UNIT 1  PRE-COCOON SECTOR

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1.0 OBJECTIVES

After reading this unit, you will be able to:

- explain the Kissan nursery, methodology of plantation and workout the economics of nursery and silkworm rearing;
- summarize the development of mulberry garden and silkworm rearing techniques;
- explain the techniques of composting and vermi-composting;
- explain the package of practices for silkworm rearing;
- identify mulberry diseases and pests, their causes, symptoms and their preventive and control methods; and
- select the control measures for pests and diseases in the local area.

1.1 INTRODUCTION

The Entrepreneurship Development Programme (EDP) is an integrated process of identification, motivation, training, counselling and support aimed at enlarging the supply of entrepreneurs and leading to creation of new enterprises. It is a human resource development programme that aims to create an output of competent new entrepreneurs with viable enterprises. In India, as in many developing countries, the socio-economic environment has not been favourable to the emergence of entrepreneurial talents. It is not as if these talents do not exist, historically entrepreneurs have originated from all strata of society. But, the entrepreneurial potential has remained unused and latent because of several impediments. Economic development, hence, depends on activating these latent talents.
The search for latent entrepreneurial ability and its development for promoting small enterprises are the principal objectives of the Entrepreneurship Development Programme (EDP). Some might not have enough confidence to take up new enterprises and some might not know how, where and when they can market their produce once production starts.

An entrepreneurship Development Programme was, therefore, organised to meet many of these constraints, with a package of training-cum-counselling inputs, combining motivation development, project counselling and preparation, managerial orientation, information on sources of help and support, accounting and book keeping and business opportunity guidance. Further, the trained EDP candidates are provided with a continuous follow up by the trainer organization to solve the problems faced, if any, by the trainee to set up a new business venture.

Central Silk Board (CSB) is a statutory body under the administrative control of the Ministry of Textiles, Government of India. The board is entrusted with the responsibility of developing silk industry covering the full gamut of silk activities in the country. For the development of the technology in silk industry, the CSB has established different research institutes separately for pre- and post-cocoon activities. To attract new / existing entrepreneurs, the CSB has established an entrepreneurship development cell, which is involved in conducting EDPs throughout the length and breadth of the country for the last two decades and significant results have been obtained in creating and developing new entrepreneurs. In fact, many of the government-sponsored schemes were channelled through these trained EDP candidates.

Business opportunities that are available in the area of sericulture have been listed in Table 1.1.

Table 1.1: Business Opportunities in Sericulture Industry

<table>
<thead>
<tr>
<th>No.</th>
<th>Business Opportunities</th>
<th>Details/Scope/Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Pre-cocoon Activity</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Production of Bio-fertilizers</td>
<td>Application to mulberry garden – saves money &amp; improves soil fertility.</td>
</tr>
<tr>
<td>4.</td>
<td>Production of disinfectant chemicals</td>
<td>Used in silkworm rearing to protect silkworms from disease causing organisms.</td>
</tr>
<tr>
<td>5.</td>
<td>Production of bio-control agents</td>
<td>To protect mulberry as well as silkworm crops from natural enemies.</td>
</tr>
<tr>
<td>6.</td>
<td>Production of rearing equipments - mountages</td>
<td>For use in silkworm cocoon crop.</td>
</tr>
<tr>
<td>7.</td>
<td>Preparation of garlands / flowers and greeting cards from waste cocoons</td>
<td>Value addition and commercial value.</td>
</tr>
<tr>
<td>8.</td>
<td>Pupa oil / powder extraction</td>
<td>Used in detergents and animal feeds manufacturing.</td>
</tr>
</tbody>
</table>


11. Chawki Rearing | Supply of chawki worms – increases the profitability and success of the crop.

II. Post-cocoon Activity

1. Reeling | Process of extracting raw silk thread from cocoons.

2. Twisting | For strengthening the bave.


5. Dyeing | Process of colouring the thread / cloth.

6. Computer Aided Designing | Production of simulated designs which can be weaved.

III. Services

1. Mass disinfection of rearing houses | On rental / contract basis.

2. Renting out of the implements and mountages | As most of them are used for a specific time during the crop, most of the farmers do not own them.

3. Cocoon collection and transportation to the market | Cocoon markets are situated far away from production points and are connected by good roads and timely transport.

4. Distribution of chawki (young age) worms | Transport is not available in private sector for sericulture.

1.2 KISSAN NURSERY

Mulberry is a vegetatively propagated perennial crop and propagation is done through cuttings. Earlier, the demand for new mulberry varieties was met by the farmers easily because the farmers used to do silkworm rearing by using only leaves, and the shoots remained as such and they were used for multiplication. But, nowadays, farmers have adopted the new shoot rearing technology, wherein late age silkworms are fed by shoots. Hence, the availability of cuttings to the new plantations has become difficult and hence a Kissan Nursery is very much required. The farmers can earn money by producing quality saplings of improved mulberry varieties. This is called Kissan Nursery. Important features of Kissan nursery are:

- Farmers get good quality saplings,
- Farmers save time and money,
- Ready saplings are available and gaps in the garden can be filled, and
- Potential yield will be achieved by farmers.

1.2.1 Varieties of Mulberry

The scientific name of the mulberry is *Morus alba*. There are many varieties of mulberry. Among them, the following are the popular varieties *viz*. S36, V1, S13, S34. The varieties can be selected based on the requirement, irrigation facilities, suitability of the variety to the place etc.
1.2.2 Mulberry Plantation Technique

a) When can mulberry be planted?
February-April months are suitable for planting in nurseries so that saplings will be ready by June/August to take up plantation since there will be monsoon rains.

b) Where can the mulberry be planted?
Red, sandy, loamy soils with pH range of 6.5 to 7.5 is good for plantation.

c) Land preparation for nursery
Immediately after the selection of the land for nursery, get it ploughed with tractor for two times minimum. Spread 10-20 MT/acre of decomposed farm manure to the entire land followed by ploughing with country plough. Level the land for easy irrigation. Make the raised beds and also irrigation channel all round the beds. Irrigate the beds 15 days prior to planting of cuttings so that all weed seeds will germinate.

1.2.3 Seed Cuttings

a) How Can We Select the Material for Seed Cuttings?
Be careful in selecting the source of seed cuttings. The source material from which the cutting material is obtained should be free from diseases and pests. The seed material should have an ample supply of stored food to nourish the developing roots and shoots until new plants become self-sustaining. Hence, collect the seed cuttings from exclusive seed gardens of 6-8 months growth after pruning.

Transport the seed cuttings during cooler hours to avoid driage.

b) Preparation of Cuttings
Prepare cuttings of 10-15 cm. length with 3-4 healthy buds using a secateur or sharp bill hook. Nowadays, cutting preparation machine is also available. Do not take over matured basal portion, immature top green portion and cuttings with peeling/splitting of the bark of the shoots. Soak the cuttings in 0.1% Diathane M-45 solution for 30 minutes before plantation to prevent any fungal disease.

1.2.4 Plantation in the Nursery Bed

- Plant the cuttings immediately. Avoid driage and preserve the cuttings under the shade covered with wet gunny bags or green leaves if you cannot plant immediately.
- Plant the cuttings in the nursery bed in a straight position exposing only one bud above the surface of the soil. Leave 20 cm distance in-between rows and 10 cm in-between cuttings.
- Nursery bed with size of 3mx1m accommodates 150 cuttings.
- After planting, do not forget to press the soil around the cuttings to ensure firm fixing and start irrigation immediately.
- Irrigate once in 4-6 days depending on the soil texture and weather conditions.

1.2.5 Maintenance of Nursery

a) Weeding
Perform manual weeding first after 25-30 days and then after 55-60 days of planting. Do not disturb the sprouted cuttings.
b) **Sprouting**

Sprouting starts 10-12 days after planting. Allow only one shoot/cutting to develop and remove smaller shoots using secature.

c) **Fertilizer Application**

When saplings attain 20-25 cm. height in about 55 to 60 days after planting, apply urea at the rate of 20 g/sq. m. after second weeding i.e., 60 g/bed. It boosts the growth of the sapling.

d) **Disease Control**

After 30-40 days, spray 0.1% Bavistin to prevent foliar disease and spray 0.1% D.D.V.P. to prevent pest infestation.

### 1.2.6 Uprooting and Transplantation

After 4 months of planting, the saplings will attain about 90 to 100 cm height and will be ready for transplantation. Two days before uprooting, irrigate the beds for easy uprooting. Uproot the saplings carefully without damaging the bark of main roots. **Plant the saplings as quickly as possible for high rate of survival and transport the saplings during cooler hours.**

Check for any root-borne diseases like root knot and root rot before taking up the plantation. Burn the infected saplings and discard.

### 1.2.7 Economics

By following standard nursery technique, one can get good returns, as indicated in Table 1.2.

#### Table 1.2: Economics of Cost of Production

<table>
<thead>
<tr>
<th>Area</th>
<th>0.5 acre</th>
<th>1.0 acre</th>
<th>2.0 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of saplings expected (@ 80% survival)</td>
<td>64,000</td>
<td>1,28,000</td>
<td>2,56,000</td>
</tr>
<tr>
<td>Total cost of production (Rs.)</td>
<td>32,175</td>
<td>61,750</td>
<td>1,20,100</td>
</tr>
<tr>
<td>Cost of production/sapling</td>
<td>0.49</td>
<td>0.48</td>
<td>0.47</td>
</tr>
<tr>
<td>Total return @ Rs.1.00/sapling</td>
<td>64,000</td>
<td>1,28,000</td>
<td>2,56,000</td>
</tr>
<tr>
<td>Net return @ Rs.1.00/sapling</td>
<td>32,825</td>
<td>66,250</td>
<td>1,35,900</td>
</tr>
<tr>
<td>Total return @ Rs.0.75/sapling</td>
<td>Rs.48,000</td>
<td>Rs.96,000</td>
<td>Rs.1,92,000</td>
</tr>
<tr>
<td>Net return @ Rs.0.75/sapling</td>
<td>Rs.16,825</td>
<td>Rs.34,250</td>
<td>Rs.71,900</td>
</tr>
</tbody>
</table>

### Check Your Progress 1

**Note:**  
a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) List out the business opportunities in sericulture.

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................................................................................................................................................
................................................................................................................................................
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Entrepreneurial Opportunities in Sericulture

Activity 1
Visit a nearby sericulture farm and collect information on cost of production of mulberry saplings.

1.3 COMMERCIAL CHAWKI REARING

Rearing young age silkworm up to 2nd moult is called Chawki Rearing. It is an important aspect of sericulture industry. In India, silkworm eggs are supplied to the farmers in majority and the chawki rearing will be done by the farmers. In Uttarakhand and North-West states of India, chawki worms are supplied to the farmers as done in developed countries like Japan, China and Korea. Nowadays, many chawki rearing centers supply the chawki worms and farmers also prefer this. Hence, it has become a good business opportunity. Important advantages of chawki centers are:

- It ensures uniform embryonic growth and good hatching resulting in healthy and robust silkworms.
- The number of missing larva is minimized resulting in higher larval population.
- Farmers save eight days so that disinfection can be done effectively and they can attend to other works.
- Minimization of pest and disease outbreak by synchronization of crops.
- Easy and effective crop monitoring.
- Stabilization of cocoon crop, improvement in quality of cocoons and increase in yield at farmer’s level.

CSRTI, Mysore has developed a commercial chawki model wherein, with 2 acres of mulberry chawki garden, 5000 dfhs/batch rearing can be done and three such batches can be done in a month. Such a unit will cater to 100-150 acres of mulberry or 100 farmers.

1.3.1 Characters of Chawki Silkworms

- Resistant to high temperature, high humidity and bad ventilation.
- Susceptible to disease.
- Ingestion is less, but digestion is more. High growth rate.

Do you know that out of the total leaf requirement, only 6% is consumed during chawki stage, but the larvae grows 400 times in body weight, 300 times in body size and 500 times in silk gland weight? So, it requires good nutrition. Body water content is very low in the newly born larvae, but increases rapidly till second instar. So, it requires high water content in mulberry leaves. Hence, moisture percentage in the leaves should be more than 75%.

You will learn more details about the chawki garden, in Unit 3 of Block 1.

1.3.2 Requirements of Chawki Rearing Centre (CRC)

A CRC needs:

a) well maintained exclusive irrigated mulberry (chawki) garden;

b) young age silkworm rearing technology package;
c) suitable rearing house with required appliances and equipments; and
d) Well trained manpower.

### 1.3.3 Package of Practices for Chawki Garden

Table 1.3 gives the recommended package of practices for chawki garden and chawki rearing.

**Table 1.3: Package of Practices for Chawki Garden**

<table>
<thead>
<tr>
<th>Area of Mulberry</th>
<th>2 acres Subdivided into 4 sub-plots of 0.5 acres each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety of mulberry</td>
<td>V1 or S36</td>
</tr>
<tr>
<td>Spacing</td>
<td>(150cm+90cm)x60cm (Paired row system or 90 cm x 90 cm (3’x3’))</td>
</tr>
<tr>
<td>Leaf yield</td>
<td>28 MT – 29 MT/2 acres/year</td>
</tr>
<tr>
<td>No. of batches for rearing</td>
<td>3 batches per month</td>
</tr>
<tr>
<td>Irrigation</td>
<td>85,000 gallons of water/ha each time once in 4-5 days</td>
</tr>
<tr>
<td>No. of DFLs reared per batch</td>
<td>5,000 dfls</td>
</tr>
<tr>
<td>Leaf requirement per batch</td>
<td>900 kg</td>
</tr>
<tr>
<td>Total No. of crops</td>
<td>32</td>
</tr>
<tr>
<td>No. of leaf/shoot let harvest/plot</td>
<td>8 (4 times leaf picking and 4 times shoot let harvest)</td>
</tr>
</tbody>
</table>

### 1.3.4 Requirements of Chawki Rearing Center

**Table 1.4: Requirements of Chawki Rearing Center**

<table>
<thead>
<tr>
<th>Type of rearing house</th>
<th>Compact, Cement floor, Plastered walls and Isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of Rearing house</td>
<td>45’ x 40’ (including verandah)</td>
</tr>
<tr>
<td>Floor area</td>
<td>1800 sq. mt.</td>
</tr>
<tr>
<td>Rearing trays (2’x3’ Plastic: 8 trays/100 dfls)</td>
<td>400 trays</td>
</tr>
<tr>
<td>Rearing stands (PVC) (27’ x 7’)</td>
<td>4 stands</td>
</tr>
<tr>
<td>Incubation frames</td>
<td>100</td>
</tr>
<tr>
<td>Feeding stand</td>
<td>6 stands</td>
</tr>
<tr>
<td>Leaf chopping machine</td>
<td>01</td>
</tr>
<tr>
<td>Ant wells: 4 ant wells /1 rearing stand</td>
<td>80</td>
</tr>
<tr>
<td>Power sprayer</td>
<td>One</td>
</tr>
<tr>
<td>Disinfection Mask</td>
<td>Two</td>
</tr>
</tbody>
</table>
Entrepreneurial Opportunities in Sericulture

### Humidity Control Equipment
- Humidifier: 2
- Wet and dry bulb thermometer: One in each room
- Circumferential Room Heater: 2
- Generator: One
- Microscope: One
- Plastic buckets, basins and mugs: 6 sets
- Litter baskets: 04
- Chopping board + knives: 01
- Old newspapers: 10 kg / batch
- Chop sticks: 8-10 pairs
- Feathers (preferably white colour): One dozen
- Gunny cloth: 50 mts.
- Kora cloth: 10 mts.
- Brushing nets (30% shade net): 100
- Bed Cleaning nets (3’ x 4” size): 200
- Disinfectants
  - Bleaching powder: 10 kg/one time
  - Sanitech: 2.5 lit/One time
  - Lime powder: 30 kg./One time
  - Bed disinfectants: 5 kg./one time
- Paraffin paper: 160 mt. (can be used for more rearings)
- Polythene sheet: 160 mt.

### 1.3.5 Comparison of the Economics of Chawki Rearing and Commercial Cocoon Production

Comparative income generation from a piece of land of 2 acres with chawki rearing and commercial rearing is depicted in Table 1.5.

**Table 1.5: Comparative Economics of Chawki Rearing and Commercial Cocoon Production**

<table>
<thead>
<tr>
<th>Type of Rearing</th>
<th>Total DFLs Reared</th>
<th>Total Cocoon Yield @ 60 Kg/100 DFLs</th>
<th>Total Income (@Rs.130/kg)</th>
<th>Total Expenditure (Rs.)</th>
<th>Net Income (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial rearing</td>
<td>2,500</td>
<td>1,500</td>
<td>1,95,000</td>
<td>1,00,000</td>
<td>95,000</td>
</tr>
<tr>
<td>Chawki rearing</td>
<td>1,60,000</td>
<td>-</td>
<td>4,80,000 [@ Rs.300/100 DFLs]</td>
<td>3,50,000</td>
<td>1,30,000</td>
</tr>
</tbody>
</table>
Additional income of Rs.30,000 will be obtained. Therefore, you as an entrepreneur can easily adopt chawki rearing.

### Activity 2

1) Observe chawki rearing centers in the field and write a report.
2) List out the requirements of CRC.
3) Work out the requirements for 1000 dfls/batch.

### 1.4 SILKWORM REARING TECHNOLOGIES AND ECONOMICS

Conducting silkworm rearing and producing the cocoons has become a big occupation to most of the farmers. The farmers are able to earn up to Rs.1 Lakh/year with one acre of land. This activity gives employment to rural people and the entrepreneur can make a sizeable income. There are various models of silkworm rearing, starting from 1 acre up to 10-15 acres.

#### 1.4.1 Silkworm Rearing

Before you start rearing the silkworms, you have to understand the life cycle of the silkworm.

Generally, the larval duration will be for 20-23 days in case of multivoltine races and 26-27 days in case of uni and bivoltine races. However, it also depends on the season, temperature, humidity, leaf quality etc. Silkworm passes through 5 instars and 4 moults. The life cycle of the silkworm is depicted in Fig. 1.1.

![Fig. 1.1: Life cycle of Silkworm](image)

#### 1.4.2 Rearing Plan

Depending on the availability of the mulberry leaf, you can plan for rearing capacity. Planning of the rearing amounts to the completion of work by 50%. Some of the points to be considered for annual planning are:

a) **Leaf Yield:** The leaf yield fluctuates depending upon the season. If you have an irrigated garden, you can get 12,000 to 14,000 kg. of leaf/acre/year in 5-6 harvests. By this, you can estimate the quantity of the layings to be brushed.

i) **Division of plots:** You can make use of the single land for the whole year (Single Plot System) or you can divide the land into two or three plots and...
make use of them for rearing alternatively (Two Plot System) or staggered rearing.

b) **Mulberry Management**: Proper management has to be ensured so as to provide sufficient gap between 2 rearings (a minimum of 10 days gap should be provided)

c) **Selection of Races**: The most popular race for commercial rearing is cross-breed of multivoltine x bivoltine or bivoltines, which can be selected based on the seasons.

d) **Rearing House**: The size of the rearing house should match the brushing capacity.

e) **Rearing Programme**: Rearing programmes may be made for 5 crops model or 10 crops model. The advantage of 10 crops model is a regular income.

### 1.4.3 Methods of Rearing

There are mainly three types of rearing:

```
Rearing

Indoor Rearing   Outdoor Rearing   Mechanical Rearing

- Shelf Rearing
- Shoot Rearing
- Floor Rearing
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The details of different types of rearing is dealt within different units of course 3.

### 1.4.4 Rearing Operations

a) **Disinfection**: The rearing equipments and rearing house should be thoroughly disinfected using recommended disinfectants.

b) **Feeding**: Feed the mulberry leaves collected from well maintained, fertilized plantations which contain sufficient nutrients. Preferably, harvest the leaves in the cooler hours of the early morning or after sunset. You can feed the mulberry leaves as whole leaves or as shoots with leaves or small branches with leaves.

c) **Frequency of Feeding**: The method of feeding has an impact on frequency of feeding. When leaf feeding is adopted, four to five feedings per day is necessary to keep leaves fresh in the bed. When you adopt shoot feeding, you can reduce the feeding to twice or thrice a day.

d) **Leaf Preservation**: Since the storage area of the mulberry has high moisture content invariably, it is susceptible to infection by fungal organisms. Therefore, care should be taken to keep the place clean before storage. When shoots are stored, keep the shoots vertical with the apical buds facing upwards. If humidity is low, keep the whole lot covered with wet polythene sheets. If you sprinkle water directly on the shoot tips, it helps in maintaining water content by preventing loss through evaporation.

e) **Bed Cleaning**: Bed cleaning is very important in silkworm rearing because the litter produced by the silkworms is enormous. You can clean once in every instar in case of shoot rearing (Fig.1.2). However, the moulting worms should be handled carefully.
f) **Spacing:** Since the worms grow rapidly, they need sufficient space too. Do you know that the success of silkworm crop depends upon spacing given in each instar in the rearing bed? Over-crowding in rearing bed leads to insufficient consumption of feed, poor growth and higher incidence of diseases which results in low cocoon yield of inferior cocoon quality. But, overspacing also leads to leaf wastage. Always follow the recommended spacing.

g) **Mounting:** The final operation in silkworm rearing is the transfer of fully grown fifth instar larvae onto special devices called mountages that facilitates spinning. This is called mounting. Mountages: There are different types of mountages like bamboo chandrides, rotary mountages and plastic mountages.

h) **Harvesting and Transportation:** Dead and decaying pupated cocoons should be removed first from the mountage to avoid staining of the good ones. After spinning, the larva moults inside and transforms into a pupa. After harvesting, cocoons should be cleaned by removing litter. Cocoons are transported in loosely filled gunny/cotton cloth bag during cooler hours of the day for marketing. For details on silkworm rearing and economics please refer to the Chapter on Rearing Technology. Table 1.6 indicates the returns from one acre mulberry garden.

### Table 1.6: Economics of 1 acre mulberry garden

<table>
<thead>
<tr>
<th>Dfls Brushing /crop</th>
<th>No. of Crops</th>
<th>Yield/100dfls</th>
<th>Total Yield/Year</th>
<th>Rate/Kg</th>
<th>Income (in Rs.)</th>
<th>Expenditure (in Rs.)</th>
<th>Net Income (in Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 dfls</td>
<td>5</td>
<td>60 kg.</td>
<td>750 kg.</td>
<td>150/Kg</td>
<td>1,12,500</td>
<td>50,000</td>
<td>62,500.00</td>
</tr>
</tbody>
</table>

**Activity 3**
1) Visit a sericulturist and observe the activities of silkworm rearing.
2) Attend the work of application of manures.

**Check Your Progress 2**

**Note:** a) Use the spaces given below for your answers.

   b) Check your answer with those given at the end of the unit.

1) Calculate the dosage of fertilizers.

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   ...................................................................................................................
   ...................................................................................................................
   ...................................................................................................................
2) Name the different types of mountages.

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1.5 WASTE RECYCLING TECHNOLOGY

You may know that from one acre of mulberry garden, we will get 6-7 tonnes of waste every year. This can be converted into compost (Fig.1.3).

![Fig. 1.3: Pit filled with farm wastes](image)

1.5.1 Composting

- Make a pit of 4.5 m (l) x 1.5 m (b) x 1 m (h) size
- Fill all wastes such as excretory material, unused leaf, weeds and green leaves in the pit layer by layer.
- Pour the slurry over these in thin layers.
- Add 20 g. phosphorus, 100-150 g. lime and potash to enrich the compost.
- After filling fully, cover with mud and slurry.
- Then, cover with palm leaves and grass.

In 3-4 months, you will get 4 tonnes of compost.

1.5.2 Method of Preparation of Vermicompost

- Fill the waste materials in a pit and allow decomposing for 10-15 days.
- Mix slurry into it.
- Shift this half decomposed materials to another tank or pit and leave earthworms in the tanks or pits.
- Protect earthworms from ants and predators.
- Maintain the moisture in the pit by spraying water.
- After 40-50 days, vermicompost is ready.
- Remove the manure from the pit and separate the earthworms from manure by sieving.
The visual differences between compost and vermicompost as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Compost</th>
<th>Vermicompost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical appearance</td>
<td>Bulky with undecomposed wastes</td>
<td>Not bulky with completely decomposed wastes</td>
</tr>
<tr>
<td>Moisture</td>
<td>Looks more moist/wet</td>
<td>Looks optimum moist &amp; looks like tea powder</td>
</tr>
<tr>
<td>Presence of pests</td>
<td>Infected by pets like root grubs often</td>
<td>Pest free</td>
</tr>
<tr>
<td>Packing character</td>
<td>Not fit for bags</td>
<td>Fit for bags of even half kg.</td>
</tr>
</tbody>
</table>

Check Your Progress 3

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What are the visual differences between compost and vermicompost?

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1.6 MASS MULTIPLICATION OF BIO-CONTROL AGENTS

1.6.1 Tukra

Tukra is caused due to infestation of mulberry plants by the mealy bug: *Maconellicoccus hirsutus* (Green). The infestation is more in high temperature zones and hence, more in Tamil Nadu than Karnataka and Andhra Pradesh. It is severe in summer. The symptoms are: malformation in the apical shoot due to flattening or thickening of the affected portion of shoot, reduction in inter-nodal distance and wrinkling and curling up of apical leaves. It reduces leaf yield, which is estimated to be approximately 4,500 kg/ha/yr. The mealy bug sucks the sap resulting in stunted growth of the plant and reduction in leaf yield. It can be controlled by releasing the biological controlling agent *Cryptoleanus montrouzieri*, also called ladybird beetle, which is a voracious eater of the mealy bug.
Cryptoleamus montrouzieri - Lady Bird Beetle

Both the adults and grubs of Cryptolaemus montrouzieri feed on all the stages of mealy bug. A single grub consumes a total of 900 eggs, 260 nymphs or 30 adults of mealy bug. C. montrouzieri can easily be multiplied on large scale on the colonies of mealy bug (Kumar et al., 1994).

The production of C. montrouzieri is followed in two steps. First step is the production of mealy bug colonies and second step is production of C. montrouzieri.

a) Procedure for Production of Mealy Bug Colonies

Procure sweet pumpkins (each weighting 2-3 kg) possessing ridges and grooves. (Pumpkins with small stalks make handling easy.)

- Wash the pumpkins with tap water to remove dust and then surface sterilize with 2% formalin.
- Plug the wounds, if any, with paraffin wax. Place fifty to seventy gravid females of mealy bug on the pumpkin for oviposition.
- Keep the infested pumpkin on a tripod stand and place in the wooden oviposition cage (1’ x 1’ x 1’) with a sliding glass in front and the back. Fix the remaining three sides with muslin cloth.
- The mealy bugs settle within 5-6 days and cover the pumpkin in about 20-25 days (Fig. 1.6).

b) Procedure for Production of Cryptolaemus montrouzieri

Release ten pairs of 10-day-old Cryptolaemus montrouzieri on 20-25 day old colonies of Maconellicoccus hirsutus maintained in each oviposition cage for a period of 10 days. The adult beetles feed on the mealy bugs as well as lay eggs singly or in groups of 4-12 in the mealy bug colony, especially in the ovisal. The grubs are visible in a week’s time. Initially, the grubs feed on the eggs and young nymphs. The fully developed beetle emerges in 30 days from the day of the exposure of mealy bug to the beetles. About 250 beetles can be recovered from each oviposition cage. Feed the adults with 50% aqueous honey. Release the adult beetles to the field after 10-15 days when the mating and pre-oviposition period is over.
c) Economics

Production capacity: 18,000 beetles per month

Facility required: A room of 20 sq. mt.

Table 1.7: Capital Investment on Articles

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Items</th>
<th>Qty</th>
<th>Rate (Rs.)</th>
<th>Total Amount</th>
<th>Durability (Months)</th>
<th>Monthly Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stand</td>
<td>8</td>
<td>1,500</td>
<td>12,000</td>
<td>120</td>
<td>100.00</td>
</tr>
<tr>
<td>2</td>
<td>Wooden cages</td>
<td>150</td>
<td>22,500</td>
<td>22,500</td>
<td>120</td>
<td>187.00</td>
</tr>
<tr>
<td>3</td>
<td>Pumpkin stand</td>
<td>150</td>
<td>5</td>
<td>750</td>
<td>36</td>
<td>20.83</td>
</tr>
<tr>
<td>4</td>
<td>Almirah</td>
<td>1</td>
<td>2,000</td>
<td>2,000</td>
<td>120</td>
<td>16.66</td>
</tr>
<tr>
<td>5</td>
<td>Chair</td>
<td>1</td>
<td>400</td>
<td>400</td>
<td>120</td>
<td>3.33</td>
</tr>
<tr>
<td>6</td>
<td>Stool</td>
<td>2</td>
<td>150</td>
<td>300</td>
<td>120</td>
<td>2.50</td>
</tr>
<tr>
<td>7</td>
<td>Table</td>
<td>1</td>
<td>800</td>
<td>800</td>
<td>120</td>
<td>6.66</td>
</tr>
<tr>
<td>8</td>
<td>Plastic containers</td>
<td>150</td>
<td>1,500</td>
<td>1,500</td>
<td>36</td>
<td>41.66</td>
</tr>
</tbody>
</table>

**Total** | **40,250** | **378.64**

Table 1.8: Recurring Expenditure

<table>
<thead>
<tr>
<th>Particulars</th>
<th>No./Quantity</th>
<th>Rate (Rs.)</th>
<th>Total amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries (Consolidated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technician</td>
<td>01</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Labourer</td>
<td>01</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Consumables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building rent</td>
<td>150 Sq. ft</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Electricity charges</td>
<td>150 units</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Water charges</td>
<td>Minimum</td>
<td>3.50</td>
<td>525</td>
</tr>
<tr>
<td>Other costs*</td>
<td></td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>6275</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Other costs include cost of rubber bands, muslin cloth, detergent, paraffin paper, thread, old news papers, brush, stationery etc.*

Total cost of production (18000 adults of *C. montrouzieri*)

Recurring expenditure : Rs. 6275.00  
Monthly depreciation : Rs. 378.64  
Monthly interest on capital : Rs. 402.50  
Total : Rs. 7056.14

Cost of production for 100 beetles of *C. montrouzieri* is Rs. 39.20

Selling rates if Rs. 70.00

1.6.2 Uzi Fly Attack

Uzi fly attacks silkworms, lays eggs on them and when these eggs hatch, the larvae eat silkworms and results in crop loss. Mechanical and chemical methods are available to control the uzi fly attack. However, biological control methods are there to reduce their population. *Nesolynx thymus* is the biological control.
Production of *N. thymus* Involves the Following Steps

a) **Production of house fly pupae**
   - Keep the house fly pupae in nylon net cage and pupa will emerge in 5-6 days. To feed adults, soak cotton in water and keep in a plastic container and add milk powder with sugar in 1:1 ratio.
   - Increase the adult colony room temperature to $28^\circ \pm 2^\circ$C and $90 \pm 5\%$ RH, 1 hour prior to introduction of the oviposition containers.
   - Place oviposition containers in adult fly cage. To collect the house fly eggs, keep cotton dipped in milk solution in a box in the nylon cage for oviposition. Remove oviposition containers in the nylon net cage after 4-5 hours. Gently remove eggs from all oviposition containers with the help of brush.
   - Soak 600 gm. cow dung cake in water for 3-4 hours and powder it. Add 600 gm each of wheat bran and wheat flour. Add 50 gm dry yeast. Mix thoroughly. Add water to make final weight of mixture about 5.5 kg and keep it in a plastic basin. Stir the mixture to ensure uniform distribution of water as well as all the ingredients.
   - Place 15-20 thousand eggs on the surface of larval medium. After 5-6 days of feeding, larvae change to creamy colour.
   - Spread nylon net in a perforated plastic tray. Keep this tray on a non-perforated plastic tray.
   - Gently transfer the larval medium containing the pre-pupa on nylon net and spread the medium. All pre-pupa will fall down through nylon net to the bottom non-perforated tray.
   - Keep these pre-pupae for pupation. In 1-2 days, pre-pupa will change into brownish colour pupae.
   - Daily separate pupae from pre-pupa with the help of wire-mesh. The pre-pupae fall through mesh.
   - Determine number of pupa by volume (30-35 pupae measures 1 ml.)

b) **Steps in mass production of Nesolynx thymus on house fly pupae**
   - Take 500 ml (about 7500 nos.) of freshly pupated (0-day old) housefly pupae and spread them in a single layer in a 2’ x 1’ plastic tray.
   - Provide 50% honey solution on both the sides of plastic strip (8” x 1”). Keep 2-3 strips in each tray.
   - Release 4-5 thousand, one-day-old *Nesolynx thymus* adults in the tray in the ratio of 1:4 (1 female parasite: 4 house fly pupae)
   - Cover the tray with thick white cloth and tightly fix it with elastic to avoid the escape of *Nesolynx thymus* from the tray.
   - After 6-7 days, remove the dead flies and empty shells, if any, by winnowing.
   - Mix equal quantity of 9-13 day old parasitized pupae.
   - Pack 50 ml of mixed pupae in nylon net pouch (4”x5”) (Fig 1.10).
   - Release two packets/100 dfls during 4th-5th day of V instar. Then, shift them to mounting/harvesting place and finally to litter pit (Fig 1.11 & 1.12).
   - From each packet, about 10,000 parasites will emerge and emergence will continue for 8-10 days.
   - Parasitised pupae (10 to 14 days old) can be refrigerated at $10\pm2^\circ$C for a maximum period of one week in case of delay in supply without affecting the quality of the parasitoids.
Fig. 1.8: Housefly adults

Fig. 1.9: Housefly maggots and pupae

Fig. 1.10: Nesolynx thymus pouch

Fig. 1.11. Release of N. thymus pouch in the rearing house

Fig. 1.12. Nesolynx thymus parasitising uzi pupa

c) Economics

Table. 1.9: Economics of production of Nesolynx thymus

<table>
<thead>
<tr>
<th>Monthly Production of Parasitoid Pouches</th>
<th>1700</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monthly expenditure</strong></td>
<td></td>
</tr>
<tr>
<td>Recurrent</td>
<td>13,000</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1,862</td>
</tr>
<tr>
<td>Interest @ 9%</td>
<td>1,125</td>
</tr>
<tr>
<td><strong>Miscellaneous:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17,000</td>
</tr>
<tr>
<td>Cost Price of one pouch</td>
<td>10</td>
</tr>
<tr>
<td>Selling price of one pouch</td>
<td>20</td>
</tr>
<tr>
<td><strong>Net profit per month</strong></td>
<td>17,000</td>
</tr>
</tbody>
</table>

Activity 4

1) Mass multiply the Cryptolaemus Montrouzieri.
2) Mass multiply N. thymus.
3) Release them and observe and record the result.

1.7 SERVICES

You may know that many of our farmers are poor. They do not have sufficient space for silkworm rearing and they do not have mountages. Some farmers are not able to afford to spend money on mountages. They need help. Without mountages, farmers cannot produce quality cocoons, with the result that farmers get lower prices for their products and also incomes will be low. Arranging mountages on rental basis
Entrepreneurial Opportunities in Sericulture
to farmers will earn money in the villages. Usually, the rent will be Rs. 4 – Rs. 5/chandrike/day.

In Kolar region of Karnataka and V. Kota region of Andhra Pradesh, one or two farmers have constructed big buildings suitable for keeping 400-500 bamboo chandrikes. They charge Rs. 7-10/chandrike/day along with mounting space. Farmers use the space and required number of mountages and mount their spinning worms. On the 5th day, they harvest and take their cocoons to market. By this, nearly 10-12 farmers are benefited. Entrepreneurs earn incomes very easily without any risk.

Providing equipments like deflossing machines, sprayers, cutting preparation machines and pruning machines to the farmers on rental basis will also earn good returns.

1.7.1 Marketing Services

Farmers use disinfectants, manures etc. for every crop. Sometimes, they will not get the materials locally and in time. Hence, as an entrepreneur you can start a unit to market these items. You can tie up with the marketing agencies, manufacturers etc. Products that can be marketed are:

- Green manure seeds
- Chemical fertilizers
- Vermicompost
- Biofertilizers
- Small agricultural equipments
- Disinfectants
- Bed disinfectants
- Masks, Gloves

1.7.2 Disinfection Services

Every farmer has to conduct two disinfections per crop. As an entrepreneur, you can take up the disinfection services. For this, you should have a good sprayer with accessories and fuels. You should contact the farmers. The farmers will procure the disinfectants. You can calculate the correct quantity of solution required for the area and disinfect thoroughly the buildings and equipments. The main disinfectants are bleaching powder, slaked lime and chlorine dioxide.

The materials required for disinfection are:

- The above said disinfectants
- Detergent
- Sprayer – rocking or power sprayer
- Buckets
- Measuring jar
- Weighing scales
- Gas masks
Metal pans
Room heaters
Slaked lime powder
Hand gloves
Muslin cloth

**Activity 5**

1) Observe the modality in sales and services with different agencies.
2) Work out the cost and returns for each service.
3) Practise the disinfection.

**1.8 LET US SUM UP**

You have learnt in this unit about the different means for self employment. They are simple and can make use of the existing facilities. In addition to providing the rural mass with employment, waste lands can also be used. The activities suggested here not only give employment but also help the farmer community to harvest good yield. Kissan nursery helps the farmers to obtain the required new varieties in a short duration of time. The farmers will benefit from new varieties. The entrepreneur will get an income within a short period with minimum expenditure. Also taking up of commercial chawki as well as late age rearing fetches good income. Recycle the sericultural wastes by employing scientific compost making and vermicompost techniques which help in enriching soil and also earn money through their sale. Likewise, there are many other activities that help to earn money like multiplication of bio-control agents, sale of required rearing materials and providing services through hiring.

**1.9 GLOSSARY**

**Bio-control Agents** : Those insects which feed on other insects (also called hyper parasites) which are used to control plant based pests.

**Business Opportunity** : The activities in sericulture that could be taken as employment and income generation activity by youth.

**Chawki Rearing** : This refers to rearing of young age silkworms up to second stage.

**Chawki Rearing Centre** : This refers to rearing young age silkworms up to first or second stage and distributing the worms to farmers for taking up rearing of late age worms. The activity is done at commercial levels in different scales.

**Kissan Nursery** : A place where the saplings (small plants) of mulberry are available at a cost.

**Mountage** : The equipment used for spinning.

**Pest** : An insect / non-insect organism which interferes with the welfare of man by way of causing economic loss, discomfort, etc.
1.10 SUGGESTED FURTHER READING


1.11 REFERENCES


1.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The following are some of the activities that provide business opportunities in sericulture:

- mulberry saplings production,
- vermicompost production,
- commercial chawki rearing,
- silkworm rearing,
bio-control agents multiplication,  
disinfection,  
co-operative cocoon marketing,  
manufacturing of mountages,  
preparation of handicrafts like garlands,  
bouquet, etc. from waste cocoons.

Check Your Progress 2

1) The recommended dosage for one acre of irrigated V1 mulberry garden:
   28:11.2:11.2
   NPK (Nitrogen, Phosphorous & Potassium) kg / acre / crop
   Requirement of Ammonium Sulphate (Source of Nitrogen)
   Ammonium Sulphate contains 20.6% Nitrogen
   Required quantity of Nitrogen is 28 kg
   So, the requirement of Ammonium Sulphate fertilizer is 28/20.6×100=136 kg
   Similarly, the requirement of Phosphorus is worked out as:
   The phosphorus content of Single Super Phosphate (SSP) is 16%
   The requirement of SSP is = 11.2/16 x 100 = 70 kg of SSP
   The Potassium content in Muriate of Potash (MOP) is 60%
   The requirement of MOP is 11.2/60 x 100 = 18 kg

2) Different types of mountages include, bamboo mountages, plastic collapsible mountages, rotary mountages, bottle brush mountages and modified rotary mountages.

Check Your Progress 3

1) Differences between compost and vermicompost are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Compost</th>
<th>Vermicompost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical appearance</td>
<td>Bulky with un decomposed wastes</td>
<td>Not bulky and with completely decomposed wastes</td>
</tr>
<tr>
<td>Moisture</td>
<td>Looks more moist / wet</td>
<td>Looks optimum moist &amp; looks like tea powder</td>
</tr>
<tr>
<td>Presence of pests</td>
<td>Infected by pests like root grubs often</td>
<td>Pest free</td>
</tr>
<tr>
<td>Packing character</td>
<td>Not fit for bags</td>
<td>Fit for bags of even half kg</td>
</tr>
</tbody>
</table>