</td>
<td>1 J = 1 N·m</td>
</tr>
<tr>
<td>Power</td>
<td>watt</td>
<td>W</td>
<td>1 W = 1 J/s</td>
</tr>
<tr>
<td>Flux</td>
<td>weber</td>
<td>Wb</td>
<td>1 Wb = 1 T·m</td>
</tr>
<tr>
<td>Flux density</td>
<td>tesla</td>
<td>T</td>
<td>1 T = 1 Wb/m^{2}</td>
</tr>
<tr>
<td>Frequency</td>
<td>hertz</td>
<td>Hz</td>
<td>1 Hz = 1 cycle/sec</td>
</tr>
<tr>
<td>Electric conductance</td>
<td>siemens</td>
<td>S</td>
<td>1 S = 1 A/V</td>
</tr>
<tr>
<td>Pressure, stress</td>
<td>pascal</td>
<td>Pa</td>
<td>1 Pa = 1 N/m^{2}</td>
</tr>
</tbody>
</table>

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INFORMATION SERVICES CENTRE
New Delhi

GUIDELINES FOR
HANDLING, STORAGE AND TRANSPORT
OF SLAUGHTER-House BY-PRODUCTS

UDC 637.82(631)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1978
Indian Standards
GUIDELINES FOR
HANDLING, STORAGE AND TRANSPORT
OF SLAUGHTER-HOUSs BY-PRODUCTS

Meat Industry Sectional Committee, APDC 19

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Dr. S. K. Banerjee

Dr. S. K. Banerjee

Smt. Anand K. G. C. Gentry

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Health Officer

Veterinary Officer (Alternate)

(Coordinated on page 2)

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Indian Standard
GUIDELINES FOR
HANDLING, STORAGE AND TRANSPORT OF SLAUGHTER-HOUSE BY-PRODUCTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 August 1978, after the draft finalized by the Meat Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 There is a great potential for utilization of slaughter-house by-products for valuable pharmaceutical products, if these can be handled, stored and transported under appropriate conditions. This standard is intended to provide guidelines for such conditions, thereby saving sizeable quantities of this raw material for the pharmaceutical industries.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the base value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard provides guidelines for proper handling, storage and transport of by-products of slaughter-houses and meat processing factories.

1.1.1 This standard does not include the guidelines for the processing of pharmaceutical products like insulin and pancreatin.

2. TERMINOLOGY

2.1 For the purpose of this standard, the following definitions in addition to those given in IS : 4393-1967 shall apply.

*Rounded off numerical values (rounded).
**Basic requirements for an abattoir.
2.1 Slaughter-House — The building, the premises or place which is licensed as a slaughter-house by the local authority for the slaughter of animals intended for human consumption.

2.2 By-Products — Slaughter-house wastes in the form of parts cut off at waste from carcasses especially edible or inedible offal, blood, etc., which are not normally intended to be utilized for human consumption.

3. ANTE-MORTEM AND POST-MORTEM INSPECTION.

3.1 The by-products shall be obtained from animals subject to proper ante-mortem and post-mortem inspection as per IS 1960-1978.

4. HANDLING, STORAGE AND TRANSPORT

4.1 Various by-products shall be handled and stored under conditions as recommended in Table 1.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of By-Products</th>
<th>Utilization</th>
<th>Handling, Storage and Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>i) Blood</td>
<td>Human food and pharmaceuticals, such as plasma, albumin and fibrin</td>
<td>In case of utilization as human food, blood shall be collected in clean receptacles. When local plasma is required, collections should be made in an antiseptic manner immediately after slaughter of animals. Where fibrin is required, the blood should be stored at chilling temperatures (6 to 7°C) in a suitable vessel container.</td>
<td>Livestock feed</td>
</tr>
<tr>
<td>ii) Feces</td>
<td>Trypsin, trypsin, phosphatase and chymotrypsin</td>
<td>Feces should be removed expeditiously, preferably within 30 minutes after slaughter of the animal to prevent a hoarse. The glands should be collected into a stainless steel or aluminum vessel and chilled (4°C) or frozen immediately. Direct contact of the hands or wearing garments with the glands should be avoided. After the tissue is chilled or frozen, it should be packed in strong sterile boxes lined with thermostable or several layers of wax paper to prevent the glands from thawing. Each container should be tightly closed to the top to give maximum air protection. The glands shall be transported and stored under refrigerated conditions.</td>
<td></td>
</tr>
</tbody>
</table>

*Code of practice for ante-mortem and post-mortem inspection of meat products (1960) (Continued)*
TABLE 1: REQUIREMENTS FOR HANDLING, STORAGE AND TRANSPORT OF SLAUGHTER-HOUSE BY-PRODUCTS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of By-Products</th>
<th>Utilization</th>
<th>Handling, Storage and Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>1.</td>
<td>Kidney and ovaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Liver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Bladder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Bronchial glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Heart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Brain and spinal cord</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Pig stomach</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
TABLE 1 REQUIREMENTS FOR HANDLING, STORAGE AND TRANSPORT OF SLAUGHTER-HOUSE BY-PRODUCTS — (Contd)

<table>
<thead>
<tr>
<th>St. No.</th>
<th>NAME OF BY-PRODUCTS</th>
<th>UTILIZATION</th>
<th>HANDLING, STORAGE AND TRANSPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>xii)</td>
<td>Hides and skins</td>
<td>Leather</td>
<td>Hides and skins should be collected and transported to place of storage within 8 hours. Hides should preferably be salted before storage.</td>
</tr>
<tr>
<td>xiii)</td>
<td>Tail hair, bristles and body hair</td>
<td>Gelatin, glue</td>
<td>Generally, tail hair bristles and body hair should be separated and transported within 8 to 10 hours.</td>
</tr>
<tr>
<td>xiv)</td>
<td>Bones</td>
<td>Gelatin</td>
<td>The bones should be freed of adhering flesh and dried. Green bones should be broken, cooked and dried. In case of desert bones, they should be neatly laid out on a sloping cement platform in the collection centres. During dry weather, the bones should be sprayed with water to encourage bacterial and insect action, and to wash off unwanted material. Care should be taken not to dry bones in direct contact with earth. Further cooking and processing is similar to green bones.</td>
</tr>
<tr>
<td>xv)</td>
<td>Hooves and horns</td>
<td>Buttons, handles, comb, horn meal, foam compound, etc</td>
<td>Hooves and horns freed of pith should be collected and transported to be stored in cool sheds. These should not be exposed to undue heat and desiccation during collection, transport and storage as these may crack or become brittle.</td>
</tr>
<tr>
<td>xvi)</td>
<td>Horn pith</td>
<td>Gelatin</td>
<td>Horns should be placed in boiling water for a short period to remove any blood, fat or adhering tissue and pith removed by a gentle tap. The pith should then be cleaned free and stored in mesh-like containers for transport.</td>
</tr>
</tbody>
</table>
ECP Common 1. Biodiversity Management

1.1 General
1.1.1 The environment quality retains and continuously supports the biological diversity of a location. Biological diversity has a great bearing on the life of indigenous people as it guides their culture, lifestyle and livelihood. There is every need to conserve and manage bio-diversity, to address critical issues as poverty, livelihood and employment generation at the local level and most importantly conservation of areas as Bio-diversity hot spots.

1.1.2 Multiplicity of the stakeholders and recognizing the primary or direct impact, secondary and tertiary adverse impact of the human activities - a set of code of conduct be set up to fortify and canalised the positive activities to protect the wetlands health and integrity for a sustainable resource utilization for the present as well as for the future.

1.1.3 The ECP would be applicable to all interventions in and around any wetland. Assessment and grading any wetland shall be conducted as per the methodology suggested. Strategies for sustainable management shall be developed as per the guidelines proposed in the ECP.

1.2 Legislations
1.2.1 The recent act and laws, which are directly, associated with the conservation of the biological resources at genetic level, are (i) Biodiversity bill 2002. (Biodiversity committee at Panchayat level, District level, state level); (ii) NBSAP (National Biodiversity strategy and action plan);(iii) SACION- Inland wetland survey;(iv) Act on Alien and invasive species; (v) Wildlife Protection Act -1972(amended up to 2003) and (vi) Karachi declaration on the conservation of the wetlands and waterfowl in South and South east Asia.

The challenges in protection of biodiversity are:
- Wetlands management and protection results from a combination of many indirect uses of laws intended for other purposes. The jurisdiction over wetlands has also been spread over several agencies, Government, semi-government and private and community.
- No inter-departmental coordination leave aside private and Government department coordination for maintaining the integrity of the wetlands.
- Wetland has been partially managed under both land use and water quality.

1.3 Biodiversity Management
1.3.1 Management of the wetlands have several possibilities, dependent on the goal of the managers.
- Often the goal can be conflicting, as in preventing pollution from reaching wetlands and using wetlands as sites of wastewater treatment or disposal.
- Flood plain zones are now managed as zones to minimize human encroachment and maximize flood water retention.
- Wetlands are now considered to be the site of protection of rich biological diversity and gene pool conservation that can be used for the future studies on genetic and bio-technological modification.

1.3.2 Management of bio-diversity shall be done to (i) maintain water quality; (ii) reduce erosion; (iii) provide buffer between rural and urban areas; (iv) maintain a gene-pool for marsh, deep water wetland plants; (v) maintain wildlife biodiversity; (vi) provide habitat for fish spawning and other food organisms; (vii) Provide food, fodder and fibre. Due to the interventions in various sectors the biodiversity is of major concern in agriculture and fishery sectors.

1.4 Agriculture Sector
1.4.1 The crop intensification and diversification has lead to loss of nearly 500 germ plasm of traditional variety of rice in North East. It shall be the responsibility of the Agriculture University to preserve these traditional varieties of rice so that they are not lost in the process of agriculture development. Moreover
it shall be the responsibility of the Extension officer to inform farmers about the importance of the traditional variety of the seeds.

1.5 Fishery Sector

1.5.1 The wetland of State could be classified into three categories based on two sets of values. The first set of values includes (a) Scientific; (b) economic; (c) educational; (d) recreational; and (e) aesthetic. The second set of values includes following features of site (i) are intrinsically most fragile and sensitive to human impact; (ii) already lost most ground due to human impact; (iii) are predictably most vulnerable to further damage and loss through anthropogenic interventions; (iv) would represent the greatest loss if they are damaged or destroyed; (v) would be the most difficult to restore or recreate if they are damaged or destroyed.

1.5.2 The wetlands of Assam can be categorized on the basis of the strength of biodiversity as (i) Grade-I - Wetland of existing high scientific values (site of special scientific interest - SSSI); (ii) Grade-II - Wetland of lesser scientific value; (iii) Grade-III - Wetland of very less scientific value. The definitions of grades of the wetland are presented in box 1-1.

**Box 1-1: Definition of Grades of Wetlands...**

The wetlands of Assam can be categorized on the basis of the strength of biodiversity.

**Grade-I Wetland**
These are - wetlands of existing high scientific values, i.e., site of special scientific interest (SSSI)

a) Wetland must have very high number of species of diversity taxonomic category, with appreciable population.

b) It harbors RDB (Red data book species) of higher taxa (birds, mammals etc), or endemic species of birds, mammals, fish or amphibian or aquatic angiosperm, or till date recognized endangered of any taxonomic group.

c) Wetland which is large enough to support the species diversity, with presently and in near future do not show any indication of developmental or anthropogenic threat. Or small area wise but support the category (b)

d) It may be unique in the district or in the region, with regard to ecosystem functioning.

**Grade-II Wetland**
These wetland are of lesser scientific value and shall have the following characteristics

a) It must be large enough, to support the high biodiversity at species level.

b) Have any one of the RDB species of higher taxa, or endemic species whose survival and population buildup could be supported by the wetland.

b) It do not show any indication of developmental or anthropogenic threat, as of now or in near future.

d) It must have all good physical and ecosystem dynamics indications, like inflow and outflow, to be elevated to higher grade.

**Grade-III Wetland**
Wetland of very less scientific value
This covers wetlands that can come under commercial fisheries, or over exploited for a long period of time. a) These have been systematically degraded, by human activities and have very less chance of recovery.

b) These could also be designated as ecological slum.

1.5.3 The sample indicators for evaluation of grade or status of wetlands shall be carried out in terms of few major taxa (1) Birds, (2) fish, and (3) angiosperm. The Birds are recognized as indicator of biodiversity. The criteria are (i) Different bird groups prefer distinctly different micro-habitat, and niche separation is clear; (ii) the food and nutritional requirements are very different; (iii) They are attracted to the site only if welfare factors are abundant and also can leave the site when the specific requirements are wanting; (iv) They are broadly euro-phagic, and live of diverse food items within the genetical boundary of the species and (v) They broadly utilize the surface of the wetlands. The Fish are (i) under surface faunal group; (ii) taxonomic diversity- at genus level show diversity in food preference; and (iii) occupy different depth. The Angiosperm are (i) evolutionary higher group; (ii) occupy more surface area; (iii) diverse nutritional requirements; (iv) diverse pollinator and (v) can support a large number of micro-
fauna and flora. The higher taxa act as indicator species for deciding the richness of wetlands. It shall be the responsibility of the department to classify the wetlands based on these indicators (presented in box 1-2) before taking it for fishery development.

**Box 1-2: Calculation of CBV value of Wetlands**

One the basis of the biodiversity and species richness information and with the physical factors of the wetlands, one can use the CBV of the site. Normally if the value is high then those wetlands are expected to be considered as the SSSI.

Value on the basis of Ranwell’s Semi-quantitative Index for Comparative Biological value(CBV) (modified)

Size (S) , diversity (D), geographical limits(G), Potential for educational research (E), combination value(C), unknown factor (X).are the characteristics taken for evaluation. Here the Diversity(Dn) expanded as D1, D2 etc for explaining the species diversity. Value between 0-5 in each factor has been taken as range.

Tentative CBV rating : S + D1 + D2 + D3 +Dn + G + E + C + X (5 point each)  S: size; D1: bird ; D2: fish ; D3 : angiosperm ; Dn : population of all Ds ; G: geographical limits; E: educational research ; C:combination value ; X : unknown factor. ( equal valuation of 5 has been allotted, as of now). The scoring is done based on above parameters and if the score is above 30, then the wetland will be placed in Grade I; 15-30 the wetland in Grade II and Below 15 the Wetland in Grade III

**Example:** Central Assam; Data: Deo-bali-jhola (complex): Birds: 101 species (including both resident migratory species) 7 RDB species; Angiosperm : 20 species and few key stone species trees (Ficus sp); and Fishes : (apprx) 25 species.

As per above formulae CBV Value is 35

1.5.4 No intervention shall be conducted in the area designated as “Wetland Area” in Grade I Beels. Strategies for sustainable development, described in Box 1-3, shall be implemented for sub-projects categorised as “L” in addition to the provisions specified in the ECP. Similarly mitigation measures proposed in site specific EMP and EIA for Sub-projects categorised as “H” & “H” shall be developed based on these strategies.

**Box 1-3: Strategies for Sustainable Development in wetlands**

- Interventions shall be designed to ensure no net loss of natural areas. All interventions shall be located on portions of the site that are not environmentally sensitive.
- Wherever possible, large tracts of wildlife habitat or long continuous corridors should be preserved in order to facilitate movement of wildlife from place to place. These include drainage channels.
- Potentially polluting activities shall not be undertaken in the areas surrounding the wetland. Soil should be protected from pollution or spills, including runoff from pavement. Use of drugs and chemicals, and other farm activities that might adversely affect the surrounding lands and waters shall be discouraged.
- The intervention shall be designed so that it does not unduly increase storm water runoff and shall not alter the natural drainage pattern of adjacent area. Design and construction practices shall minimize erosion.
- Construction (if any) shall be planned out in a timely and careful manner so that fish, wildlife and their habitat are not unduly disturbed or destroyed.

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1 In addition to the interventions the following activities shall also be included i) storm water and erosion control ii) clearing of debris and vegetation from streams and stream banks iii) development of drainage and riverworks schemes (not routine maintenance) iv) stream channel modifications v) roads and stream crossings vi) structures such as pump stations on banks, vii) off-stream storages of less than 1 ML viii) works ancillary to dam construction such as access roads (not dams themselves).

2 Planning an intervention to ensure minimal disturbance to natural environment can be ensured by following the two steps to be taken in following this guideline. The first is to determine the extent and type of existing natural features, and the second is to design and construct so as to avoid or mitigate the impact on the natural features.

3 There are several ways to reduce the impact which development has on storm water runoff. The first is to retain vegetation and plant trees on the site because trees and vegetation absorb water and reduce the rate of storm water runoff. The careful design of storm water collection, conveyance and treatment systems. Setting ponds or other techniques are a possibility.
1.5.5 Emphasis should be given on conservational aspects in **Grade I** wetlands. Conservation strategies for Grade I wetlands are detailed in Box 1.4

| Developing Public Awareness on conservation of wetland: Increase the level of public and landowner knowledge and benefits from wetland conservation on private lands through education and incentives for wetland protection, restoration, stewardship, and enhancement. |
| Define and map "Wetland Area boundaries" for all wetland in the state. Categories wetlands into Grade I, Grade II and Grade III. These documents should be widely publicized. |
| 1 km diameter surrounding the wetland be demarcated as ecological influence zone. The restriction be made on the pattern of house construction, agricultural activities, road construction looking at the geomorphology, hydrology and soil quality around the wetlands. No permission be given to chemical waste generating factories at the catchments area of the beel. |
| Traditional management techniques, which has been followed by the villagers be recorded and scientific evaluation of the methods adopted be done keeping in mind the capacity of such methods to maintain the diversity. |
| Commit all stakeholders and other departments in each district to the goal of no net loss of wetland in all actions and functions. |
| Declare areas within the wetland area as "AREAS SECURED FOR CONSERVATION". |
| Develop organization capacity at district level for tracking wetland activity and long-term monitoring of wetland restoration and protection efforts. |
| Wastewater disposal into the wetland be monitored and proper treatment mechanism be established wherever applicable. |
| Mono-culture to be abandoned, multi-species culture, protection be encouraged. Compulsory use of organic farming in fringe areas of the beel. |
| Brick factories be allowed to be established only in selected sites, avoiding the biodiversity rich wetlands. They should not be allowed to shift the place annually. |
| Endangered species of fishes should come under special breeding programme. |
| New non-Piscean fauna, like crab, prawn, and mollusk be encouraged for commercial cultivation. |

1.6 Guidelines for Agriculture practices in periphery of beels

Irrigated agriculture in the periphery of beels using chemical fertilizers and pesticides is common. The following steps have been suggested:

- Use of chemical fertilizers and pesticides; both in terms of quality and quantity in the catchment of the beel be stopped.
- Over utilization of the wetland water for irrigation be stopped.
- Compulsory use of organic farming in fringe areas of the beel.

* Continuous bunding for demarcation should be discouraged.
Traditional varieties of rice, oil seed, vegetable be allowed to be cultivated only.
Monitoring of the wetland areas for siltation due to cultivation be done
Throwing of plastic and plythene bags and containers be prevented.

1.7 Animal Husbandry

1.7.1 The Cattle And Buffalow Breeding Policy for the state takes into consideration the Bio-Diversity aspects and preserves genetic line through backcrossing. The Biodiversity Management Document thus has not considered this issue.
2.1 General

2.1.1 AACP envisages development of marketing linkages and value addition to agricultural produce. This would require construction of i) Markets and Storage facilities ii) Food Processing Plants for processing and storage of agricultural produce. In addition, construction of i) veterinary hospital/dispensary ii) Artificial Insemination Centre iii) poultry farm iv) Dairy farm v) Dairy Processing plants, for animal husbandry and dairy development activities would also be undertaken as part of AACP.

2.1.2 This Environmental Code of Practice outlines the i) Siting Guidelines ii) Design Requirement and iii) Construction Guidelines that need to be adopted to prevent adverse impacts due to construction of infrastructure facilities.

2.2 Legislations

2.2.1 Urban areas have general development control regulations for siting of any activities, which are of the industrial or commercial nature. In rural areas no such regulations are in place. Therefore the guidelines stated in this code of practice shall be useful for maintaining the environment of the rural and urban areas.

2.2.2 This Code has been developed on the lines of the National Building Codes of India, 1983.

2.3 Dairy Farms

2.3.1 Siting Guidelines for Dairy Farms: Locating Dairy activities in rural areas shall take into consideration:

General
- All local building byelaws and development regulation (if any).
- Shall not locate in low-lying areas, marshes and swamps. Preferably fallow land shall be selected.
- Shall not be located within 1 km of National parks, Sanctuaries, Ramsar Sites, Grade I Beels, Biosphere Reserves and Classified Forests. Site for location shall not be on grazing land, community conservation areas, sacred groves or near sacred tanks.
- Large rural dairies shall be preferably located down wind of the prevalent wind direction, if located within 0.2 km of the settlement.
- Shall be located at least 20 m from any surface water body or any drinking water source
- Locate milking areas at least 45 m from structure housing poultry
- Should obtain a No Object Certificate from the Sarpanch/PRI to any construction activity in the village.

Waste Collection and Storage: Areas where rainfall is more than 800 mm or water table is below 20 m, the following precautions are to be undertaken:
- Long term storage by stockpiling wastes on direct ground is not recommended
- Should be located at least 20 m from any surface water body or any drinking water source;
- Shall not be located in low lying areas susceptible to flooding
- Shall not drain freely into surface water streams.
- Should be kept covered during the monsoon season/rains to prevent runoffs
- For storage of wastes, in case of small and medium size dairy, earthen storage structures shall be used, where as in case of large dairy, concrete storage structures shall be used. (Details of the Waste Storage facility is provided in Appendix ECP Common 2.1)

Feed storage: The following points shall be considered for feed storage structures in areas of high rainfall.
- Well drained site not susceptible to water logging
- Storage facility shall be covered to reduce loss of feed.
- Feed shall not be placed on bare floor, it shall be stored on at least on brick platform of mud mortar
2.3.2 Siting of Peri-Urban Dairies: Peri-urban dairies located in Class I & Class II towns shall in addition to the above have guidelines provided in Box 2.1

- Shall not be located upwind to any settlement
- Shall not be located in low lying area
- Shall be located at least 50 m from any natural water body or any drainage channel or drinking water source
- Shall have adequate space for housing of cattle
- Shall construct concrete waste storage of appropriate capacity as described above
- Shall have designated storage area for storage of feed and fodder away from milking area or the residential area.
- Shall have adequate supply of clean drinking water.
- Shall have separate storage area for feed, animals.
- Residential quarters shall not be used as storage facilities and shall be at a minimum distance of 15 m from any of the facility
- Shall have adequate access facility.
- Shall not be located upwind to the prevailing wind direction

2.3.3 However the guidelines for Peri-urban dairies presented in Box 2.1 shall override the general provisions stated above in case of contradiction.

2.4 Design Requirement:

2.4.1 Ventilation: To maintain hygienic conditions in the dairy premises a good ventilation system will be important. The dairy shall be well ventilated to remove any harmful gasses and odour. Drainage: The milking shed shall be well drained and well lit. Moreover the following consideration are (i) internal surfaces of walls should be finished with a smooth impervious surface to at least 1500mm above floor level; (ii) Finish floors with a non-slip free-draining surface sealed at the junction of the floor and walls; (iii) The floor shall be impervious to moisture, have a non slip surface and adequate falls for drainage. A fall of between 1:30 or 1:50 allows for easy cleaning.

2.5 Poultry Farms

2.5.1 Siting Guidelines for Poultry Farm: Following factors are to be considered while locating poultry farms:

- All local building byelaws and development regulation (if any).
- Shall not be located in low-lying areas, marshes and swamps. Preferably fallow land shall be selected.
- Shall not be located on grazing land, community conservation areas, sacred groves or near sacred tanks.
- Shall not be located in existing or proposed residential areas and land identified for future residential development in current planning strategies or town planning schemes; and existing or proposed rural-residential areas identified in current planning strategies or town planning schemes.
- Should obtain a No Object Certificate from the Sarpanch/PRI to any construction activity in the village.
- Minimum buffer distances5 for new poultry sheds and neighboring land are i) “500 metres from any existing or future residential zone ii) 300 metres from any existing or future rural-residential zone iii) 100 metres from the boundary of the poultry farm”.

5 Some variation may be permitted in accordance with farm policy/industry policy.
ECP Common 2: Building Activities

- Shall be located at least 20 m from any surface water body or any drinking water source
- Rural large poultry shall be preferably located down wind to settlement, if located within 0.2 km of the settlement.
- Since the water table is high to prevent leaching from nutrients and manure, poultry shed shall not be located on bare ground.
- Shall not be located on land encompassing drinking water reservoirs where the risk of contaminants entering the water is too high. These areas consist of up to a 1km buffer around reservoirs, including the reservoir itself.

Waste Collection and Storage

- Ventilation of the poultry shed shall be maximised during clearing of litter.
- Beneficiary shall take all necessary action to maintain litter in dry and friable condition.
- All wastes shall be contained in dry condition, preferably within shed until removed for disposal.
- Disposal of litter by spreading on land adjoining the shed shall be discouraged.
- Poultry litter shall be used as manure for vegetables

2.5.2 Design Requirement:

Flooring:
- The floor of poultry farm shall be made of material, which makes it easy for removal of litter.
- Floor construction shall prevent mixing of litter with underlying soil and shall be constructed with of concrete, compacted earth.

Shed Design: Poultry shed shall be designed in such manner that rain water do not seep in.

Ventilation: The shed shall be well ventilated to remove dust emanating from litter

2.6 Veterinary Facility

The Veterinary infrastructure such as Veterinary Hospitals, Dispensary, Artificial Insemination Centres shall be strengthened. The codes of practice for siting, construction, waste storage has been described below

2.6.1 Siting Guidelines for Veterinary Facility: For proposing site for veterinary Hospitals the District Veterinary Officer shall consider the following

- All local building byelaws and development regulations (if any).
- Shall not locate in low-lying areas, marshes and swamps. Preferably fallow land shall be selected.
- Veterinary facility planned for treating more than 3000 animals per annum shall not be located within 1 km of National parks, Sanctuaries, Ramsar Sites, Grade I Beels, Bio-Sphere Reserves and Classified Forests. Shall not be located on grazing land, community conservation areas, sacred groves or in near sacred tanks.
- Should obtain a No Object Certificate from the Sarpanch/PRI to any construction activity in the village
- Shall have adequate area for preparation of separate isolation wards for the sick or diseased animals, which can be dangerous for both humans as well as for other animals
- The site shall be away from flood prone and water logging areas;
- Shall have adequate area for waste collection storage and disposal.
- Shall not be located within 0.2km of any drainage channel, natural waterbody and drinking water source.

Waste Collection and storage: Facilities for waste collection and storage shall conform to the following guidelines:

- Shall not be located with in 0.3 km of any drainage channel, natural water body and drinking water source.

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* Large poultry farms are defined as ones which houses more than 1000 birds

* Poultry litter is a valuable fertilizer and soil conditioner as it is rich in nitrogen, phosphorous and potash in the ratio 3:2:1
- Shall not be located in any area prone to water logging.

2.6.2 Design Requirement:

General design requirements are presented below

- Dry and wet areas of the building shall be located separately;
- Area of the facility shall be fenced;
- Plinth of the building and waste collection facility shall be located above the HFL;
- Waste collection facility shall have adequate area for waste collection, storage, segregation and disposal;
- Waste collection site shall be secured to prevent entry of stray animals and covered to protect it from rain;
- Drainage from the facility shall be connected to the municipal sewer and ponding shall not be allowed;
- Septic tank shall be planned and constructed taking adequate precaution (Refer Appendix ECP Common 2.2: Guidelines for Design and Construction of Septic Tank)

2.6.3 The code of building plan shall be as per the national building code of India revised in 1983. The plan of the buildings and elevations and sections accompanying the notice shall be drawn to a scale of 1: 100. The plans shall:

- Include floor plans of all floors together with the covered area clearly indicating the size and spacing of all framing members and sizes of rooms, the position of staircases, ramps and lift wells;
- Show the use or occupancy of all parts of the buildings;
- Show exact location of essential services, for example, WC, sink, bath and the like;
- Include sectional drawings showing clearly the sizes of footings, thickness of basement wall, wall construction, size and spacing of framing members, floor slabs and roof slabs with their materials. The section shall indicate the heights of buildings and rooms and also the height of the parapet; and the drainage and the slope of the roof. At least one section should be taken through the staircase;
- Show all street elevations;
- Indicate details of served privy, if any;
- Give dimensions of the projected portions beyond the permissible building line;
- Include terrace plan indicating the drainage and the slope of the roof; and
- Give indications of the north point relative to the plan.

2.6.4 The services plans shall include all details of building and plumbing services, and also plans, elevations and sections of private water supply and sewage disposal system, if any (see Part VIII Building services and Part IX Plumbing services-NBC 1983).

Construction Guidelines:

2.6.5 It shall be the responsibility of the respective District officers executing any construction activity to ensure:

- Construction activities shall be planned to avoid construction during the monsoon season;
- Construction workers camp shall not be located near settlement or drinking water source such as well, natural water body likely to flood;
- Construction material shall be stockpiled to prevent its flow into any drainage channel or water body;
- Construction camps shall be provided with facilities for drinking water and sanitation;
- Construction wastes shall be dumped in pre-designated sites. Dumping sites for construction wastes shall be identified in consultation with the District Officer. The site shall not i) block any drainage channel, ii) be any low lying area. The construction wastes shall be recommended for construction of embankment of approach road, back fill etc.

2.6.6 The guidelines for Civil works in construction and electrical and mechanical erection are presented as Appendix ECP Common 2.3.
2.7 MARKETS & STORAGE FACILITIES

2.7.1 Construction of Rural markets (haats) and wholesale agriculture markets the following environmental considerations are required to be undertaken.

2.7.2 Siting Guidelines for Marketing and Storage Facility: For siting of a market and storage facility the following shall be considered:
- All local building byelaws and development regulation (if any).
- Shall not be located in low-lying areas, marshes and swamps. Preferably fallow land shall be selected.
- Wholesale Market facility shall not be located within 1 km of National parks, Sanctuaries, Ramsar Sites, Grade I Beels, Bio-Sphere Reserves and Classified Forests. Shall not be located on grazing land, community conservation areas, sacred groves or in near sacred tanks.
- Wholesale and rural markets shall not be located 1 km and 0.5 km respectively of any drainage channel or natural water body, drinking water source.
- Shall not be located in any site prone to water logging or affected by flood
- Wholesale markets shall be located at least 1 km of the boundaries of the settlement while rural markets shall preferably maintain a buffer of 0.5 km.

Waste Collection and Storage: Facilities for waste collection and storage shall conform to the following guidelines:
- Shall encourage segregation of waste at source. Market Operators shall be educated about the process and its importance.
- Shall be located more than 1 km and 0.5 km from rivers, natural water bodies, and drinking water source.
- Shall have proper drainage system for collection of wastewater
- Shall be properly fenced and secured to prevent littering of waste

2.7.3 Design Requirement:

The marketing facility shall have:
- Adequate space for storage and grading of agriculture produce
- Fenced to prevent any access of stray animals
- Shall have adequate area for collection, storage and treatment of waste
- Shall have provision for a composting/vermi-composting plant.
- The access road shall be provided with adequate number of cross drainage structures.
- Drainage channels shall be connected to municipal sewers. In case of Non-existence of sewer line it shall be connected to storm water drainage channels. Wastewater shall not be allowed to stagnate in low-lying areas.

2.7.4 The District Agriculture officer during the preparation of the Detailed project proposal underline the system requirement for collection, handling, segregation and disposal of waste to be generated during operation.

2.8 Processing Plant

2.8.1 Siting Guidelines for Processing Plant: In addition to the economic and operational and legal aspects for site selection the following environmental aspects shall also be considered:
- no land use conflicts or potential conflicts with adjacent sites
- shall be at a minimum distance of 1 km from any natural drainage channel, perennial natural water body.
- Shall not be located within 0.5 km of any drinking water source (if the source is the only source of water)
- shall have a minimum setback distance from 30 m from waste disposal facilities, incompatible processing facilities, and any offensive trades. However, a greater or lesser distance could be accepted depending on specific site conditions.
- Shall not be located in low-lying areas
2.8.2 Design Requirement: Designs for dairy processing shall consider the following:

Walls and Ceilings
- shall be smooth, impermeable, washable and light coloured
- suitable materials would include tile, concrete, plaster, sealed brick, or other equivalent materials.
- Kept in good repair.
- clean and free from flaking material.
- free of pitting and cracks.

Floors
Floors of all rooms in which dairy products are received, processed or stored shall:
- be constructed of sealed concrete or other equally impervious and easily cleanable material,
- be smooth and not allow for pooling of liquids,
- where applicable, be provided sufficient gradient for liquids to drain. Generally a minimum slope of 2% or more is recommended.
- floor to wall joints should be coved (generally a 15 cm extension is recommended) and sealed for ease of cleaning and maintenance.
- be kept clean and in good repair.
- floors in storage rooms used for storing dry ingredients or packaging materials, or utility rooms (electrical service, etc.) shall be smooth and cleanable.

Floor Drains
- floor drains shall be provided, where necessary, to effectively prevent accumulation of liquids.
- rain lines shall be sloped, individually trapped, and properly vented to outside air.
- floor drains shall be separate from sewage drains to a point outside the plant.
- equipped with removable covers and located so that they are accessible for cleaning and sanitizing.
- for equipment discharging large volumes of water, drainage shall be designed to prevent flooding of surrounding areas.
- shall be constructed such that there is no cross-connection between the drains or drain lines, and the water supply, the dairy product lines or equipment, or the CIP system.

2.8.3 Waste Collection storage and Management
2.8.4 Issues, actions and responsibilities for planning, design and management of waste have been described in ECP Dairy 2: Processing Plant Management.

Appendix ECP Common 2: Storage of Waste from Farm...

Earthen Storages. Earthen storages are for semi-solid manure storage should in addition to the criteria specified in Clause 1.6.2 the following criteria should be:
- Structurally sound
- have a impervious floor
- be lined with an impervious material.

Concrete Storages. Storages built with concrete structure should in addition to the criteria in Clause 1.6.2:
- structurally sound
- have reinforced concrete walls;
- have a concrete floor which is sealed to the walls;
- be constructed entirely above ground to minimize seepage of groundwater into the structure;
- be roofed to keep out rain;
- if roofed, be well ventilated.
APPENDIX ECP COMMON 2.1 : GUIDELINES FOR DESIGN AND CONSTRUCTION OF SEPTIC TANK

2.8.5 Where a septic tank is used for sewage disposal, the location, design and construction of the septic tank shall conform to requirements. A subsoil dispersion system shall not be closer than 18 m from any source of drinking water, such as well, to mitigate the possibility of bacterial pollution of water supply. It shall also be as far removed from the nearest habitable building as economically feasible but not closer than 6 m to avoid damage to the structures.

The requirements for septic tanks are:

- **Dimensions of Septic Tanks** – Septic tanks shall have a minimum width of 75 cm, a minimum depth of 1 m below the water level and a minimum liquid capacity of 1 m. The length of tanks shall be 2 to 4 times the width.

- Septic tanks may be constructed of brickwork, stone masonry, concrete or other suitable materials as approved by the Authority.

- Under no circumstances shall effluent from a septic tank be allowed into an open channel drain or body of water without adequate treatment.

- The minimum nominal diameter of the pipe shall be 100 mm. Further, at junctions of pipes in manholes; direction of flow from a branch connection shall not make an angle exceeding 45 degree. With the direction of flow in the main pipe.

- The gradients of land drains, under drainage as well as the bottom of dispersion trenches and soak ways shall be between 1:300 and 1:400.

- Every septic tank shall be provided with ventilating pipe of at least 50 mm diameter. The top of the pipe shall be provided with a suitable cage of mosquito proof wire mesh.

- The ventilating pipe shall extend to a height, which would cause no small nuisance to any building in the area. Generally, the ventilating pipe may extend to a height of about 2 m, when the septic tank is at least 15 m away from the nearest building and to a height of 2 m above the top of the building when it is located closer than 15 m.

- When the disposal of septic tank effluent is to a seepage pit, the seepage pit may be of any suitable shape with the least cross sectional dimension of 90 cm and not less than 100 cm in depth below the invert level of the inlet pipe. The pit may be lined with stone, brick or concrete blocks with dry open joints, which shall be backed with at least 7.5 cm of clean coarse aggregate. The lining above the inlet level shall be finished with mortar. In the case of pits of large dimensions, the top portion may be narrowed to reduce the size of the RCC cover slabs. Where no lining is used, especially near trees, the entire pit shall be filled with loose stones. A masonry ring may be constructed at the top of the pit to prevent damage by flooding of the pit by surface runoff. The inlet pipe may be taken down a depth of 90 cm from the top as an anti-mosquito measure; and

- When the disposal of the septic tank effluent is to a dispersion trench, the dispersion trench shall be 50 to 100 cm deep and 30 to 100 cm wide excavated to a slight gradient and shall be provided with 15 to 25 cm of washed gravel or crushed stones. Open joined pipes places inside the trench shall be made of unglazed earthenware clay or concerted and shall have a minimum internal diameter of 75 to 100 mm. Each dispersion trench shall not be longer than 30 m and trenches shall not be placed closer than 1.8 m.

APPENDIX ECP COMMON 2.3: GUIDELINES FOR CIVIL WORK AND ELECTRICAL AND MECHANICAL REQUIREMENTS

Requirements of Construction of Civil Works

(i) Construction of civil works should be entrusted only to contractors experienced in construction of water retaining structures. Ordinary contractors tend to cover poor work by plastering whereas no dependence can be placed on plastering.

(ii) The form work has to be of good quality.

(iii) Polyvinyl chloride (PVC) water bars should be provided at all joints.

(iv) Concrete has to be minimum M 20 grade and must be vibrated while laying. Minimum cover of 25 mm should be provided over bars which could be increased up to 40 mm in aggressive areas. Use of bars painted with anti corrosive paints is preferable.

(v) Sulphate resistant cement should be used specially in digester domes or USAB gas domes.

(vi) All pipes crossing concrete structures should be connected through puddle pieces.
ECP Common 2: Building Activities

(vii) Ductile or cast iron pipes should be used in pressure mains. Where fluids are aggressive or soil is waterlogged HDPE or PVC pipes should be used.

(viii) The site of treatment plant should have a proper storm water drainage system to prevent plant units or machinery getting damaged due to flooding.

(ix) It is preferable to provide a bypass system between the entry and last point of the treatment plant. Each unit should be linked to it to enable it to emptying of that unit, if necessary.

B. Mechanical and Electrical erection requirements

(i) Electrical and mechanical items in a treatment plant have to be designed for operation in tropical, humid climate (45°C and 100% humidity).

(ii) Motors up to 100 hp are squirrel cage induction motors. Motors above 150 hp should be slipring motors. For outdoor normal locations, they should be totally enclosed, fan cooled and where gas is likely, they should be flame proof. For clean indoors, drip proof motors should be installed. Starters should be installed to suit horse power and local regulations.

(iii) Cables should be generally armoured PVC and outdoor cables should be laid in 1 m deep trenches.

(iv) A motor control panel should be provided in the pump room and a hydraulic flow diagram should be provided to help operators understand the operation.

(v) In addition to the starter in control room, push button starters should be provided near all outdoor motors.

(vi) Minimum thickness of steelwork under water is 6 mm.

(vii) General area lighting should be provided between 50 to 100 lux.
ECP Common 3. Guidelines for Training & Awareness

3.1 General

3.1.1 Improving awareness on environmental issues and imparting knowledge on provisions of ECP shall be instrumental in effective implementation of AACP without having adverse environmental impact. Training shall improve the attitude and knowledge base of different stakeholders in the project. The training strategy developed as part of the EMF shall i) raise awareness among decision makers, administrators involved in implementation ii) provide and continually improve technical inputs to the stakeholders, beneficiaries etc iii) promote awareness of indirect stakeholders to ensure interagency coordination. In addition to the above continuous awareness program shall be organized both the PMU and District Level Officials. Guidelines on training presented in Environment Management Framework provide information on planning and preparatory activities for training. It also guides the implementing agencies towards selecting modes of training and identification of target groups.

3.1.2 Each of the implementing department has developed training plans for providing technical inputs and upgrading the skills of the beneficiaries. These training will focus on the technical aspects but does not incorporate environmental issues and mitigation measures. This ECP provides guidelines for incorporation of environmental aspects into existing training plans.

3.2 Training Conducted by Department

3.2.1 Training organized by the respective department for imparting technical expertise shall include environmental aspects and measures detailed in the respective Codes of Practice. It will be the responsibility of the ETO in the implementing department to ensure the inclusion of the environmental aspects in training modules of technical subjects.

3.2.2 The training module should be designed such that environment safeguards or benefits that might accrue due to adoption of such technology or inputs shall be highlighted during imparting technical knowledge.

3.2.3 The training sessions shall also present a broad overview of environment impacts and its consequences due to various unwarranted action taken by beneficiaries.

3.2.4 Training sessions shall highlight and demonstrate best practices vis a vis present practices. Deficiencies and drawback in the present practice shall also be explained to beneficiaries

3.2.5 On-Farm training shall provide practical demonstration on environmental impact and provide solutions.

3.3 Training By External Agencies

3.3.1 Progressive farmers and officials are sent to agencies and institutes outside the state to undertake training on technical aspects. These trainings presently do not have any environmental component.

3.3.2 The ETO shall ensure that trainings conducted by external agencies, institutions or consultants do not focus only on the production or growth aspects. Aspects such as environment, health and safety are given due weightages.

3.3.3 Training modules of institutes, which provide specific inputs on environment health and safety shall only be considered for imparting training.

3.3.4 Training modules of the institutes shall be scrutinized by the ETO to ascertain the extent to which environment aspects have been addressed. Future training shall be based on this evaluation.
3.4 Modes of training

3.4.1 Modes of training shall be selected based on the target group for the training. Guidelines for modes of training to be organized by department are presented below:

3.4.2 Use of visual aids shall be maximized

3.4.3 Local modes of delivery shall be encouraged

3.4.4 On farm demonstrations of environment aspects shall be encouraged

3.4.5 Progressive farmers shall be encouraged to share their experience and act as trainers.

3.4.6 Traditional modes of training shall be preferred for training of beneficiaries and field level officials.