LIVELIHOOD TRAINING MODULE
RESOURCE MATERIAL

ENGLISH VERSION

MIZORAM STATE RURAL LIVELIHOODS MISSION
RURAL DEVELOPMENT DEPARTMENT
GOVERNMENT OF MIZORAM

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OBJECTIVES :

1) To understand the concept of livelihood and various approaches for livelihood promotion.
2) To identify the community livelihood and beneficial strategies for promotion of sustainable livelihoods.
3) To improve the skills and capabilities of community to support farm, off-farm and non-farm based activities.
4) To ensure food and nutrition security at the household and the community level.

DURATION :

These livelihood training are planned for duration of 5 days each with a provision for one day field visit to best practice site within district.

EXPECTED OUTCOME :

1) Community sensitization on the concept of livelihood and various approaches for livelihood promotion
2) Community appreciation on importance of convergence for sustainable livelihood promotion
3) Community sensitization on farming system for maximum utilisation of all resources available
4) Better awareness on skills enhancement available under NRLM

Opening session

Topic 1 – Pre test/expectation

Objectives :

Understanding the participants practice and knowledge about farm and off-farm-based activities

Duration : 15 minutes

Expected outcome : To have an overview about the participants understanding on farm and off farm based activities

Module Plan

Topic	Content	Methodology	Process	Materials Required
Pre test/ expectation	Test Question	Individual test	The trainees will be given paper to write down their experience, practice and knowledge on farm and off-farm based activities	Foolscap paper, Pen

Topic 2 – Introduction to livelihood

Objectives :

To aware the participants on the basic principle of livelihood

Duration : 30 minutes

Expected outcome : Participants will develop understanding and awareness on the concept of livelihood

Module Plan

Topic	Content	Methodology	Process	Materials Required
Introduction to livelihood	* Meaning and concept of livelihoods * Assessment of livelihoods reality	Lecture	Trainer will give lecture on livelihood	LCD projector, Laptop

A livelihood is defined as comprising "the capabilities, assets and activities required for means of living". A livelihoods is said to be sustainable 'when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base'.

Livelihood is :

- a set of economic activities, involving self-employment and/or wage-employment.
- by using one's endowments (human and material).
- to generate adequate resources (cash and non-cash).
- for meeting the requirements of self and the household.
- usually carried out repeatedly and as such become a way of life.
- Ideally, a livelihood should keep a person meaningfully occupied, with dignity, in a sustainable manner.

Four characteristics :

1) Income :

- Income can either be in the form of money, goods, services or in any other form.
- Some income can flow now and some in the future.
- Income could vary with time.
- Income could come in different streams, within the same vocation or from different vocation.
- Some people might receive income in advance, i.e., before putting in efforts. Some receive income by way of transfers
- The income can be enhanced by increasing the number of sources of income, or by increasing the income from any one source.

2) Expenditure :

- Expenditure is to be looked in terms of money, time and energy.
- Most expenditure is to earn income, survive or reduce risk.
- It can also be analysed in terms of perception.

3) **Employment :**

- It means spending time for generating income or obtaining goods.
- It can be increased by increasing the number of days of work within an existing livelihood or by adding new sources of income.

4) **Risk :**

- It exist in any livelihood but the degree of risk may vary.
- Risks also come in the form of spurious seeds, lack of storage facility and market fluctuations in price.
- All these kinds of risks need to be assessed in order to plan for any intervention.
- Addressing the risks involves identifying, assessing, reducing, mitigating and coping.

Livelihoods Framework :

It helps in unravelling the complexity in a livelihoods and identifying all the supports required by a household or community.

- The livelihoods framework provides answers to the following key questions :
- What are the objectives of livelihoods intervention?
- What are the capitals that a household uses to take up activities that achieve livelihoods objectives?
- What is the context in which a household finds itself in and how does the context affect the livelihoods of that household?
- How are the activities, objectives, capitals and contexts related to each other?

Four arrows :

Desired direction of changes of characteristics of livelihood.

Characteristic	**Desired direction of change**
Income (I)	Increase
Expenditure (E)	Decrease
Employment (E)	Increase
Risk (R)	Decrease

It must be noted that decrease in expenditure does not mean going without food. Rather, it means reducing expenditure without foregoing the quality of life. These four characteristics do not act independent of each other. Rather, each one has the potential to influence others. Hence, changes in any one characteristic (arrow) bring about some cascading changes in the other arrows. These relationships make the livelihoods approach a people-centred approach.

Six Capitals :

1) **Natural capital :** It comprises all the items that exist naturally around us – all the items that the nature has given to human kind. It covers non-living creations like land, water, air, natural light and living creations like trees, animals, birds and insects.

2) **Physical capital :** It is all that is man-made. The house, the roads, electricity connections, water supply and sewerage, irrigation systems, schools, libraries etc., fall under this category.

3) **Social capital :** It is support that a family gets from others in the society. This could in the form of encouragement and caution that the household gets from the society, the feeling of binding that exists in the community/network to which the household belongs to, and the enforcement of social norms like repayment of debt and completing the agreed work by the community. Such support, if proper, equitable and democratic in nature, contributes to household achieving the development aims in a just manner.

4) **Human capital :** It comprises of the following attributes of human beings : skills, knowledge, abilities, attitudes and aptitudes. These attributes make human beings into human capital.

5) **Financial capital :** It helps human beings to obtain some goods for consumption and production. Financial capital has two important characteristics : stock and flow. Stock is the amount of financial capital one has or can access at any given point of time. Flow is the money that comes from activities/entitlements/remittances.

6) **Spiritual capital :** It is the specific quest present in human beings that makes them seek a better living than the present and a spirit to fight in the face of adversity. Persons who lack this do not benefit from improvements in other capitals or contexts.

Four Contexts :

1) **Environmental and Ecological :** It comprised of the natural regional characters available in the situation. Though situated in the forest, one area could enjoy a salubrious climate, while another area may be malaria-prone. Similarly, though situated on the coast, one area may have potable groundwater, while another village may suffer from salt water incursion and hence may have to get potable water from a long distance. The presence or absence of natural or physical capitals do not necessarily and clearly indicate the ecological context. One needs to understand it separately.

2) **Techno-Economic :** It comprises the availability of technical know-how and the economic institutions present in the community. The manner in which a village frequently visited by agricultural scientists traverses a different development path compared to a village which does not have this luxury. Similarly, though rich in mineral wealth, an area may not prosper unless good roads/rail transport and electricity are available to mine the minerals and transport it to the place where it is used. Thus, the exposure to technology, the acceptance of new technology, adopting lives to suit the new technology are the aspects that require to be analyzed.

3) **Patterns of distribution :** obtained in a particular context determines the scope and limits of activities possible. The distribution could be related to wealth, existing resources, know-how, access to energy, technology, market, information, education, skills, social status, or political power among the households in the community, or the issues like age structure of the community.

4) **Pattern of expenditures and investments :** in securing food, clothing, health, housing, education, credit, insurance, production and employment differ between communities. These differences not only cause different possibilities in the present, but also indicate the potential possibilities that could be taken up in future. The differences ultimately impact demand generation and investment and thus offer scope as well as limit the possibilities of further progress.

ASSESSMENT OF LIVELIHOODS REALITY

Assessment of the current situation with respect to livelihoods is the first step in any livelihoods intervention planning. The assessment can be taken up :

- To obtain the livelihoods context of a community before undertaking specific research related to household reactions to various variables and their livelihoods strategy.
- To come up with a broader understanding of the situation in order to help the governments develop a policy or intervention strategy.

Livelihoods Enhancement Action Plans (LEAP) :

1) **Social mapping :** The villagers show each household and all other constructions present in the village. It is generally drawn on the ground using colours/rangoli and other material locally available. Social map is helpful in assessing the livelihoods situation of the village.

- Total population (women and men ration, demographic details) and families,
- Social composition (caste groups) of a village,
- Poor households and characteristics associated with poverty,
- Ownership of assets,
- Occupations of the households,
- Housing pattern,
- Number of different livestock,
- Migrant population,
- Number of vulnerable persons like single women, old age persons with disabilities etc.
- Access to various government schemes
- Membership in various informal and formal institutions,
- Leadership in the village.

Analysis of vulnerable persons in the village (as obtained from social map)

Village :	**Block :**	**District :**
Date of exercise :		
Type of Vulnerability	**No. of families**	
	With vulnerable persons	**Accessing entitlements**
Widows		
Single women		
Physically handicapped persons		
Mentally challenged people		
Suffering from various disease		
Household without ration cards		
Migrating households		

Infrastructure/Services analysis in the village (as obtained during social mapping)

Village :	**Block :**	**District :**		
Date of exercise :				
Name	**Location**	**Accessibility**	**Remarks Quality, timely service etc.**	
General				
Roads				
Electricity				
Safe drinking water				
PDS shop/centre				
Education Anganwadi centre				
Centre for continuing education				
Information/public TV				
Primary school				
High school				
College				
Library/reading room				
Technical and other				
Health				
ANM services				
PHC				
Government hospital				
Nursing homes				
Private clinics				
Veterinary services				
Communication				
Telephone				
Bus stop				
Railway Station				

Agriculture				
Agriculture cooperative society				
Market yard				
Agricultural extension service				
Others				
Dairy				
Fire station				
Police station				
Post office				
Bank				

2) **Resource mapping :** It shows all the natural resources present in or around the community, along with the issues like quality, use and access to these resources. This map, along with related discussions, enables the community and the facilitator to know the following information.

- Extent of natural resources present, used and issues related to access.
- Distribution of resources by type.
- Seasonality of resource use.
- Changes in resource use over the years.
- Distribution of ownership and access to the resources.
- Relationship between ownership of land and its uses.
- Investments made to improve and maintain resources and source of such investments.
- Risk faced and what did they do at the time of risk? Do they foresee any risk in future and how are they preparing to handle the risk?

3) **Livelihoods mapping :** It is a tool that lists all the existing livelihoods/vocations in the community and helps the community to select the major livelihoods/vocations (in which the poor involve themselves) for further analysis. It also brings out the gaps that exist in the support mechanisms for these.

After listing all the vocations being taken up in the village, the community is asked to give the following information to each activity :

- Number of households engaged in the activity and the number of households for which this activity is the primary livelihood.
- Seasonality for the activity.
- Days of employment provided by the activity.
- Range of income from the activity.
- Importance for the village.

The following format 'Livelihoods mapping 1' can be used to record the information obtained during the above exercise.

Livelihoods mapping 1						
Village :		Block :			District :	
Date of exercise :						
Participants :						
Facilitated by :						
Number	**Activity**	**Household #**		**Season**	**Employment days**	**Income range**
		Primary	**Other**			

The following additional information is noted in 'Livelihoods mapping 2' for the following three types of livelihoods/vocations :

a) Livelihoods/vocations in which a large number of families are engaged in.
b) Livelihoods/vocations in which the numbers of persons engaged are increasing.
c) Livelihoods/vocations recently introduced into the village.

Livelihoods mapping 2								
Village:		Block :			District :			
Date of exercise :								
Participants :								
Facilitated by :								
Name of the activity :								
Support mechanisms					**Market interaction**			
Support required	**Available (Y/N)**	**Ease of availability**	**Quality of support**	**Cost of support**	**Input markets**	**Terms markets**	**Output**	**Terms**

4) Traded-in and Traded-out : It provides aggregate information of items going out of and coming into the village, both for consumption as well as productive activities. Items traded internally within the village are specifically not captured in this tool. This tool points out :

- Any anomalies present among those items going out of the village and coming into the village.
- Items for which a scope for local value addition exists.

Traded-in and Traded-out		
Village :	Block :	District :
Date of exercise :		
Participants :		
Facilitated by :		

Traded-in (Items coming into the village, including services obtained by villagers from outside)								
Item	**HH purchasing**	**Unit of reporting**	**Periodicity of purchase**	**Quantity purchased by HH per period**	**Quantity purchased by HH per year**	**Rate per unit (Min. & Max.)**	**Total purchases by village**	**Season of purchase**

Traded-out (Items going out of the village, including services provided by villagers to outsiders)								
Item	**HH selling**	**Unit of reporting**	**Periodicity of sale**	**Quantity sold by HH per period**	**Quantity sold by HH per year**	**Rate per unit (Min. & Max.)**	**Total sale by village**	**Season of sale**

5) Income expenditure analysis :

- It brings out the match/mismatch between the cash flows at the household level, other vulnerabilities of the households and coping mechanisms adopted by the households.
- The facilitator select sample households to represent important categories (2-3 households from about 3 categories) in the village.
- The income and expenditure of the past one year or more is the focus of the exercise.

Income and Expenditure Analysis					
Village :	Block :			District :	
Name of household :	No. of members :	Adult male :	Adult female :	Children male :	Children female :
Livelihood activities of the household :					
Date of exercise :					
Participants :					
Facilitated by :					

Income				**Expenditure**			
Source	Periodicity	Season	Amount (Rs)	Item	Periodicity	Season	Amount (Rs)

6) Value-chain analysis : It is a description of

- All the steps through which something attains its value.
- The processes, technology and costs involved in the steps.
- The manner in which the value created gets divided among the actors involved in the steps.

After livelihoods mapping, the facilitator identifies the most important 3-4 livelihoods/vocations for further analysis using the tool of value-chain analysis. Information for this tool is obtained in a four step process.

Step 1: Information from the practitioners of the livelihoods.

Step 2 : Information from persons outside the village, who are related to value addition and marketing activities, following the product through the chain of actors that it passes through till it reaches the end consumer in its various forms.

Step 3 : Identification of best practitioners within the community or nearby.

Step 4 : Best practices adopted anywhere else.

A format of value-chain analysis of a farm-based livelihood can be seen below :

Value-chain Analysis								
Village :			Block :			District :		
Date of exercise :								
Participants :								
Facilitated by :								
Item of value chain :								
	Inputs	Pre-production	Production	Harvest	Post-harvest	Local value addition	Marketing I	Marketing II
Activities								
Materials, Tools								
Person power/labour								
Time								
Seasonality								
Technology								
Expenditure								
Credit (with source)								
Risks								
Infrastructure required								
Total production/sale								
Profit								
Recent changes								
Best practices								
Gaps								
Opportunities								

7) Local market opportunity analysis :

- It is used to observe items that come into the market and go out of the market visited by the target communities.
- The information can indicate opportunities that exist in the local markets.
- Some items could be made locally or processed locally or value could be added to those items that are going out.
- It can provide employment to people.

Local Market Opportunities					
Market studied :		Block :		District :	
Date of study :					
Participants who studied :					
Facilitator :					
Items coming into the market					
Item	Total value	Source markets	Processing of item in the source market	Terms & conditions	Season
Items going out of the market					
Item	Total value	Target markets	Processing after item enters into the target market	Terms & conditions	Season

Topic 3 – Training on soil testing and soil health management

Objectives :

Understand the basic principles of soil testing and enhance understanding about living soil as a medium for plant growth

Duration : 45 minutes

Expected outcome : Participants will develop understanding and awareness on the importance of soil testing for medium growth of plant

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on soil testing and soil health management	* Essentiality of soil testing in crop production for sustainable livelihood * Technique of soil sample collection	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on soil testing through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Concept and importance :

Soil test may refer to one or more of a wide variety of soil analyses conducted for one of several possible reasons. Possibly the most widely conducted soil tests are those done to estimate the plant-available concentrations of plant nutrients, in order to determine fertilizer recommendations in agriculture. In agriculture, a soil test commonly refers to the analysis of a soil sample to determine nutrient content, composition, and other characteristics such as the acidity or pH level. A soil test can determine fertility, or the expected growth potential of the soil which indicates nutrient deficiencies, potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals. The test is used to mimic the function of roots to assimilate minerals. Soil test plays a major role in managing fertilizer programs, increasing plant growth and yield, and managing costs. A soil test will report at what level each nutrient can be found, and which nutrients need adjustment.

Soil tests often check for plant nutrients in three categories :

- Major nutrients : nitrogen (N), phosphorus (P) and potassium (K)
- Secondary nutrients : sulphur, calcium and magnesium
- Minor nutrients : iron, manganese, copper, zinc, boron, molybdenum and chlorine

Soil testing is an essential component of soil resource management. Each sample collected must be a true representative of the area being sampled. Utility of the results obtained from the laboratory analysis depends on the sampling precision. Hence, collection of large number of samples is advisable so that sample of desired size can be obtained by sub-sampling. In general, sampling is done at the rate of one sample for every two hectare area. However, at-least one sample should be collected for a maximum area of five hectares. For soil survey work, samples are collected from a soil profile representative to the soil of the surrounding area.

Techniques of soil sample collection :

Materials required :

1. Spade or auger (screw or tube or post hole type)
2. Khurpi
3. Core sampler
4. Sampling bags
5. Plastic tray or bucket

Points to be considered :

1. Collect the soil sample during fallow period.
2. In the standing crop, collect samples between rows.
3. Sampling at several locations in a zig-zag pattern ensures homogeneity.
4. Fields, which are similar in appearance, production and past-management practices, can be grouped into a single sampling unit.
5. Collect separate samples from fields that differ in colour, slope, drainage, past management practices like liming, gypsum application, fertilization, cropping system *etc*.
6. Avoid sampling in dead furrows, wet spots, areas near main bund, trees, manure heaps and irrigation channels.
7. For shallow rooted crops, collect samples up to 15 cm depth. For deep rooted crops, collect samples up to 30 cm depth. For tree crops, collect profile samples.
8. Always collect the soil sample in presence of the farm owner who knows the farm better

Procedure :

1. Divide the field into different homogenous units based on the visual observation and farmer's experience.
2. Remove the surface litter at the sampling spot.
3. Drive the auger to a plough depth of 15 cm and draw the soil sample.
4. Collect at least 10 to 15 samples from each sampling unit and place in a bucket or tray.
5. If auger is not available, make a 'V' shaped cut to a depth of 15 cm in the sampling spot using spade.
6. Remove thick slices of soil from top to bottom of exposed face of the 'V' shaped cut and place in a clean container.
7. Mix the samples thoroughly and remove foreign materials like roots, stones, pebbles and gravels.
8. Reduce the bulk to about half to one kilogram by quartering or compartmentalization.
9. Quartering is done by dividing the thoroughly mixed sample into four equal parts. The two opposite quarters are discarded and the remaining two quarters are remixed and the process repeated until the desired sample size is obtained.

10. Compartmentalization is done by uniformly spreading the soil over a clean hard surface and dividing into smaller compartments by drawing lines along and across the length and breadth. From each compartment a pinch of soil is collected. This process is repeated till the desired quantity of sample is obtained.

11. Collect the sample in a clean cloth or polythene bag.

12. Label the bag with information like name of the farmer, location of the farm, survey number, previous crop grown, present crop, crop to be grown in the next season, date of collection, name of the sampler etc.

Guidelines for sampling depth

Sl. No.	Crop	Soil sampling depth	
		Inches	cm
1	Grasses and grasslands	2	5
2	Rice, finger millet, groundnut, pearl millet, small millets etc.(shallow rooted crops)	6	15
3	Cotton, sugarcane, banana, tapioca, vegetables etc. (deep rooted crops)	9	22
4	Perennial crops, plantations and orchard crops	Three soil samples at 12, 24 and 36 inches	Three soil samples at 30, 60 and 90 cm

Topic 4 – Paddy cultivation

Objectives :

Sensitizing the participants towards the importance of paddy and System of Rice Intensification (SRI)

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness towards the importance of paddy and System of Rice Intensification (SRI)

Module Plan

Topic	Content	Methodology	Process	Materials Required
Paddy cultivation	* Paddy cultivation in Mizoram * SRI vs shifting cultivation * Settle / permanent cultivation * Seed selection * Land selection & preparation * Seed treatment * Harvesting * Post harvest management	Power point presentation, Interactive learning method	The trainer will discuss the topic on paddy and SRI. Trainer encourage trainees participation by asking them relevant, practical and electives question	LCD projector, Laptop

PADDY (*Oryza sativum*) :

Family – Poaceae

Paddy is an important cereal crops of India and the world. India is the second largest producer and consumer of paddy. Paddy is generally grown in all state of India. Rice contain 6 – 7% protein and good amount of minerals. It is consumed in the form of boil rice and also in preparation of various types of dishes.

Climate requirement :

Paddy is water loving crop, it can be grown successful in area where annual rainfall receiving is between 1000 mm – 1500 mm throughout the year. It requires moderately high temperature of around 30°C - 35°C during germination period (sowing in nursery or field). It is short day nature crop and require around 8-10 hours photoperiod for their flowering and maturity. Excess rainfall is harmful.

Soil and its preparation :

Paddy is generally grown in all types of soil in different part of the country. The ideal soil for the cultivation of rice is clay loam to clay soil. The soil should have good amount of organic matter with pH range of 5.5 – 7.5.

For the preparation of soil, one or two deep ploughing should be done in the month of May – June to exposed the soil for receiving the moisture from rainfall and also to control insect and disease through high temperature during the same month.

Varieties :

a) Hilly areas – PNR - 381, Saket – 4, Pusa – 169, VL dhan – 206, Manhar, VLK – 35
b) Plain areas – Saket – 4, Pusa – 169, Pusa – 33, Ratna

Seed rate :

- For direct sowing : 80 – 100 kg/ha
- For transplantation : 35 – 40 kg/ha

Method of rice cultivation :

1) Direct sowing : Broadcasting and Line sowing
2) Transplanting : Dry – wet method, Wet – wet method

Soil preparation for transplanting of seed :

For the preparation of land for transplanting, the field should be plough once followed by harrowing soon after receiving of rains. Under irrigation condition, the field should be puddle with standing water.

Transplanting :

Usually 2 – 3 healthy seedlings of 20 – 30 days old should be planted at a spacing of 20 x 15 cm apart during Kharif and 30 – 35 days old seedlings should be planted at 15 x 15 cm apart during Rabi season. However the ideal seedling is 21 days old which give better result.

Manure and fertilizer :

A well rotten FYM or compost at the rate of 20-25 tonnes per hectare should be incorporated into the soil up to a depth of 15 cm one week before transplanting. The amount of fertilizers depends upon the status of the soil which may be find out through soil analysis.

Water management :

Paddy is the largest consumer of water. About 5000 litres water is required to produce 1 kg paddy. Until the transplanted seedling is well established, the water is allowed to stand in the field at a depth of 2-15 cm water. Therefore, about 5 cm water may be maintain upto dough stage, the water should be drain out from the field at least 1 week before harvesting. In kharif season, extra irrigation is not needed.

Weed management :

Infestation of weed in rice field reduced grain yield by 50-70% in upland, 30 5 in drilled irrigated and 20-22 % in transplanted crop. The weed may be control by giving 2–hand weeding i.e. 1st weeding at 20-25 days after transplanting and 2nd weeding at 40-45 days after transplanting.

Plant protection :

1) Blast :

It is caused by *Pyricularia oryzea*

Boat or eye shape spot with grey or dark brown margin appears on the leaf sheath at the time of panicle emergence, the stem below the ear head get infected and turn into brown to black spot, that may covered the whole stem and stop translocation of food.

Control measure :

1. Treating the seed with Agrosan GN at the rate of 2.5 g/kg of seed.
2. Growth tolerant varieties like Ratna, IR – 24 and Zaya.
3. Crop rotation.

2) Sheath Blight :

It is caused by *Corticium sasaki*

The symptom of disease appear on leaf and leaf sheath as 2-3 long greenish lesion surrounded by bluish grey narrow bands. The disease ear head grains remain empty.

Control :

1. Collect and warm infected plant
2. Use long duration crop rotation.
3. Use healthy seed and seedling

3) Stem rot :

It is caused by *Leptophearia salvini*

Develop large number of black smooth, shining sclerotia in the stem, such infected stem gets rotten and falls.

Control measure :

1. Destroy infected stubble by burning and deep ploughing.
2. Avoid standing water for long period.

4) Khaira disease :

Deficiency symptoms of zinc in the soil. Usually occurs in nursery bed. It may also appear as patches after 10-15 days after transplanting. Growth of disease effected plants is stunted.

5) Tungo virus :

Older leaf turns into yellow starting from the tips and margin interveinal chlorosis is observed. Plant become stunted and bears penical with empty grain.

Control measure for 4 & 5 :

1. Grow resistant variety such as Ratna and IR – 20.
2. Isolated plant showing disease symptoms in the initial growth should be destroy.
3. Use crop rotation.

Insect : Stem roller, leaf roller, Gundhi bug and rice thrips are the major insect of paddy.

Control : Maintain proper spacing and regular weeding.

Harvesting :

Different varieties of paddy mature within 100 – 150 days of growth period.

Yield :

The average yield of paddy is 15 – 20 tonnes per hectare.

SYSTEM OF RICE INTENSIFICATION (SRI) :

System of rice intensification is a new system of rice cultivation. It involves cultivating rice with as much organic manure as possible, starting with young seedlings planted singly at wider spacing in a square pattern and with intermittent irrigation that keeps the soil moist but not inundated, and frequent inter culture with weeder that actively aerate the soils.

Method of SRI cultivation :

Nursery management :

The seeds for SRI cultivation should be healthy. The nursery should be 1 meter width and length according to one wills. Bed should be walled by wooden, bamboo or any material that is convenient to the farmer. Pre – sprouted seed are sown on raised nursery bed. After that, apply a layer of fine manure. Spread sprouted seed sparsely and then cover with another layer of manure. Cover with paddy straw and water carefully. Depending on the size of farm, nursery bed should be made at 2 – 3 places.

Seed rate :

For SRI cultivation, 5 kg seed per hectare is enough i.e. 2 kg per acre.

Transplanting :

8 – 12 days old seedlings are transplanted. Care should be taken during pulling out and transplanting of seedlings. A metal sheet is inserted 4 – 5 inches below the seed bed and the seedlings along with seed and soil lifted without any disturbance to the root.

Due to its young seedlings and softness or sensitivity, transplanting should be done within 15 – 20 minutes from the pulling out of seedlings. Because of early sowing, the plants have long duration for growing, which result in better growth and increase in penicle.

Spacing :

Lines should be drawn both ways at 10x10/12x12 inches apart with the help of marker and transplant at the intersection.

Land preparation :

Land should be plough thoroughly and maintain careful and proper levelling so that water can be apply evenly. During transplanting, land should be made moist and excess water should be drained out of it.

Irrigation :

The purpose of irrigation is just to wet the soil, just enough to saturate the soil with moisture. Subsequent irrigation is needed when the soil develops fine cracks.

Weed management :

Weeding should be done from the 10^{th} day of transplanting. In SRI, chemical weedicides is not recommended; hence rotary weeder is commonly used for weeding.

Fertilizers :

Compost or FYM should be applied instead of adding chemical fertilizers. 10 tonnes per hectare of FYM is recommended for better growth of the plants.

Yield :

By common method of rice cultivation, the average yield is 20-25 qtls/ha. But by SRI method the yield is thrice that of the common practices.

Benefits of SRI :

1. Higher yield both grains and straw
2. Reduced duration
3. Lesser chemical input
4. Less water requirement
5. Lesser seed rate

Topic 5 – Training on organic farming

Objectives :

Sensitizing the participants toward the application of organic fertilizer

Duration : 45 minutes

Expected outcome : Participants will develop understanding and awareness towards organic farming and application of organic fertilizer

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on organic farming	* Importance of organic farming * Impact on the environment sustainability *Vermicompost	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on organic fertilizer. Trainer will asked the participants experience of using organic fertilizer	LCD projector, Laptop

What is organic farming?

Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organism, antibiotics and growth hormones.

Organic farming promotes the use of crop rotation and cover crops, and encourages balanced host/predator relationships. Organic residue and nutrient produced on the farm are recycling back to the soil. Cover crops and composted manure are used to maintain soil organic matter and fertility. Integrated pest management and soil conservation system are valuable tools of organic farm. Organic farming works in harmony with nature rather than against it. This involves using technique to achieve good crop yields without harming the nature, environment or the people who live and work in it.

General principles of organic farming :

1) Protect the environment, minimize soil degradation and erosion, decrease pollution, optimize biological productivity and promote sound state of health.
2) Maintain long term soil fertility by optimizing condition for biological activity within the soil.
3) Prepared organic products, emphasizing careful processing and handling method in order to maintain the organic integrity and vital qualities of the products at all stags of production.
4) Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation.
5) To promote more usage of natural pesticides.

Advantages of organic farming :

1) Nutrition : The nutrition value of food is largely a fuction of its vitamin and mineral content. In this regard, organically grown food is dramatically superior in mineral content to that grown by modern conventional method.

2) Poison free : A major benefits to consumers of organic food is that it is free of contamination with health harming chemical such as pesticides, fungicides and herbicides.

3) Maintain soil fertility : It conserves the soil fertility by using mulching system, which prevent the surface runoff, land degradation and erosion.

4) Food taste better : The originally grown food taste better than that of conventionally grown. The tastiness of fruits and vegetables is directly related to its sugar content which in turn is a function of the quality of nutrition that the plant itself enjoyed.

5) Lower input cost : In organic farming, the cost of production is much more less as compared to the conventional farming which involves the use of chemical fertilizer.

6) Increased life : Organically grown plants are nourished naturally as a result of which organically grown foods can be stored longer and do not show susceptibility to rapid mold and rotting.

Method of organic farming :

1) ***Crop rotation :*** It is the practice of growing a series of dissimilar or different types of crops in the same area in sequence season. It is done so that the soil of farm is not used to only one type of nutrient. It helps in reducing soil erosion and increase soil fertility and crop yield.

Example : Rotation of two rows within a year
Paddy – legume crop (cowpea) – paddy
Rotation of three crops within a year
Paddy – cowpea – mustard - paddy

2) ***Green manuring :*** Green manures are crop grown specifically for building and maintaining soil fertility and structure, though they have other factions. They are normally incorporated back into the soil, either directly or after removal and composting. The common green manuring crops are cowpea, mustard, soyabean, red gram, pea etc.

3) ***Crop diversity :*** Leaving behind the practices of monoculture, organic farming involves the use of poly-culture in which different kinds of crops are harvested and cultivated in order to meet the increasing crop demand and produce the required soil microorganisms.

4) ***Organic waste :*** Organic waste are of animal dung, urine and slurry from biogas plants and human habitation waste such as human urine, town refuse, sewage, poultry litter etc. and slaughter house waste such as bone meal, blood meal, horn and hoof meal and fish waste. These materials contain high dose of organic materials which is a good source of nutrients to the plants and crops.

5) ***Biological pest control :*** Biological pest control is a method of controlling pests such as insect, mites, using other organism. The pest is control by introducing natural enemy of the pest; it can also be done by planting trap crops.

6) ***Weed management :*** At the ground level, weed refers to the unwanted plant that grows in agriculture fields. However, in organic agriculture, there is more focus on suppressing the weed rather than eliminating it completely. This is adopted by two processes :

- **Mulching :-**

It is a process wherein plastic films are used in order to block the growth of weed.

- **Mowing and cutting :-**

Wherein there is removal of weeds top growth.

TYPES OF ORGANIC FARMING :

Organic farming is categorized on the basis of use of different types of process and fertilizing techniques to produce a new and pure healthy variety of crops which is very essential for living species. The two main types of organic farming are :

1) ***Pure organic farming :*** A type of organic farming in which crops is produced with help of different kinds of organic fertilizers and different kinds of biological natural insecticides without any interference of inorganic fertilizers or chemicals.

2) Integrated Organic farming : A type of farming in which development of crops from natural resources having the complete nutritive value and also manage to prevent the crops or plants from pest. It involves integrated nutrient management and integrated pest management.

VERMICOMPOST :

Vermicompost is the product or process of composting using various worms to create heterogeneous mixture of de-composting vegetable or food waste. Vermicompost is the excreta of earthworms, which is rich in humus and nutrients, it can be done on small and large scale. It is mostly rear in the brick tank of convenient size. By feeding these earthworms with biomass and careful management, we can produce the required quantities of vermicompost

Materials for preparation of vermicompost :

1. Crop residue
2. Weed biomass
3. Vegetable waste
4. Leaf litter
5. Cattle dung
6. Field soil

Earthworm varieties :

Out of many species of earthworms, ***Eisenia foetida*** (Red wigglers) ***Eudrilus Eugehiae***, ***Periony excavates*** are the common species for vermicomposting. The most used is *Eisenia foetida* (Red earthworm), due to their fast multiplication, which results in better and fast production of cast. More over their habit of feeding is from top to bottom, which is most convenient for vermicompost production.

Physiology : ***Eisenia foetida***

1.	Body length	:	3 – 10 cm
2.	Body weight	:	0.4 – 0.6 g
3.	Duration of mature	:	50 – 55 days
4.	Potential yield	:	1000 earthworm can produce 2 qntl in months
5.	Amount of egg produce	:	One in 3 days

6. Duration from egg to mature stage : 20 -30 days

Method of preparation :

Before preparing vermicompost one has to know the needs of earthworms. Compost worms need five basic things which are:

1. An hospitable living environment, usually called bedding.
2. A food source
3. Adequate moisture
4. Adequate aeration
5. Protection from extreme temperature.

Vermicomposting can be done in two ways, on the ground and in the tank, if prepared in flat ground, the compost material should arrange/heap at 6x2x2 feet. This method is of low cost and easy process.

The other common process is preparing in the concrete/ brick tank. A cement tub may be constructed to a height of two and half feet and a breath of 3 feet. The bottom of the tub is made to slope to drain the excess water from the vermin-composting unit.

Steps of preparation :

1. The site for vermin-composting should be properly selected. The place should in shade area with high humidity and cool.
2. The compost material such as green leaves; crop residue, etc. should be properly chopped into small pieces.
3. The cattle dung should be dried in open sunlight for vermicompost production.
4. The proportion of cattle dung and crop residue should be maintain at 3:1. This should be first compost for 15 – 20 days.
5. After this, the worms of 1000 red wigglers are placed inside the bedding by scattering on top of the compost.
6. After putting worms, the compost pit/bedding should be watered.
7. The pits should have a roof made of various materials available such as, straw, silpaulin etc.
8. For moistening of the beds, water should be given every day. The amount of water needed depends on the size of the pits/tank.
9. The vermin-compost will be ready to harvest in 50 – 60 days.
10. In the tub of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in a week.

Nutritive value of vermi-compost :

The nutrient content in vermicompost vary depending on the waste materials thar are being used for compost preparation. It contains NPK and other nutrients that are important for good growth of crops.

1.	pH	:	6.8
2.	Total Nitrogen (%)	:	1.02
3.	Available N (%)	:	0.15
4.	Available P (%)	:	0.30
5.	Available K (%)	:	0.24
6.	Ca (mg/100g)	:	8.8
7.	Mg (mg/100g)	:	5.50

Topic 6 – Training on Integrated Pest Management and Integrated Nutrient Management

Objectives :

Creating an awareness on the importance of INM and IPM

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness towards the importance of INM and IPM

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Integrated Pest Management and Integrated Nutrient Management	* Types of pest * Organic pest management * Trap crop * Introduction of nitrogen fixing plant * Green manure and organic manure * Crop rotation Creating an awareness on the importance of INM and IPM	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on INM & IPM through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

What is Integrated Pest Management?

Integrated pest management is based on ecological principles and involves the integration and synthesis of different components/control tactics into pest management system.

Huffaker and Croft (1976) have described a series of phases in the evolution of an IPM programme :

1) Single tactics phase – Emphasis is generally placed on a single pest utilizing a single tactic.
2) Multiple tactic phase - This phase embraces a variety of tactics (cultural, mechanical, physical, chemical, biological, host resistance, regulatory etc.) in manipulating pest population.
3) Modelling phase – This involves, the conceptualizing of the process involves in pest management system through mental, pictorial, flowchart and mathematical models. As the volume and complexity of data increase, more sophisticated modelling techniques become necessary.
4) Management or optimizing phase - This process involves the construction of a functional IPM system utilizing compatible subsystem in optimizing the integration of this IPM system with the overall crop production system.
5) System implementing phase - This is the ultimate phase through which the optimal systems are unified for delivery to and utilization by the farmer.

Pest management :

The use of chemicals for the control of pests increased tremendously during the last decades. It was realized later that many of these chemicals were not biologically degradable and they not only persisted in the environment but also became concentrated through the food chains. With the consciousness of using the chemicals judiciously to minimize the pollution hazards, the scientist recommended that pest should be controlled by integrating the use of biological agents with the use of insecticides. Based on this concept, Barlett (1956) coined the term 'Integrated pest control' which was defined as the blending of biological control agents with chemical control measures.

According to National Academy of Sciences, IPM refers to an ecological approach in pest management in which all available necessary techniques are consolidated in a unified programme, so that population can be manage in such manner that economic damage is avoided and adverse side effects are minimized (NAS, 1969).

Different method of pest control :

1) ***Cultural method*** : The cultural methods of insect control comprise regular farm operations, which are performed to destroy the insects or to prevent them from causing injury. A large number of insect are normally killed by farmers unconsciously when they expose them to adverse climatic or biological condition through agriculture operations like ploughing, hoeing, weeding etc. For achieving cultural control, the agricultural practices can be categorised under various groups :

a) ***Tillage :*** Characteristics of soil such as texture, chemical composition, moisture, temperature and soil fauna influence the survival of soil – infesting insects. These characteristics also influence the quality of food which determine the abundance of a given pest. Thus, with the proper stirring and management of the soil, many insects can be controlled.

b) ***Clean seed :*** A number of insect pests are carried over from one crop to the next through seeds, cuttings or other infested plant parts. Certified seeds, free from pests and diseases, should be used for raising a new crop. The seeds should also be treated with salt solution or other materials before sowing.

c) ***Irrigation :*** After harvesting of the plants, the field should be irrigated by flooding, this will let the insects drowned and will driven out and exposed to their natural enemies.

d) ***Crop spacing :*** Maintaining of proper spacing results in decreasing of pest attacks. The insect attack is more high in closely planted crops.

e) ***Crop rotation :*** Crop rotation minimize the attack of a given crop by replacing with different types of crops. Rotation of crops like maize – sugarcane, Cotton – maize – rice, Cotton – cowpea – Soybean minimise the incidence of insect pests.

f) ***Trap crops :*** Some early crops are sown in narrow strips around a major crop to serve as a trap for the pests that might be common to both. The trap crop can be harvested early or otherwise cut and use as fodder. Trap may also attract natural enemies thus enhancing natural control.

Example :

Main crop	Trap crop (s)	Insect pest (s)
Cabbage	Mustard	Diamond back moth
Cowpea	Pigeon pea	Cowpea borer, flower thrips, Bihar hairy catterpillar
Tomato	Cucumber	Whitefly, mites
Maize	Cucurbits, Sorghum	Shoot fly

g) **Pruning and thinning :** Some pest are normally carried from the old crops to the new one. It is particularly so in the same case of perennial plants, such as the fruit trees. Proper pruning of the undesirable portion of citrus plants is useful for keeping under check the citrus leaf minor.

h) Proper timing of sowing and harvesting can check the pest attack. The destruction of crop residue also check the attack of pest.

2) **Mechanical and physical method :** Mechanical and physical control measures involves the use of force or physical factors of the environment with or without the aid of special equipment. The physical control measures give immediate tangible result and are generally popular and convincing to the farmers even though they are time – consuming, laborious when much damage has already been done.

Manual labour : It means working with hands, sometimes with the aid of some simple equipment like bags, nets etc.

a) ***Hand picking :*** Insects can be hand picked if they are easily accessible to the picker, large and conspicuous and present in large number. This method is recommended for dealing with adults and egg clusters of the lemon butterfly, grabs of the mustard sawfly etc.

b) ***Hand nets and bag nets :*** The bags is a strong cloth bag, 2 meter long with its out measuring 1 x 1.5 metres and supported with bamboo sticks and two strings on the upper side. It is scraped on the surface of the ground by two men and is recommended against the surface grasshopper, crickets etc.

c) ***Beating and hooking :*** Killing houseflies with fly flappers and locusts with broom or thorny bushes is effective.

d) ***Shaking or Jarring :*** Shaking of small tree and shrubs, particularly in the morning in the cold season when the insects are benumbed and collecting them in open tubs containing keratinised or simply burried in the pits is effective against locusts and the defoliating beetles.

e) ***Mechanical exclusion :*** Mechanical exclusion consists of the use of devices by which insects are physically prevented from reaching crops and agriculture produce. The various methods include : screening windows, doors and ventilators of houses to keep away the insects. Wrapping individual fruits of pomegranate and citrus with butter paper envelopes to save them from insect attack, trenching field or erecting barriers, using red

light in the monsoon to keep away most of insect, scaring birds by creating noise with explosive etc, are quite effective in preventing insects attack.

f) ***Mechanical trap :*** Various type of trap are : Cricket trap, house fly trap, light traps, electric traps etc.

3) **Chemical :**

4) **Biological :** Biological control or biocontrol constitutes a deliberate attempt to use natural enemies either by introducing new species into the environment of a pest or by increasing the effectiveness of those already presents. Traditionally this method was employed to control insect pests by parasites, predators and pathogen.

Agents of biological control :

a) ***Vertebrates :*** Fishes, tadpoles, frogs and toads destroy large number of mosquito larvae and other harmful aquatic insects. On land also, frogs, toads, salamanders and lizards are active all day eating insects, many of which are crop pests. There are many useful birds which destroy pests of crops and are often seen following the plough and they pick up grubs and other insects that get exposed.

b) ***Arthropods :*** From the point of view of biological control, three groups of arthropods are important, which are

i) Spiders – The spiders universally live a predatory life and are constantly on the look out for insects as their food. They catch them directly or with the help of various types of snares made out of webs.

ii) Mites – Vegetables mites are notorious pest of many crops, some of them also infest man and domestic animals and cause scabies. They act as ectoparasites on many small insects, on the eggs of locust and grasshopper.

iii) Insects form the single largest and the most important group of predators and parasites. It is believe that 25 – 33 % of insects are useful to farmers as they control or suppress population of known or potential pests.

5) **Host resistance, Regulatory :**

What is Integrated Nutrient Management?

Integrated nutrient management is the maintenance or adjustment of soil fertility and plant nutrient supply at an optimum level to sustain the desired crop productivity. This is done through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. In other words, integrated nutrient management is the use of different sources of plant nutrients integrated to check nutrient depletion and maintain soil health and crop productivity.

Concepts :

1. Regulated nutrient supply for optimum crop growth and higher productivity.
2. Improvement and maintenance of soil fertility.
3. Zero adverse impact on agro-ecosystem quality by balanced fertilization of organic manures, inorganic fertilizers and bio- inoculants.

Why is Integrated nutrient Management required?

The increasing use of chemical fertilizers to increase the production of food and fibre is causing concern for the following reasons :

- Soils which receive plant nutrients only through chemical fertilizers are showing declining productivity despite being supplied with sufficient nutrients.
- The decline in productivity can be attributed to the appearance of deficiency in Secondary and micronutrients.
- The physical condition of the soil is deteriorated as a result of long-term use of chemical fertilizers, especially the nitrogenous ones. It also aggravates the problem of poor fertilizer nitrogen use efficiency (NUE).
- Excess nitrogen use leads to groundwater and environmental pollution apart from destroying the ozone layer through N_2O production.

Why is Integrated Nutrient Management important?

The recent energy crisis, high fertilizer cost and low purchasing power of the farming community have made it necessary to rethink alternatives.

Unlike chemical fertilizer, organic manure and bio fertilizer available locally at cheaper rates. They enhance crop yield per unit of applied nutrients by providing a better physical, chemical and microbial environment. This ultimately improves crop yield.

The available quantity of animal excreta and crop residues cannot meet the country's requirements for crop production. Therefore, maximizing the usage of organic waste and combining it with chemical fertilizers and bio fertilizers in the form of integrated manure appears to be the best alternative.

Different sources of organic manures for Integrated Nutrient Management :

There are various sources of organic manure to be used for INM. Some of these are mentioned below:

i) Compost/vermin-compost

ii) Farm Yard Manure (FYM)

iii) Poultry Manure

iv) Pig manure

v) Urban and rural solid and liquid waste. Wastes from agro based industries

vi) Crop wastes

Topic 7 – Spices

Objectives :

Train the participant to impart the knowledge of spices management for better production

Duration : 45 minutes

Expected outcome : Participants will develop understanding and awareness towards the knowledge of spices management for better production

Module Plan

Topic	Content	Methodology	Process	Materials Required
Spices (Ginger, Chilli, Turmeric, Garlic, Onion, Dhania)	* Introduction of spices * Different varieties * Seed treatment * Propagation of land * Spacing requirement * Diseases and pest management * Harvesting * Post harvest management * Marketing	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on spices through powerpoint followed by an interactive session with the participants	LCD projector, Laptop, leaflet

GINGER :

(*Zingiber officinale L*)

Family: Zingiberaceae

Ginger, indigenous plants, is an important spice crop of the world. It is valued in medicine as a carminative and stimulant of the gastro-intestinal tract. Dry ginger is used for manufacture of essence, soft-drinks, non-alcoholic beverages etc. It is produced into various forms such as paste, pickle etc.

In India, ginger is grown on various regions across the country; India is the largest producer and exporter of ginger, sharing 40% of world production.

Climate and soil :

Ginger grows best in warm and humid climate. It is mainly cultivated in the tropics from sea level to altitudes of 1500 m, both under rainfed and irrigated conditions. For successful cultivation of the crop, a moderate rainfall at the showing time till the rhizomes sprout, fairly heavy rainfall during the growing period, and dry weather with a temperature of 28°C – 35°C for about a month before harvesting are necessary.

Ginger thrives best in well drained soils like sandy or clay loam, red loam or laterite loam. A friable loam, rich in humus is ideal. However, being an exhausted crop, soil should be rich in fertility.

Varieties :

1) Maran (Assam)
2) IISR Varada, IISR Rajetha (High yielder, high quality bold rhizomes, Low fibre content – 3.29 % to 4.50 %)
3) Himagiri (Best for green ginger, less susceptible to rhizome rot disease, suitable for rainfed condition, Fibre content – 6.05, essential oil – 1.7%)

Sowing :

The best time for planting ginger in North Eastern States is during April. Under irrigated conditions, it can be planted well in advance during the middle of February or early May.

Seed rate : The seed rate varies from 1500 – 1800 kg per hectare from region to region.

Preparation of land planting :

Preparation of land starts with the receipt of early showers. Land should be ploughed to remove Weeds, stables, roots etc. Beds of about one metre width, 15 cm height and of any convenient length are prepared at an interspace of 40 – 50 cm in between beds.

Ginger is always propagated by rhizomes, known as seed rhizomes. Carefully preserved seed rhizomes are cut into small pieces of 2.5 – 5.0 cm length each having one or two good buds.

Seed treatment :

The seed rhizomes are treated with 0.3 % Mancozeb for 30 min, drained and planted at a spacing of 20 – 25 cm along the rows and between the rows.

Manuring :

At the time of planting, well decompost cattle manure or compost at the rate of 25 – 30 tonnes per hectare along with 2 tonnes of neem cake is to be applied along with 50 kg P_2O_5 and 25 kg K_2O. They may be applied either by broadcast over the beds prior to planting or applied in pits at the time of planting.

Mulching :

Mulching the beds with green leaves or organic waste is an important operation for ginger. Besides a source of organic manure, mulching prevents washing of soil, conserves soil moisture, prevents weed growth and improves the physical properties of the soil. Mulching is done at the time of planting and second mulching at 46 days after planting.

Weed management :

Weeding is done just before fertilizer application and mulching. Two or three weeding is required depending on the intensity of weed growth. Proper drainage channel are to be provided when there is stagnation of water.

Rotation and mixed cropping :

Being exhausted crops, it is not desirable to grow ginger in the same land continuously for years and is hence commonly rotate with other crops. The crops most commonly rotated with ginger are Tapioca, chillies, Paddy, maize and vegetables. Ginger is also grown as an intercrop in coconut, arecanut, coffee, orange and mango plantations.

Harvesting and curing :

Harvesting is done from 6th month onwards for marketing the produce as green ginger. The rhizomes are thoroughly washed in water two or three times to remove the soil and dirth and sun dried for a day.

For preparation of dry ginger, the crop is harvested between 245 to 260 days after planting, when the leaves turn yellow and start gradually drying up.

Yield :

The average yield per hectare varies from 15 – 25 tonnes.

Plant protection :

Pests/Disease	Symptoms	Control measure
Shoot borer	Larvae bore into the pseudo stem and feed on growing shoots, yellowing and drying of the infested shoots.	Spray malathion 0.1%during July – October at monthly interval
Leaf roller	Rolls the leaves and feed on them	Spray carbaryl 0.1%
Diseases Soft rot or rhizome rot	Collar region exhibits rotting and it spreads to rhizome and root. Leaves exhibit yellowing symptoms	1. Provide good drainage and select healthy, disease free seed rhizome. 2. Treat seed rhizomes with 0.3% Mancozeb for 30 min. before storage and planting.

CHILLI :

Introduction :

Chilli is one of the most valuable crops of India. The crop is grown largely for its fruits all over the India. It is used in India as a principle ingredient of various curries, and chutneys. It is also used for vegetables, spices, condiments, sauces and pickles. Dry chillies are used for curry powder. Red colour in chilli is due to "Capsanthin". Pungency in chillies is due to the active constituent "Capsaicin", an alkaloid, is extracted from chillies and is used to medicine.

Climate :

The chilli is a plant of tropical and sub -tropical region -It grows well in warm and humid climate and a temperature of 20°C to 25°C. Low moisture in soil during blossom development and fruit formation causes the bud, de-blossom and fruit drops. Excessive rainfall is detrimental to the crops, because it brings about defoliation and rotting of the plant. As a rained crop, it is grown in areas receiving an annual precipitation of 25-30 inches.

Varieties :

1. Agnirekha
2. Musahvadi
3. Phule Jyoti
4. Jayanti

Soil and its Preparation :

Chilli can be grown in all type of soft but the sandy - loam, clay loam and loam soils are best suited for it, the soil must be well drained and well aerated. Acidic soils are not suitable for chilli cultivation.

The land is prepared by giving 2-3 ploughings and clod crushing after each ploughing. Compost or FYM @ 150-200 quintals should be spread and mixed well in the soil at least 15-20 days before sowing.

Layout & Spacing :

Ridges and furrow type of .layout is used. Seedlings are raised on raised bed. Spacing for rained crops is 60 x 45 cm & for irrigated crops is 60 x 60 cm.

Manures & Fertilizers :

9 to 10 tones/hectare of FYM or compost is applied at the time of field preparation. In chilli for rained crop 50 kg N and 25 kg P should be applied 1/2 dose of N full dose of P applied at the time of transplanting. Remaining Yi dose of N applied 30 days after transplanting for .irrigated crop 100 kg N, 50 kg P & 50 kg K should be applied per hectare. Fertilizers are applied in four equal doses. First applied at the time transplanting remaining doses are applied at 4^{th}, 11^{th} & 13^{rd} week after transplanting.

BIO FERTILIZER AND BIOPESTICIDE :

(Pseudomonas /Trichoderma/ Phosphate solubilizing bacteria (PSB)/Azospirillum)

Seed treatment :

One container/ 500gm for an acre of seed (if seed rate is >10 kg. use two containers)

Soil Application :

Mix 1 container (1liter)/5 kg (Solid) in 100 kg of farmyard manure and cover it for 7 days with polythene. Turn the mixture in every 3-4 days interval and then broadcast in the field.

Foliar Spray :

Dilute 1 container in 50 litre of water and spray to the crop of an acre.

Seedling (Root Dipping) :

Dilute 1 container/500gm in 10 litres of water, keep the seedling roots in immersed condition for 30 minutes and transfer it to the field.

Intercultural Operations :

2-3 shallow hoeing should be given to the soil to kill the weeds and provide soil mulch during early stages of growth- Application of weedicides for controlling the weeds is found effective. Lasso @ 1.5 liter per hectare with one hand weeding or Tok-E 25@ 2 liters per hectare with one hand weeding were effective in controlling the weeds.

Weeding should be done at 10 days after sowing and after that it should be followed up at 10 -15 days interval.

Diseases of Chilli :

1) Damping Off :

It is a serious disease of brinjal seedlings and mainly occurs in nursery bed. The disease infected seedlings rot at ground level and then the plants fall over ground. The seedlings die in patches.

2) Bacterial Leaf Spot :

Small dark, greasy spots are formed on leaf, petiole and tender parts, of the plant. Water soaked spots appear on green fruits. In severe cases the leaf may drop off arid cause considerable loss to the crop.

3) Anthracnose :

Dark sunken spots are formed of fruits and pink or dark coloured dots appear in the centre of the sunken spots. Due to this spots, the fruits rot and fall. The fungus may cause "Die back" of the twigs also. Die back disease attacks mainly the upper portion of the plants spreading gradually from the top to downward; as a result the branches dry up. Moist weather, shade and heavy dew favour the occurrence of the disease.

Control Measures :

1. During land preparation, ploughing should be done carefully to turn up the bacteria and fungus living in the soil to exposed them to extreme temperature.
2. Proper drainage system should be maintained for easy flow of excess water.

Insect pest :

Fruit borer Integrated pest management of fruit borer :

 Set up pheromone traps for Helicoverpa armigera or Spodoptera litura at 12 nos./ha.

 Collection and destruction of damaged fruits and grown up caterpillars.

 Spray *Bacillus thuringiensis* at 2 g/lit.

 Provide poison bait with carbaryl 1.25 kg, rice bran 12.5 kg, jaggery 1.25 kg and water 7.5 lit/ha or spray any one of the following insecticide

Thrips :

1. Grow Agathi as Intercrop

2 Proper weeding

Yield :

The average yield of chilli is 500 -700 kg per hectare.

TURMERIC (*Cucurma longa*) :

Family: Zingiberaceae

Turmeric is herbaceous plant. The rhizomes have 1.8 -5.4 percent cucurmin, the pigment and 2.5 – 7.2 percent of essential oil. It is uses as an important condiment and as a dye with varied application in drug and cosmetic industry.

Climate and soil :

Turmeric can be grown in diverse tropical conditions from sea level to 1500 m in the hills, at a temperature range from 20°C - 35°C with a rainfall of 1500 – 2250 mm per annum. It can also be grown as an irrigated crop.

It is also grown in different types of soils from light black, sandy loam and red soils to clay loams, but it thrives best in a well drained sandy loam rich in humus content with a pH range from 4.5 – 7.5.

Varieties :

Sl. No.	Variety	Duration (Days)	Yield(t/ha)	Cucurmin content (%)
1	CO 1	285	5.85	3.2
2	Suguna (Assam)	190	7.20	4.9
3	Suvarna (Manipur)	210	4.60	4.0
4	Ranga	250	7.0	6.3
5	Rasmi	240	7.8	6.4

Preparation of land :

The land is prepared with the receipt of early monsoon. Soil is brought to a fine tilt by giving a deep ploughing to removed weeds, stubbles, roots etc. Immediately after the receipt of pre-monsoon showers, beds of 1 – 1.5 m width, 15 cm height and of convenient length are prepared with a spacing of 40 – 50 cm between beds. Planting is also done by forming ridge and furrows.

Planting :

Planting of turmeric is mostly done during April-May. Since turmeric is shade loving plant, castor or *Sesbania grandiflora* may be raised along the border lines in the field.

Seed materials :

Whole or split mother rhizomes are used for planting. Well developed healthy and disease free rhizomes are to be selected. The rhizomes are treated with 0.3% Mancozeb and 0.5 % Malathion for 30 minutes before storing.

Manures and manuring :

Farm yard manure @ 10 t/ha is applied as basal dressing. Manuring can be applied as broadcasting or may be put it in the pits. If available, Neem cake of 200 kg per hectare as basal dose is also recommended.

Mulching :

The crop is to mulched immediately after planting with green leaves or banana pseudo stem or sugarcane trash @ 12 – 15 tonnes per hectare. It may be repeated for second time after 50 days with the same quantity of green leaves after weeding and application of fertilizers.

Weeding :

Weeding may be done thrice at 60, 120 and 150 days after planting depending upon weed intensity.

Growing as intercrop:

Turmeric can be grown as intercrop in arecanut, orange and mango. It can also be raised as a mixed crop with chillies, onion, brinjal, colocasia and cereals like maize etc.

Harvesting :

Depending on the variety, the crop becomes ready for harvest in seven to nine months. Usually, it extends from January to March. Early variety matures in 7-8 months, medium varieties in 8 – 9 months and late varieties after nine months.

Yield :

The average yield per hectare is 20-30 tonnes of green turmeric.

Preservation of seed rhizomes :

Rhizomes for seed purpose are generally stored after heaping under shade of a tree or in well ventilated shed and covered with turmeric leaves. Sometimes the heap is plastered with earth mixed with cow dung. The seed rhizomes can also be stored in pits with saw dust.

Processing :

It involves three steps :

Curing :

Fingers are separated from mother rhizomes and are usually kept as seed material. The fresh turmeric is cured before marketing. Curing involves boiling of fresh rhizomes in water and drying in the sun. The boiling last for 45 – 60 minutes when the rhizomes are soft.

The cooked fingers are taken out of the pan by lifting the trough and draining the solution into the pan. The cooking of turmeric is to be done within two or three days after harvesting. The cooked fingers are dried in the sun by spreading 5 -7 cm thick layers on bamboo mat or any convenient to the growers. During night time, the materials should be heaped or covered. It may take 10 – 15 days for the rhizomes to become completely dry.

Polishing :

Dried turmeric has poor appearance and a rough dull outer surface with scales and root bits. The appearance is improved by smoothening and polishing outer surface by manual and mechanical rubbing.

Plant protection :

Pest/disease	Symptoms	Control
Pest Shoot bore	Larvae bore into the pseudostem and feed on the growing shoot resulting in yellowing drying of the infested shoots	Proper weeding should be done.
Rhizomes scale	Feed on plant sap in the field or on rhizomes in storage, resulting in withering and drying	Dip the rhizomes in Mancozeb or Malathion 0.5 %
Disease Rhizome and root rots	Complete drying of leaves, in advanced stages, rhizomes get decomp[osed and decayed.	Drench the soil with 0.1 % wet cerasan

GARLIC (*Allium sativum L*) :

Family : Alliaceae

Garlic is a common spices crop that possesses a high nutritive value, its preparation are administered as a cure against stomach disease, sore eyes and ear ache. It is commonly used in the preparation of various dishes. Garlic produce a small groups of bulbs called cloves covered with a thin skin.

Climate and soil :

It is grown under a wide range of climatic conditions, however it cannot with stand too hot or too cold weather. It prefers moderate temperature in summer as well as in winter. Short days are very favourable for the formation of bulbs.

Garlic requires well drained loamy soils, rich in humus, with fairly good content of potash.

Seed materials :

Garlic is propagated by cloves, all the cloves are planted except the long slender ones in the centre of the bulbs. Bulbs with side growth should be discarded.

Seed rate :

150-200 kg cloves per hectare.

Sowing method :

1) **Dibbling :** Cloves may be dibbled 5 – 7.5 cm deep, keeping their growing end upwards. They are placed 7.5 cm apart from each other in rows of 15 cm apart and then they are covered with loose soil.
2) **Furrow planting :** The furrows are made 15 cm with hand hoe. In this furrows cloves are dropped by hand 7.5 – 10 cm apart.

Sowing time :

June – July and October – November.

Manures :

25 tonnes of FYM per hectare is applied as a basal dose. 7.5 t/ha vermicompost is also recommended.

Irrigation :

First irrigation is given after sowing and then field is irrigated every 10 – 15 days depending upon the soil moisture. It is recommended to irrigate 2 – 3 days before harvesting.

Weeding :

First interculture or weeding is given with hand hoe one mo0nth after sowing. Second weeding is given one month after the first weeding. Hoeing the crop just before the formation of bulbs (about two and half month from sowing) loosens the soil and helps in the setting of bigger and well filled bulbs.

Harvesting :

Garlic is a crop of four to five months duration. When the leaves start turning yellowish or brownish and shoe signs of drying up, the crop is ready for harvest.

Yield :

Average yield level is 6 – 8 tonnes per hectare.

Plant protection :

Thrips cause withering of the leaves. To check the pest attack, it is recommended to give proper weeding and maintain proper drainage system.

ONION :

The onion is one of the most important commercial vegetable crops grown in India: The demand for onion is worldwide. It is used both in raw and mature bulb stage as vegetable and spices. The pungency in onion is due to a volatile oil known as ally-propyl disulphide. The bulb of onion consists of swollen bases of green foliage leaves and fleshy scales. Maharashtra, Tamil Nadu, A.P., Bihar and Punjab are the important onion producing states.

Climate :

Onion is a cool season crop. It is grown during winter and harvested before the real hot season begins. Onion can be grown under a wide range of climatic condition. But it succeeds best in mild season without extremes of heat and cold. According to Rao and Purewal (1954), it can be grown as a rainfed crop even at elevation of 1500 to 2000 m between April and August, Onion produce bulbs more rapidly at warm (21°C to 26°C) that at cool 15°C to 21°C) temperature.

Soil and its preparation :

Onion can be grown on various soils. But sandy loam, silly loam and deep friable soils are best suited for onion crop. The land is prepared by giving 5-6 ploughings. The optimum pH range is between 5.8 and 6.5.

Seed rate and time of sowing :

In onion 10 to 12 kg seeds require/ha. For kharif it is sown in June & for rabi sown in October-November.

Layout and Spacing :

Ridges & furrow type of layout is follow15x10 cm spacing is given. In case of onion preferably flat beds are use because

1. As in flat beds, plants accommodate are more than ridges & furrow so we get more yield.

2. In flat bed (levelled), there is equal distribution of water & fertilizers. So we get uniform size & compact bulb of onion which have good keeping quality in storage and transport.

3. In percentage of twines is less in flat beds than ridges & furrow.

Manures and fertilizers :

25 to 30 cart loads of well rotten FYM or compost applied at the time soil preparation per hectare. For onion 50 kg N, 25 kg POs & 25 kg Potash should be applied, as usual method.

Intercultural, weeding and other operations :

Cultural operation keeps the field absolutely free from weeds to produce a good crop of onion. Weeds if not controlled in early stage but removed later on, will injure the onion bulbs and the out-turn will be poor. 2-3 hoeing and weeding are enough for the crop. After 2 to 3 irrigations, earth up the poor plants.

Irrigation :

The root system of onion is restricted in top 8 cm and roots penetrate seldom deeper than 15 cm. Water requirement of the crop at the Initial growth period is less. Irrigation should be stopped 15-20 days before attaining maturity for improving the keeping quality of bulbs.

Frequent irrigation delays maturity. In kharif season, depending upon the rains and time of planting 6-10 irrigations are enough. In rabi, 10-15 irrigations are given at bulb formation, irrigation is necessary and moisture stress at this stage results in low yield.

Disease and pest control :

1. Purple blotch (*Alternari porri*)

Symptoms:

On leaves eye shape, colour spot develop which are surrounded a broad chlorotic margin. This spots are very prominent on the flower stalk. Lesions may girdle leaves and stalk which drops after 2 – 3 weeks.

2. Anthracnose (*Collectotrichum gloesporiodes*)

Symptoms:

The characteristics of symptoms are curling, twisting and chlorosis of the leaves. The effected leaves shrivel, droop down and withered.

3. Fusarium (*Fusarium oxysporum*)

Symptoms:

The roots may turn pale yellow and gradually decay until the entire root disappears.

Control :

1. Maintain proper drainage
2. Deep ploughing during summer
3. Avoid injury during cultural operation
4. Crop rotation of 4-5 years with non-host crop has been found effective in eliminating the disease. Mixed cropping with tobacco and sorghum is effective. Seed treatment with *Trichoderma viride* and *Pseudomonas fluorescence* reduced onion basal rot incidence.

Insect :

The common pest of onion is thrips, red spider, mites etc.

Control :

Plant barrier of 2 rows of maize or inner row of wheat and outer row of maize atleast 30 days before onion planting

Yield :

On an average, Onion can yield 150 – 250 quintals per hectare.

CORIANDER (*Coriandrum sativum*) :

Family : Apiaceae

Coriander is an annual herb, mainly cultivated for its green tender leaves. The young plants as well as the leaves are used in the preparation of chutney and are also used in seasonings in curries, soups, sources etc. It has medicinal properties too.

Climate and soil :

It is tropical crop and can be grown throughout the year (Except very hot season i.e. March–May) for leaf purpose. A dry and cold weather free from frost especially during flowering and fruiting stage favours pest and disease incidences. Heavy rains affect the crops.

It can be cultivated on almost all types of soils provided sufficient organic matter is applied. Black cotton soils with high receptivity of moisture are best under rainfed conditions.

Varieties :

Sl. No.	Variety	Duration(days)	Yield/Ha (kg)
1	Col	110	500
2	CO 2	90 – 110	600 – 700
3	CO 3	85 – 95	640
4	C0 (CR) 4	65 – 70	600

Field preparation :

For raising a rainfed crop, the land is ploughed 3 – 4 times following rains and field must be planted immediately to break the clods and to avoid soil moisture.

Sowing season :

It is mostly grown as a Rabi season crop and hence sowing is done between middle of October and middle of November and harvested during January – February.

Seed rate :

A seed rate of 10 – 15 kg per hectare is required. Seeds stored for 15 – 30 days record better and early germination than freshly harvested seeds. Seeds soaked in water for 12 – 24 hours before sowing also enhance better germination.

Manuring :

About 10 tonnes of FYM is applied at the time of land preparation.

Irrigation:

First irrigation is given 3 days after sowing and thereafter 10 -15 days interval depending upon the soil moisture available in the soil.

Weeding :

The first hoeing and weeding are given in about 30 days. Depending upon the growth one or two more weeding are done.

Harvesting :

The crop will be ready for harvest in about 90-110 days depending upon the varieties and growing season. In certain varieties, harvesting 50 percent leaves at 60 days and 75 days may be done which will fetch additional income but without affecting the grain yield.

Yield :

The rainfed crops yields on an average of 400 to 500 kg/ha and the irrigated crop 600 to 1200 kg/ha.

Topic 8 – Vegetables

Objectives :

To improve the agriculture product from pre production stage to the post production through simple and effective form of agriculture practice

Duration : 60 minutes

Expected outcome : Participants will develop understanding toward pre production stage to the post production of vegetables through simple and effective form of agriculture practice

Module Plan

Topic	Content	Methodology	Process	Materials Required
Vegetables (Brinjal, Cabbage, Cauliflower, Tomato, Bitter gourd, Pumpkin, French beans, Mustard, Beet root, Cow pea, Maize)	* Introduction of vegetables * Different varieties * Propagation of land * Spacing requirement * Weed management * Diseases and pest management * Harvesting * Post harvest management * Marketing	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on vegetables through powerpoint followed by an interactive session with the participants	LCD projector, Laptop, leaflet

BRINJAL :

About the crop:

Brinjal (*Solanum melongena* L.) is one of the most common vegetables grown throughout the country for its purple, green or white pendulous fruit. It is a member of the Solanaceae family and is closely related to tomato and potato. Brinjal is an erect annual plant, often spiny, with large, coarsely lobed fuzzy leaves, 10-20 cm long and 5-10 cm broad. The plants usually grow 45 to 60 cm high and bears long to oval shaped, purple or greenish fruits. Flowers are white to purple, with five-lobed corolla and yellow stamens. The fruit is a fleshy berry, containing numerous small, soft seeds.

Climate and Soil :

Brinjal is a warm season crop and requires a long warm growing season. But, it can be successfully grown as a rainy season and summer season crop and can be cultivated even at an elevation of 1200 m above MSL. However, the crop is very susceptible to frost and crop growth is severely affected when temperature falls below 17°C. Brinjal can be grown on all types of soils. However, it grows best in loose, friable, well-drained silt loam or clay loam soils rich in organic matter. An early crop gives good yield in light soils. The crop is moderately tolerant to acidic soils and a pH range of 6.0-6.8 is considered optimum for its growth and development.

Varieties :

Some of the common varieties of brinjal are-

i. Pusa purple long	ii. Pusa purple cluster	iii. Pusa kranti
iv. Pusa barsati	v. Pusa ankur	vi. Vaishali

Seed rate :

About 370-500 g of seeds per hectare.

Raising seedlings :

Brinjal is a transplanted vegetable. Seeds are sown in the nursery and one month old seedlings are transplanted to the main field. For sowing the seeds, raised seedbeds of 90 to 100 cm width and convenient length are prepared in open space with fertile topsoil to which well-decomposed organic matter has been incorporated. Prior to sowing, treat the seeds with fungal culture of *Trichoderma viride* @ 4 g/kg of seed or Thiram @ 2g/kg of seed to avoid damage from damping off disease. Sowing should be done thinly in lines spaced at 5-7 cm distance at a depth of 2-3 cm and covered with a fine layer of soil followed by mulching with green leaves. After sowing the seeds, irrigate with a rose-can daily in the morning. To avoid mortality of seedlings due to damping off, drenching of the beds with Bavistin @1.5-2.0 g/litre is effective. Remove the mulch immediately after germination of the seeds. Harden the seedling one week before transplanting by withholding irrigation, and irrigate profusely on the previous day of transplanting. The seedlings are ready for transplanting within 4-6 weeks of planting when they attain a height of 15 cm with 2-3 true leaves.

Time of planting :

For rain fed crop, transplant the seedlings during May-June before the onset of south west monsoon. Planting can also be done during September-October for irrigated crop.

Spacing :

Spacing depends upon the variety and season of planting. Transplant less spreading varieties at 60 x 60 cm. For spreading varieties provide wider spacing of 75-90 x 60 cm.

Manuring :

Apply well rotten FYM or compost @ 20-25 t/ha at the time of land preparation and mix well with the soil. A fertilizer dose of 75:40:25 kg $N:P_2O_5:K_2O$ / ha may be given. Half the dose of nitrogen, full phosphorus and half of potash may be applied as basal dose before transplanting. One fourth of nitrogen and half of potash may be applied 20-30 days after planting. The remaining quantities may be applied two months after planting.

Weeding :

The field should be kept weed-free, especially in the initial stage of plant growth, as weeds compete with the crop and reduce the yield drastically. Frequent shallow cultivation should be done at regular interval so as to keep the field free from weeds and to facilitate soil aeration and proper root development.

Irrigation :

Continuous supply of moisture should be maintained around the root zone of the plant. A light irrigation is given on the first and third day after transplanting. Irrigate at three or four days interval during summer.

Plant protection:

Pests:

1. Shoot and fruit borer (*Leucinodes orbonalis*)

Shoot and fruit borer causes serious damage to the crop leading to severe reduction in yield. Short pinkish larva of the pest initially bores into the terminal shoots resulting in withering and drying up of the shoot. In the later stage, it bores into the young fruits by making holes and feeding from within thereby making the fruits unfit for consumption. Attacked fruits rot in severe case.

Control : Continuous cropping of brinjal on the same field should be avoided. As soon as the pest attack is noted, remove and destroy the affected parts along with the insect. Fruits showing any boring symptom should also be picked and destroyed. Spray Carbaryl 0.15 % at an interval of 15-20 days to control fruit and shoot borer under large-scale cultivation.

2. Leaf eating beetle (*Epilachna vigintioctopunctata*)

The yellowish coloured grubs and adults of the beetle feed voraciously on leaves and tender plant parts, and the leaves are completely skeletonized leaving only a network of veins. When in large number, the pest causes serious defoliation and reduces yield.

Control : Collection and destruction of infested leaves along with the grubs, adults and eggs reduces damage to the crop. Spraying malathion (2 ml/litre of water) or carbaryl (2-4 g/litre of water) effectively controls the pest.

3. Leaf roller (*Eublemma olivacea*)

Caterpillars of the leaf roller pest roll the leaves and feed on green matter while remaining inside the folds. The folded leaves wither and dry up.

Control : Collection and destruction of the infested leaves along with the insects in the initial stage itself help to minimize damage to the crop. Spraying carbaryl (0.1%) or malathion (0.05%) controls the pest effectively.

Diseases :

1. Damping off (*Pythium* spp., *Phytophthora* spp., *Rhizoctonia* spp.)

A serious disease in the nursery. High soil moisture and moderate temperature along with high humidity especially in the rainy season favour the disease. Two types of symptoms are observed, viz., pre emergent and post emergent damping off.

Control : For avoiding damping off in the nursery, sow the seeds as thin as possible in the raised beds prepared in the open area during summer months. Healthy seeds should be selected for sowing and should be treated with Thiram @ 2g/kg of seed before sowing.

2. Phomopsis blight (*Phomopsis vexans*)

It is a serious disease of brinjal infecting the foliage and the fruits. The fungus infects the seedlings in the nursery causing damping off symptoms. When the leaves are infected, small circular spots appear which later become grey to brown with irregular blackish margins. Symptoms on fruits appear as minute, sunken dull and dusky spots, which later merge and the infected fruits rot.

Control : Adopting good field sanitation, destruction of infected plant material and crop rotation help to reduce the spread of the disease. Seeds obtained from disease free plants should be used for planting. Seed treatment with Thiram (2 g/kg seed) protects the seedling in the nursery stage. Spraying with Dithane Z-78 (0.2%) or Bordeaux mixture (1%) effectively controls the disease in the field.

3. Fruit rot (*Phytophthora nicotianae*)

The symptoms first appear as small water soaked lesions on the fruit, which later enlarges in size considerably. Skin of infected fruit turns brown and develops white cottony growth. High humidity favours the development of the disease.

Control : Removal and destruction of the affected fruits and spraying the crop with Dithane M-45 (0.3%) thrice at an interval of 10 days effectively controls the disease.

4. Mosaic

A viral disease caused by Potato Virus Y and transmitted by aphids like *Aphis gossypi* and *Myzus persicae*. Characteristic symptoms of the disease are mosaic mottling of the leaves and stunted growth of the plant when infected in the early stages. The leaves of infected plants are deformed, small and leathery.

Control : The disease incidence can be minimised by reducing the population of aphids, removal and destruction of infected plants and eradication of susceptible weed hosts.

Harvesting :

The fruits become ready for first picking in about 60-160 days after transplanting depending on the variety. Varieties with elongated fruits take more time to ripen. Harvesting at correct maturity is important, as over mature brinjal fruits turn pithy and bitter. Harvest the fruits when they attain good size and become greenish yellow or bronze in colour and skin is glossy, but before seeds begin to enlarge significantly and mature. Pressing the thumb against the side of the fruit can indicate the maturity of the fruit. If the pressed portion springs back to its original shape, the fruit is too immature. Regular harvesting also encourage continued fruit set. Depending on variety and season the average yield of brinjal varies from 20-30 t/ha.

CABBAGE :

About the crop :

Cabbages (*Brassica oleracea* var. *capitata*) are one of the oldest vegetables grown in the world. The crop require cool moist weather for producing best quality heads, and therefore its cultivation in the state is limited by climate and is restricted to the cooler parts of Mizoram.

Climate and soil :

Cabbage grows well on a wide range of soils from light sand to heavier clays, but well-drained sandy loam to clay loam soils are ideal for its best growth. The optimum soil pH should be in the range 6.0–6.5. Good drainage is important, and soils that become waterlogged after heavy rain or irrigation are unsuitable.

Varieties :

Some of the common varieties of brinjal are-

i. Pusa drum head	ii. Golden acre	iii. Kaveri
iv. Ganga	v. Sri Ganesh	vi. Pride of india

Seed rate :

About 500-750 g of seeds per hectare.

Time of planting :

The ideal time for planting cabbage is from August-November.

Planting :

Seeds are sown in nursery beds and three to five weeks old (with 5-6 leaves) healthy seedlings transplanted to the main field. Prepare the field by three or four ploughing and the seedlings are transplanted on ridges at a spacing of 45 x 45 cm preferably in the morning or late evening. Before transplanting, the roots of the seedlings are dipped in a solution of bavistin @ 2g/litre. Clipping two third of the leaves helps to reduce evapo-transpiration losses.

Manuring :

Apply 25 t/ha FYM or compost. Fertilizer dose is N:P_2O_5:K_2O 150:100:125 kg/ha. Apply full dose of P_2O_5 and half dose of N and K_2O before transplanting. Apply remaining half dose one month after transplanting.

Weeding :

Two to three hand weeding and 1-2 very shallow hoeing should be done to remove weeds and to make the soil better aerated. Application of pre-emergence weedicide followed by a hand weeding 60 days after transplanting is also effective in checking the weed population.

Irrigation :

Irrigate immediately after transplanting of seedlings and subsequent irrigations are given at an interval of 10-15 days depending upon the season and soil conditions. Avoid water stress from formation to maturity of the head. Avoid excess irrigation at crop maturity to prevent splitting of heads.

Earthing up :

Earthing up plants one month after transplanting ensures good size of heads. At the time of earthing up, support the plants with soil to avoid toppling of the plant during head formation.

Plant protection :

Pests :

1. Diamondback moth (*Plutella xylostella*)

The caterpillars feed on the leaf epidermis and later make holes in the leaves. Severely affected leaves are completely skeletonised.

Control : Spraying malathion (0.1%) and trap cropping with mustard controls the pest.

2. Leaf webber (*Crocidolomia binotalis*)

Caterpillars web up the leaves and live inside the knotted mass affecting flowering and pod formation adversely.

Control : Removal and destruction of webbed bunches of leaf and dusting the crop with carbaryl (4%) or spraying with malathion (0.05%) is effective.

3. Cabbage butterfly (*Pieris brassicae*)

The larvae feed gregariously on the foliage and burrow into the heads, making it unfit for marketing.

Control : The caterpillars should be hand picked and destroyed. Spraying malathion (0.1%) or carbaryl (0.15%) gives excellent control of the pest.

4. Aphids (*Brevicoryne brassicae, Myzus persicae, Lipaphis erysimi*)

Nymphs and adults suck cell sap devitalizing the plants and the affected parts become discoloured and malformed.

Control : Spraying of malathion (0.1%).

The insecticide application should be stopped 15-20 days before harvest.

Diseases :

1. Stalk rots (*Sclerotinia sclerotiorum*)

This disease causes serious loss in the field, storage, under transit and market conditions. The infections begin as circular water soaked areas which become soft and watery as the disease progresses and damage the entire cabbage head.

Control : Avoid planting cabbage and other susceptible crops in fields infested with white mold. Mechanical injuries to cabbage heads during harvesting operations should be avoided.

2. Black rot (*Xanthomonas campestris* pv. *campestris*)

The infected tissue turns brown and dies, and severely affected leaves drop off. The infected stems and roots become black. The heads of the infected plants remain small and its quality is reduced making it unfit for consumption.

Control : Avoiding continuous cropping of crucifers in the same field and use of resistant varieties offer good control. Treat the seeds with agrimycin-100 (100ppm) or streptocycline (100 ppm).

3. Downy mildew (*Perenospora parasitica*)

Small, light green-yellow lesions on the upper leaf surface, later a grayish white moldy growth is developed on the under surface of the leaf, and the leaf eventually becomes papery and die. Cabbage heads develop sunken black spots.

Control : Removal of weeds and alternate hosts and spraying with copper oxychloride (0.3%) are effective in controlling the disease.

4. Damping off (*Pythium debaryanum*)

Seedlings develop lesion near the collar region and tissue beneath become soft due to which seedling collapse and die.

Control : Seed treatment with *Trichoderma viride* (3-4 g/kg of seed) or thiram (2-3 g/kg of seed) and soil drenching with dithane M 45 (0.2%) or bavistin (0.1%) afford protection against the disease.

Harvesting :

Cabbage is ready for harvest at 90-120 days after planting. Harvest the crop promptly when the heads are firm and mature, as delayed harvest can result in split heads and disease incidence. However, harvesting immature heads reduces yield, and they have shorter shelf life than mature heads, as they are too soft to resist handling damage. The heads are to be harvested by bending it to one side and cutting it with a knife. Average yield of cabbage for early varieties is 25-30 t/ha and that of late type is 40-60 t/ha. Place the cabbages on a rack made of wood or chicken wire, do not stack them on the ground. Mature cabbages with a good firm heart, and in good condition, can be stored in a cool, airy frost proof condition for several weeks.

CAULIFLOWER :

About the crop :

Cauliflower is one of several vegetables in the species *Brassica oleracea* in the family Brassicaceae. It is an annual plant that reproduces by seed. Typically, only the head (the *white curd*) is eaten.

Climate and soil :

A temperature range of 15-21°C is considered as optimum for growth and curd formation of cauliflower. Temperature below 10°C during growth delays maturity resulting in the formation of undersized buttons, whereas high temperature will result in yellowish leafy curds. Well drained sandy loam to clay loam soils rich in organic matter with a pH range of 5.5-6.5 is considered as optimum for growing cauliflower.

Varieties :

Some of the common varieties of brinjal are-

i. Pusa early synthetic	ii. Himani	iii. Swathi
iv. Pusa deepali	v. Early patna	vi. 74-6-C

Seed rate :

About 600-750 g of seeds per hectare

Time of planting :

The ideal time for planting cabbage is from August-November.

Planting :

Seeds are to be sown in raised nursery beds of size 3.0 m x 0.6 m and 10-15 cm height. Seed rate is 600-750 g/ha. Prior to sowing seeds are treated with fungal culture of *Trichoderma viride* (4 g/kg of seed) or Thiram (3g/kg of seed) to avoid damage from damping off disease. Sow the seeds thinly in lines spaced at 5-7 cm distance at a depth of 1-2 cm and the beds are to be covered with dry straw or grass to maintain required temperature and moisture. Irrigate with a rose can daily. Three to five week old seedlings are used for transplanting. Main field is prepared by three or four ploughings. Seedlings are transplanted at a spacing of 60 x 45 cm.

Manuring :

Apply FYM or compost @ 25 t/ha and fertilizers @ 150:100:125 N:P_2O_5:K_2O kg/ha. Apply full dose of P_2O_5 and half dose of N and K_2O before transplanting and remaining N and K one month after transplanting.

Weeding :

Keep the field free from weeds by 2-3 hand weeding. Also carry out 1-2 very shallow hoeing without injuring the roots to remove the weeds and also to loosen the soil for better aeration.

Irrigation :

Adequate supply of moisture is required both during growing and curding phase to ensure even growth and proper development of curds. First irrigation is given just after

transplanting of seedlings and subsequent irrigations are given at an interval of 8-10 days depending upon the season and soil conditions.

Earthing up :

In order to produce large sized curds, earth up the plant one month after transplanting. At the time of earthing up the plants are supported with soil to avoid toppling of the plant during head formation.

Plant protection :

Pests :

1. Diamondback moth : *Plutella xylostella*

The caterpillars feed on the leaf epidermis and later make holes in the leaves. Severely affected leaves are completely skeletonised. It is one of the most serious pests of cauliflower grown under comparatively high temperature conditions.

Control : Spraying the crop with malathion (0.1%) gives excellent control of the larvae. Trap cropping with mustard attracts the pest population towards it, which can be destroyed by spraying dichlorvos (1ml/litre).

Diseases :

1. Stalk rot : *Sclerotinia sclerotiorum*

Symptom starts as circular water-soaked areas, which becomes soft and watery as the disease progresses. The fungus eventually colonizes the cauliflower head and produces large, black, seed like structures. This fungus can cause serious losses in the field, in storage, and under transit and market conditions.

Control : Avoid planting cauliflower and other susceptible crops in fields infested with white mold. Mechanical injuries to flower heads during harvesting operations should be avoided.

2. Black rot : *Xanthomonas campestris* pv. *Campestris*

The infected tissue turns pale green yellow, which later becomes brown and dies. Affected areas enlarge and severely affected leaves may drop off. The veins in infected leaves, stems, and roots become black. The heads of the infected plants remain small and its quality is reduced making it unfit for marketing.

Control : Avoid continuous cropping of crucifers in the same field. Use black rot tolerant varieties. Treat the seeds with agrimycin-100 (100 ppm) or streptocycline (100 ppm). Planting should be done on raised beds to facilitate drainage. Remove and destroy affected plants.

Harvesting :

Cauliflower is ready for harvest at 90-120 days after planting. The curds should be harvested promptly when they are of full size but still compact, white and smooth. Delayed harvesting results in the curds turning loose, leafy and ricey. Average yield obtained from early varieties is 6-10 t/ha. Mid season varieties, yield 12-20 t/ha while the yield of late types is 20-30 t/ha.

TOMATO :

About the crop :

Tomato (*Solanum lycopersicum* L.) is one of the most widely grown vegetables in the world. It is very popular among consumers and is commonly used as a salad vegetable in raw form. The fruits are also processed into juice, ketch-up, sauce, soups etc. Tomatoes form an important source of vitamins A and C in diets**.**

Climate and soil :

Tomato is a warm season crop. The best fruit colour and quality is obtained at a temperature range of 21-24°C. Temperatures above 32°C adversely affects the fruit set and development. The plants cannot withstand frost and high humidity. It requires a low to medium rainfall. Bright sunshine at the time of fruit set helps to develop dark red coloured fruits. Temperature below 10°C adversely affects physiological activities. Wide ranges of soils from sandy to heavy clay are suitable for growing tomato. However, well-drained, sandy or red loam soils rich in organic matter with a pH range of 6.0-7.0 are considered as ideal. Tomatoes benefit from crop rotation.

Varieties :

Some of the common varieties of tomato are-

i. Sakthi	ii. Mukthi	iii. Anagha
iv. Pusa ruby	v. Pusa early dwarf	vi. Arka alok

Seed rate :

About 400 g of seeds per hectare

Raising seedlings :

Tomato is a transplanted vegetable. Seeds are sown in the nursery and one month old seedlings are transplanted to the main field. For sowing the seeds, raised seedbeds of 90 to 100 cm width and of convenient length are prepared to which well decomposed organic matter has been incorporated. To avoid mortality of seedlings due to damping off, drench the seedbed first with water and then with Bavistin (15-20 g/10 litres of water). Remove the mulch immediately after germination of the seeds. Restrict irrigation one week before transplanting and irrigate profusely on the previous day of transplanting.

Time of planting :

Transplant the seedlings during October-November for an irrigated crop.

Spacing:

Transplant the seedlings at 60 x 60 cm.

Manuring :

Apply well rotten farmyard manure or compost @ 20-25 t/ha at the time of land preparation and mix well with the soil. A fertilizer dose of 75:40:25 kg $N:P_2O_5:K_2O$ / ha may be given. Half the dose of nitrogen, full phosphorus and half of potash may be applied as basal dose before transplanting. One fourth of nitrogen and half of potash may be applied 20-30 days after planting. The remaining quantity may be applied two months after planting.

Weeding :

Field should be kept weed free, especially in the initial stages of plant growth, as weeds compete with the crop and reduce the yield drastically. Providing 2-3 hoeing at regular interval helps to keep the field free from weeds and facilitates soil aeration and root development.

Plant protection :

Pests :

1. Tomato fruit worm (*Heliothis armigera*)

Caterpillars feed on leaves and other vegetative parts in the initial stage. Later cause extensive fruit damage by entering through cut holes and burrows and feeding the internal content. Infestation is severe during October-March.

Control : Judicious use of synthetic pyrethroids like fenvalerate (50 gm a.i./ha) or deltamethrin (10 gm a.i./ha) controls the fruit borer.

2. Epilachna beetles (*Epilachna vigintioctopunctata*)

The yellowish grubs and adults feed voraciously on the leaves and tender parts of the plant, and completely skeletonizes the leaves leaving only a network of veins. The pest often causes serious defoliation when appeared in large number.

Control : Collection and destruction of infested leaves along with the grubs, adults and eggs reduces the pest incidence. Spraying malathion (2ml/litre of water) or carbaryl (2-4 g/litre of water) effectively controls the pest.

3. Jassids (*Amrasca biguttula biguttula, Cestius phycitis*)

Nymphs and adults of the pest suck sap from the lower surface of the leaves and infested leaves curl upward along the margins, turn yellowish and show burnt up patches. Fruit setting is also adversely affected. The pest is the natural vector of mycoplasmal disease like little leaf and viral disease like mosaic.

Control : Spray malathion (0.1%) or dichlorvos (0.05%) 20 days after transplanting.

4. Tabacco caterpiller (*Spodoptera litura*)

Caterpillars feed gregariously on tender leaves, shoots and fruits at night. The pest is confined to nursery beds and assumes cutworm habits. The adult moths are greyish brown coloured with white marking on upper wings.

Control : Spray nuvan (0.5 ml/ 2 litres of water). Avoid the use of highly toxic insecticides.

Diseases :

1. Bacterial wilt (*Pseudomonas solanacearum*)

It is one of the most serious diseases of tomato crop. High soil moisture and soil temperature favour disease development. Characteristic symptoms of bacterial wilt are the rapid and complete wilting of normal grown up plants. Lower leaves may drop before wilting. A white streak of bacterial ooze comes out when infected plant parts are cut and immersed in clear water.

Control : Uproot and destroy the plants affected by bacterial wilt. Cultivate resistant varieties like Sakthi, Mukthi and Anagha and crop rotation with non host crops is also recommended in bacterial wilt prone areas. Seedling treatment with streptocycline (1 g/40 litres of water) for 30 min protects the seedlings in the initial stages of growth.

2. Early blight (*Alternaria solani*)

Serious foliage disease characterized by the appearance of leaf spot and leaf blight. Symptom starts as small, black lesion, usually on the older leaves, which later enlarge with concentric rings in a bull's eye pattern, with the surrounding tissue being yellow in colour. High temperature and humidity favour the disease and result in serious damage to foliage. Stem infestation show girdling of the plant near the soil resulting in death of the plant. Infected fruits show lesions and concentric rings.

Control : Removal and destruction of the affected plant parts and crop rotation helps to minimize the disease incidence. Spraying the crop with dithane M-45 (0.2 %) or bavistin (0.1 %) is recommended for effective disease control.

3. Late blight (*Phtophthora infestans*)

Symptoms usually begin on the shoulders of the fruit as large, green to dark brown lesions, which later turn brown destroying large areas of tissue. White mouldy growth appears on the lower leaf surface and fruits. Humidity coinciding with mild temperatures for prolonged periods favours the disease development causing severe economic losses.

Control : Follow crop rotation with non host crops and avoid planting tomatoes near potatoes. Select disease free seeds and seedlings for planting. Treat the seed with thiram (2-3 g/kg of seed) before planting. Spray dithane M-45 (2 g/kg of seed) at 15 days interval, starting from 30 days after transplanting.

Harvesting :

Depending on the variety, fruits become ready for first picking in about 60-70 days after transplanting. The harvesting stage depends upon the purpose to which the fruits are to be used. On an average, the yield varies from 20-25 t/ha. Hybrid varieties may yield up to 50-60 t/ha.

BITTER GOURD :

About the crop :

Bitter gourd (*Momordica charantia*) is one of the most popular vegetables in Mizoram. The fruits are used in a variety of culinary preparations and possess high nutritive and medicinal value. The fruits are rich in vitamin C and folate, and contain alkaloids likely momordicine, saponine and albuminoides which are medicinally important

Climate and soil :

Bitter gourd can be cultivated from lowland to altitudes up to 1000 m. It requires a minimum temperature of 18^0C during early growth, but optimal temperatures are in the range of 24–27^0C. The crop can tolerate low temperatures, but extreme cool temperatures will retard growth. The plants are adapted to a wide variety of rainfall conditions. Bitter gourd tolerates a wide range of soil but prefers a well drained sandy loam soil rich in organic matter. The optimum soil pH is 6.0–6.7 but plants tolerate alkaline soils up to pH 8.0.

Varieties :

Some of the common varieties of Bitter gourd are-

i. Priya ii. Preethi iii.Priyanka iv. Arka harit

Seed rate :

About 5-6 kg of seeds per hectare

Time of planting :

The ideal time for planting bitter gourd is from January-March and September-December.

Planting :

For the rainfed crop, sowing can be started after the receipt of first few showers during May-June. Prepare the soil to a fine tilth by ploughing and harrowing. Pits of 60 cm diameter and 30-45 cm depth are taken at a spacing of 2m x 2m. Well rotten FYM and fertilizers are mixed with topsoil in the pit. The seeds are soaked in water for 24 hours prior to planting for better and quicker germination. Soaking seeds in a solution of bavistin @ 0.2 % for 6 hours and drying in shade before sowing is also recommended to reduce the attack of soil born fungus.

Manuring :

Apply FYM @ 20-25 t/ha as basal dose along with half dose of N (35 kg) and full dose of P_2O_5 (25 kg) and K_2O (25 kg/ha). The remaining dose of N (35 kg) can be applied in two equal split doses at the time of vining and at the time of full blooming. A fertilizer dose of 70:25:25 kg N:P_2O_5:K_2O / ha in several splits is recommended. The fertilizer dose per pit would be 28:10:10 g N:P_2O_5:K_2O.

Weeding :

Earthing up is done during rainy season. Hand or hoe weeding can be performed as needed. Mulching is commonly used for bitter gourd crops grown on raised beds. Use organic or plastic mulch depending on availability. Mulch can be laid down before or after transplanting and after sowing.

Irrigation :

Bitter gourds do not tolerate drought. Maintain good soil moisture in the upper 50 cm of soil where the majority of roots are located. During the initial stages of growth, irrigate at 3-4 days interval and alternate days during flowering/fruiting.

Plant protection :

Pests:

1. Epilachna beetle (*Epilachna* spp.)

The yellowish coloured grubs and adults of the beetle feed voraciously on leaves and tender plant parts, and the leaves are completely skeletonized leaving only a network of veins. When in large number, the pest causes serious defoliation and reduces yield.

Control : Remove and destroy egg masses, grubs and adults occurring on leaves. Spray carbaryl 0.2 %.

2. Pumpkin beetle (*Aulacophora fevicolis, A. cincta and A. intermedia*)

Adult beetles eat the leaves, makes hole on foliage and causes damage on roots and leaves. Grubs cause damage by feeding on root. It also feeds on flowers and bores into developing fruits.

Control : Incorporate carbaryl 10% DP in pits before sowing the seeds to destroy grubs and pupae.

3. Aphids (*Aphis gossypi*)

Aphids in large number congregate on tender parts of plant and suck sap resulting in curling and crinkling of leaves. Ants carry aphids from one plant to another.

Control : Apply 1.5% fish oil soap. First dissolve soap in hot water and then make up the volume. Alternatively apply dimethoate 0.05 %.

Diseases :

1. Downy mildew (*Pseudoperonospora cubensis*)

Cottony white mycelial growth is seen on the leaf surface. Chlorotic specks can be seen on the upper surface of the leaves. It is severe during rainy season.

Control : Complete removal and destruction of the affected leaves. Spraying 10 % solution of neem or kiriyath preparation. If the disease incidence is severe, spraying indofil M-45 0.2%, akomin 0.3 % or mancozeb 0.2 % will be useful.

2. Powdery mildew (*Erysiphe cichoracearum*)

The disease appears as small, round, whitish spots on leaves and stems. The spots enlarge and coalesce rapidly and white powdery mass appears on the upper leaf surface. Heavily infected leaves become yellow, and later become dry and brown. Extensive premature defoliation of the older leaves resulting in yield reduction. High humidity and heavy dew increase the severity of the disease.

Control : Control the disease by spraying Dinocap 0.05%.

Harvesting :

Bitter gourd requires close attention at harvest time and fruits must be harvested frequently. Normally, it takes 15-20 days after fruit set or 90 days from planting for fruit to reach marketable age, however, fruits can be harvested at earlier stages depending on the purpose for which it will be used. Ideally, at harvest fruits should be light green, thick and juicy, and the seeds should be soft and white. Harvest every 2-3 days using a pair of scissors or a sharp knife to cut the fruit stalk. Average marketable yields are 15-20 t/ha.

PUMPKIN :

About the crop :

Pumpkin (*Cucurbita moschata*) is a popular vegetable of Mizoram. It is a rich source of potassium and Vitamin A. The bright orange colour of pumpkin is an indication of an important antioxidant, beta carotene. Beta-carotene is the precursor of vitamin A in the body, which performs many important functions in overall health.

Climate and Soil :

Pumpkin requires a minimum temperature of 18^{o}C during early growth, but optimal temperatures are in the range of 24–27^{o}C. It can tolerate low temperatures and are adapted to a wide variety of rainfall conditions. Pumpkin tolerates a wide range of soil but prefers a well drained sandy loam soil that is rich in organic matter. The optimum soil pH is 6.0–6.7, but plants tolerate alkaline soils up to pH 8.0.

Varieties :

Some of the common varieties of brinjal are :-

i. Arka chandan ii. Ambili iii. Saras

iv. Suvarna v. Arka suryamukhi

Seed rate :

About 1-1.5 kg of seeds per hectare.

Time of planting :

The ideal time for planting pumpkin is from January-March and September-December.

Planting :

For the rain fed crop, sowing can be started after the receipt of first few showers during May-June. Prepare the soil to a fine tilth by ploughing and pits of 60 cm diameter and 30-45 cm depth are taken at a spacing of 4.5 x 2 m. Well rotten FYM and fertilizers are mixed with topsoil in the pit.

Sow four or five seeds in a pit at 1-2 cm depth. Deeper sowing delays germination. As seedlings require ample water for quicker germination, a pre-sowing irrigation 3-4 days before sowing is beneficial.

Manuring :

Apply FYM @ 20-25 t/ha as basal dose along with half dose of N (35 kg) and full dose of P_2O_5 (25 kg) and K_2O (25 kg/ha). The remaining dose of N (35 kg) can be applied in two equal split doses at the time of vining and at the time of full blooming. A fertilizer dose of 70:25:25 kg N:P_2O_5:K_2O/ha in several splits is recommended. The fertilizer dose per pit would be 28:10:10 g N:P_2O_5:K_2O.

Weeding :

Conduct weeding and raking of the soil at the time of fertilizer application. Earthing up is done during rainy season. Hand or hoe weeding can be performed as needed. Mulching is commonly used for pumpkin crops grown on raised beds.

Irrigation :

During the initial stages of growth, irrigate at 3-4 days interval, and alternate days during flowering/fruiting. Furrow irrigation is the ideal method of irrigating. But in water-limited environment, trickle or drip irrigation can be resorted to. During rainy season, drainage is essential for plant survival and growth.

Plant protection :

Pests :

1. **Epilachna beetle** : *Epilachna* spp.

The yellowish coloured grubs and adults of the beetle feed voraciously on leaves and tender plant parts, and the leaves are completely skeletonized leaving only a network of veins. When in large number, the pest causes serious defoliation and reduces yield.

Control : Remove and destroy egg masses, grubs and adults occurring on leaves. Spray carbaryl 0.2%.

2. **Pumpkin beetle***: Aulacophora fevicolis, A. cincta and A. intermedia*

Adult beetles eat the leaves, makes hole on foliage and causes damage on roots and leaves. Grubs cause damage by feeding on root. It also feeds on flowers and bores into developing fruits that touch the soil.

Control : Incorporate carbaryl 10% DP in pits before sowing the seeds to destroy grubs and pupae.

Diseases :

1. **Downy mildew**: *Pseudoperonospora cubensis*

Cottony white mycelial growth is seen on the leaf surface. Chlorotic specks can be seen on the upper surface of the leaves. It is severe during rainy season.

Control : Complete removal and destruction of the affected leaves. Spraying 10 % solution of neem or kiriyath preparation. If the disease incidence is severe spraying mancozeb 0.2% will be useful.

2. **Powdery mildew**: *Erysiphe cichoracearum*

The disease appears as small, round, whitish spots on leaves and stems. The spots enlarge and coalesce rapidly and white powdery mass appears on the upper leaf surface. Heavily infected leaves become yellow, and later become dry and brown. Extensive premature defoliation of the older leaves resulting in yield reduction.

Control : Control the disease by spraying Dinocap 0.05%

Harvesting :

Pumpkins are ready to harvest when the stems connecting the pumpkin to the vine begin to shrivel. Harvest the fruits whenever they are a deep, solid colour (orange for most varieties) and the rind is hard. Pumpkins that are not fully mature or that have been injured do not store well. Average marketable yields are 30 t/ha.

BEET ROOT :

About the crop :

Beet root (*Beta vulgaris*) belongs to the Chenopodiaceae family and the crop requires cool moist weather for production and high yield.

Climate and soil :

Beet root is essentially a cool weather crop but it can be grown in a moderately warm climate as it attains best colour, texture and quality in a cool weather condition. A temperature range of 18-21°C is considered as ideal for obtaining good quality roots, rich in sugar with intense red colour. When temperature goes below 10°C, bolting starts before the beets attain marketable size. Well drained sandy loam soils are best suited for the crop. A pH range of 6-7 is considered as best for getting optimum yield.

Varieties :

Some of the common varieties of brinjal are -

i. Detroit dark red ii. Imperator

Seed rate :

About 7-8 kg of seeds per hectare

Time of planting :

The ideal time for planting cabbage is from August-January.

Planting :

Prepare the land to a deep friable condition to have least resistance to the root development. Incorporate well-decomposed FYM @ 20-25 t/ha during last ploughing. Recommended seed rate is 7 to 8 kg/ha. Pre-soaking of seeds for 12 hours in water facilitates better germination in the field. Before sowing, the seeds are treated with thiram or captan (2.5-3 g/kg of seed) to control pre-emergence damping off. It is usually grown on ridges to facilitate good root production.

Manuring :

Apply FYM 20 t/ha as basal. N:P_2O_5:K_2O 75:37.5:37.5 kg/ha is recommended. Full dose of P_2O_5 and K_2O and half dose of N are applied as basal. Remaining half dose of nitrogen is applied as top dressing when the plant starts growing vigorously.

Weeding :

Weeding should be done at regular intervals to keep down the weeds. Manual weeding is commonly practiced.

Irrigation :

It is necessary that enough soil moisture is available to help uniform seed germination and growth of plant. Give a light irrigation soon after seed sowing to ensure good germination. The crop should be irrigated at an interval of 4-5 days in summer and 10-12 days in winter.

Earthing up :

Earthling up is done to support the structure of the plant and to prevent the exposure of roots to sunlight. Earthing up should be done, when the root starts growing.

Plant protection :

Pests :

1. **Beet leaf miner :** *Pegomyia hyocyami*

The maggots feed in the epidermal layers of the leaf by making serpentine mines with silvery appearance. The affected leaves turn pale yellow, get distorted and crumpled and gradually dry and die away.

Control : Destroy fallen leaves and other plant debris after harvest.

2. **Web worms :** *Hymenia* sp. or *Loxostege* sp.

Green caterpillars web up the leaves and live inside the knotted mass. Flowering and pod formation is adversely affected.

Control : Removal and destruction of webbed bunches of leaves help to check further spread of the disease.

3. **Semilooper :** *Plusia spp.*

The caterpillars voraciously feed on the foliage causing severe damage.

Control : Hand picking the larvae and spraying the crop with carbaryl (0.1%) controls the pest.

Diseases:

1. **Leaf spot :** *Cercospora beticola*

Circular spots appear on the leaf surface, which later dry up giving a shot-hole appearance to the leaves. In case of severe infection, leaves dry and drop prematurely, exposing crown.

Control : Removal and destruction of affected plants, crop rotation and spraying copper oxychloride (0.3 %) control the disease effectively.

2. **Downy mildew:** *Perenospora schachtti*

White powdery growth appears on the lower leaf surface. The affected leaf dries and shrivels quickly and infected flower shoots become stunted and distorted.

Control : Phytosanitary measures, crop rotation and use of resistant cultivars are recommended. Seed treatment with thiram (2.5-3 g/kg of seed) and spraying dithane Z-78 (0.3%) is also effective.

3. Purple leaf of beetroot : Tobacco mosaic virus (TMV).

Plants become stunted and leaves show a tendency to stand erect and come closer. Leaves of infected plants show an unusual intense purple colouration.

Control : Removal and destruction of virus-infected plants and weed hosts helps in minimizing disease.

Harvesting :

Beet root crop become ready for harvest within 60-75 days of sowing when the roots attain diameter of 3-5 cm. The roots are harvested before the development of spongy tissue within the roots. Usually the plants are pulled by hand and the tops are removed. The average yield of beetroot varies from 20-25 t/ha.

COW PEA :

About the crop:

Cowpea can be grown in homestead garden throughout the year during summer where rice crop cannot be raised due to water scarcity. Cowpeas are one of the most important food legume crops in the semiarid tropics covering Asia, Africa, southern Europe, and Central and South America. A drought-tolerant and warm-weather crop, cowpeas are well-adapted to the drier regions of the tropics, where other food legumes do not perform well.

Climate and Soil :

Cow pea can be grown in warm humid climate and well drained soils.

Seed rate :

Bushy type: 20-25 kg/ha

Trailing type: 4-5 kg/ha

Time of planting :

The ideal time for planting cowpea are February-March, May-June and October-November based on variety.

Planting :

Plough the land thoroughly 2-3 times and remove weeds and stubbles. Make channels of 30 cm breadth and 15 cm depth at 2 m apart to drain off excess rainwater.

Manuring :

Apply FYM 20 t/ha. NPK 20:30:10 kg/ha. Lime : 250 kg/ha or dolomite 400 kg/ha. Lime may be applied at the time of the first ploughing. Half the quantity of N, whole of phosphorus and potash may be applied at the time of final ploughing. The remaining N may be applied 15-20 days after sowing.

Weeding :

Hoeing at the time of application of application of second dose of nitrogen will give adequate aeration to the soil and help the root system to spread easily. Withhold irrigation and apply Potash to induce flowering.

Irrigation :

Giving two irrigations is highly beneficial, ie: at 15 days after sowing & at the time of flowering. Irrigation at the flowering stage induces better flowering and pod set.

Plant protection :

Pests :

Pod borer : Larvae bore the pods. Neem oil emulsion 5%/Carbaryl 0.2 %/Fenthion (Labacid 50 EC) 1 ml per litre field sanitation

American serpentine leaf miner : Eats away the chlorophyll of the leaves leaving snake like white scars on the leaf lamina. Neem oil emulsion 10%, field sanitation.

Black pea aphids : Sucks sap from the leaves, stem, flowers and pods. Neem oil emulsion 10%/ *Nattappochedi* – soap emulsion/ fungus *Fusarium pallidoroseum* at 300 g/cent immediately after infestation is observed. (only 1 application is necessary). Spray Malathion (0.05%) or quinalphos (0.03%) for controlling pea aphids.

Pod bug : Adults and nymphs suck sap from the pods. Pods get shrivelled and discoloured. 20g garlic paste in Malathion 50 EC @ 4 ml per litre, Mechanical control.

[Note: Apply the insecticides after harvesting mature pods and pick the pods only 10 days after the application of insecticides.]

Diseases :

1. Anthracnose of cowpea *(Colletotrichum lindemuthianum)*

Causes water soaked lesions on leaves, which later become brown and enlarge to form circular spots. The infection may spread to the petiole and young stem also. Petiole infection results in defoliation. Anthracnose can be managed with seed treatment with Thiram @ 3 g/kg of seed followed by Carbendazim spray @ 0.05 % at 15, 30 & 45 days after seedling emergence.

2. Dry root rot of cowpea *(Macrophomina phaseolina)*

Infected plant suddenly wilts and dies. The bark of the root and basal stem becomes fibrous. The disease appears in patches and become severe during dry periods. Dry root rot can be managed by seed treatment with *Trichoderma viride* @ 4 g/kg of seed or Carbendazim 0.05 per cent of seed or *Pseudomonas fluorescens* @ 10 g/kg of seed or neem cake soil application @ 20 kg/ha.

Spray malathion (0.1 per cent) or quinalphos (0.05 per cent) for controlling pea aphids.

Spray carbaryl 0.2 per cent to protect the crop from pod borers. Repeat the application, if infestation persists. Apply the insecticides after harvesting mature pods and pick the pods only 10 days after the application of insecticides.

Harvesting :

Harvest at tender stages when the tip is pliable and they snap. For grain purpose pods are harvested when they start drying.

Yield :

Green pod yield of 10-20 tons and grain yield of 1.2-1.5 tons per ha.

Post Harvesting :

The pods are then to be pre-cooled in shade to reduce the field heat. They are the tied into small bundles and packed. The seeds are sun dried till they become brittle. The seeds are extracted by using bamboo stick or pulse thresher.

MAIZE :

About the crop :

Maize can be grown throughout the year at altitude ranging from sea level to about 300m. it grows best in areas with rainfall of 600-900 mm. it requires fertile, well-drained soil with a pH ranging from 5.5-8.0, but pH 6.0-7.0 is optimum.

Season :

As a rainfed crop, maize is grown in June-July or August-September. The irrigated crop is raised in January-February.

Varieties :

Hybrids: Ganga Hybrid-1, Ganga Hybrid-101, Deccan hybrid, Renjit, Hi-starch

Composite varieties: Kissan Composite, Amber, Vijay, Vikram, Sona, Jawahar

Seed rate :

20 kg/ha

Preparation of land and sowing :

Plough the land 3 times and prepare ridges and furrows. Dibble one seed per hole at a spacing of 60 cm x 23 cm for the rainy season crop. For irrigated crop, beds are prepared. Here, seeds are sown in lines and earthed up later into small ridges to form furrows when the crop reaches knee height.

Manuring :

Apply FYM/ compost @ 25t/ha at the time of preparation of the land. The recommended fertilizer dose is 135kg N, 65 kg P_2O_5 and 15 kg K_2O per ha. Apply full dose of P_2O_5 and K_2O and $1/3^{rd}$ dose of N as basal. Apply $1/3^{rd}$ N, 30-40 days and the rest 60-70 days after sowing.

After cultivation :

Hand hoeing and weeding on the 21^{st} and 45^{th} DAS.

Irrigation :

Irrigate the crop on the day of sowing and on the 3^{rd} day. Subsequent irrigations may be given at 10-15 days interval.

Plant protection :

Pests :

1. Stem borer: *Chilo partellus*

Central shoot withers and leading to “dead heart”. Larvae mines the midrib enter the stem and feeds on the internal tissues. Affected parts of stem may show internally tunnelling caterpillars.

Management :

- Phorate 10% CG10 kg/ha
- Carbaryl 4% G 20 kg/ha.

- For stem borer, release egg parasitoid *Trichogramma chilonis* @ 2,50,000/ha coinciding egg laying period. Three releases at weekly interval are desirable. Third release is to be accompanied with larval parasitoid Cotesia flavipes @ 5000/ha

2. Pink stem borer: *Sesamia inferens*

Pink larvae enter into the stem causing dead hart symptoms.

Management :

- Spray phosaloneb 35%EC at every 20 days interval.

Diseases :

1. Bacterial stalk rot :

Symptoms :

- The basal internodes develop soft rot and give a water soaked appearance. A mild sweet fermenting odour accompanies such rotting.
- Leaves some time show signs of wilting or water loss and affected plants within a few days of infection lodge or topple down.

Control measures :

- Use of disease resistance varieties, i.e. Hybrids Ganga Safed-2, DHM 103, show significantly less disease incidence than other hybrids.
- Avoid water logging and poor drainage.

2. Common rust :

Symptoms :

- Circular to elongate golden brown or cinnamon brown, powdery, erumpent pustules appear on both leaf surfaces
- As the crop matures brownish black pustules containing dark thick walled two celled teliospores develop. In severe cases infection spreads to sheaths and other plant parts.

Control measures :

- Plant hybrids like Deccan, Ganga-5, Deccan Hybrid Makka-103 and DHM - 1 which are resistant to this disease to minimise the disease intensity.
- Spray Mancozeb 2.5 g/lit or Dithane M-45 spray can be taken (0.4%) as soon as first symptoms are observed and it can be repeated at 10 days interval till flowering.

Harvesting :

Maize is harvested in late September or early October (harvesting should be completed by 20th October). The exact harvesting date depends whether the tassels have started to flower or not, if the plant has stopped actively growing and if the leaves have started to turn yellow. The plant must be at least 2 metres high. At the lower part of the cob, the grains should have a similar texture to that of a hard cheese and the tip of the cob should be of a soft cheeses type texture. The individual grains should be solid at the wide end and cheesy when moving towards the tip. Only the tip may still be milky.

Topic 9 – Recap of previous day

Objectives :

Knowing the trainees understanding from the previous day training

Duration : 15 minutes

Expected outcome : Participants will learn scope of improvement from previous day learning

Module Plan

Topic	Content	Methodology	Process	Materials Required
Recap of previous day	* Gap analysis * Learning from previous day * Scope for improvement	Group discussion	Small group of 5 members each will be formed where the trainees will discuss the entire previous day topic with his/her partner. Quick recap will be done by representative of each group	Chart paper, Marker

Topic 10 – Vision

Objectives :

Understanding the needs and importance of good visioning

Duration : 45 minutes

Expected outcome : Participants will learn the importance and needs of good vision

Module Plan

Topic	Content	Methodology	Process	Materials Required
Vision	* Importance of visioning * Making a vision into reality * Planning : MCP, CBA	Lecture through powerpoint presentation	Resource person will facilitate the session with brief lecture, the participants will then be divided into groups to share their vision and present in a chart paper	LCD projector, Laptop, Chart paper, Marker

Vision and strategy are both important. But there is a priority to them. Vision always comes first. If you have a clear vision, you will eventually attract the right strategy. If you don't have a clear vision, no strategy will save you. In the literature concerning leadership, vision has a variety of definitions, all of which include a mental image or picture, a future orientation, and aspects of direction or goal. Vision provides guidance to an organization by articulating what it wishes to attain. It serves as a signpost pointing the way for all who need to understand what the organization is and where it intends to go. By providing a picture, vision not only describes an organization's direction or goal, but also the means of accomplishing it. It guides the work of the organization. Seeley describes vision as a "goal-oriented mental construct that guides people's behaviour." Vision is a picture of the future for which people are willing to work.

However, vision is more than an image of the future. It has a compelling aspect that serves to inspire, motivate, and engage people. Vision has been described by Manasse as "the force which moulds meaning for the people of an organization." It is a force that provides meaning and purpose to the work of an organization. Vision is a compelling picture of the future that inspires commitment. It answers the questions: Who is involved? What do they plan to accomplish? Why are they doing this? Vision therefore does more than provide a picture of a desired future; it encourages people to work, to strive for its attainment. For educational leaders who implement change in their school or district, vision is "a hunger to see improvement" As important as it is to know what vision is, it is also important to know what vision is not. Nanus states that vision is not "a prophecy, a mission, factual, true or false, static, or a constraint on actions." To assist leaders in developing an appropriate vision, there are five characteristics :

- attracts commitment and energizes people,
- creates meaning in workers' lives,
- establishes a standard of excellence,
- bridges the present to the future, and
- transcends the status quo.

Other descriptions of vision provide more explicit information especially pertinent to educational leaders. Seeley defines two types of vision, both related to Cuban's concepts of first and second order changes. Using the construct of first order changes, those that deal with improvements, Seeley asserts that these changes are connected to first order vision or program vision. An example of a change requiring program vision is a school's adoption of a new reading program.

Second order changes are those that require restructuring or a re-conceptualization of an organization's roles, rules, relationships, and responsibilities. Seeley asserts that such second order changes require system vision. The leader has to visualize not just how a new program or practice would work, but how whole new sets of expectations, relationships, accountability structures, etc., would fit together into a coherent whole.

How to formulate a vision statement :

1. Get alone with just a journal and a pen. If you can get a way to a solitary place, so much the better.

2. Make sure you won't be interrupted. Turn off your cell phone, e-mail, television, etc.

3. Close your eyes and pray. Ask God for inspiration and guidance. What you ultimately want is alignment between His plan and your vision. But don't make this harder than it needs to be. God usually speaks through our desires..

4. Write down your current reality—all the things that you don't like. Be brutally honest. It's difficult to change unless you find your current reality unacceptable.

5. Now write down what you would like to see happen. Write it down *in detail*. If you can, use all five senses. Write it in the present tense, as though it has already happened. This will make it more believable to you.

6. Share your vision with the people who have a stake in the outcome.

7. Commit to reading your vision daily. This is critically important. "Faith is the evidence of things not seen" (Hebrews 11:1). The more you can "see" this, the more likely it will come to pass.

STEPS TO BE FOLLOWED TO BECOME SUCCESSFUL :

Step 1 – Have a Vision. Not much help here if you don't know how to have a vision. I've heard (but can't verify) that peyote helps, but I'm not sure that's the type of vision you're looking for.

Step 2 – Clarity. Define your vision down to the smallest detail. Many people find this is the time to write it down. Write it down until you can't describe it anymore, then write some more.

Step 3 – Plan. Write down exactly how this vision is going to become a reality. This is where you begin to realize what it really is going to take to achieve your vision, the sacrifices or challenges you will face. It's also where you will realize how little you know about how you're going to make that vision happen. Another thing I find is we tend to really underestimate our abilities and the time it will take to achieve any vision. So take your plan and multiply it by at least 3.

Step 4 – Act. If you got here that means that your plan didn't scare the heck out of you. You'll also realize that many things within your plan are completely outside of reality, that's good, most plans are. But the sheer act of attuning your mind and effort towards your vision (combined with action) means your vision has a greater success of becoming reality.

Why having a vision for your life matters more than individual goals :

Goals are an important part of getting what you want out of life. They can also be specific enough that we miss the forest for the to-do lists we made out of the trees. To put the concept very simply, goals are the "how" you achieve something. Exercise every day, develop a business plan, and spend less time at work. Vision, on the other hand, is the "why." What do you want to get out of life? When you look back in a couple decades, what do you want to see? To create a vision, begin by identifying your core values, your passions, what you believe to be your purpose, and how you envision your life. From there, be more specific and remember to be clear. Your vision should embody your values and your view of the future without being too generic. Your vision can also change over time. The point is to have one so you know why you're doing what you do, and you're happier doing it. The same process applies when you're creating a vision for any other aspect of your life, such as your career or business.

There's nothing wrong with having goals. In fact, a well-defined personal vision should naturally lead to a more focused goal set. However, setting arbitrary minor goals without a mind for where the stepping stones lead can sometimes make us feel more confident in where we're headed than we might feel once we get there.

How is vision related to planning?

Life is not just about how hard you can hit, it is about how hard you can get. Planning in life is extremely important. No one can simply live a life based on ad-hoc decisions and rules. There was and always will be a plan behind any successful event in history, not just this world’s, but also the individual’s.

Do you think that the Indian nation has stayed intact for nearly seventy years just by implementing some random rules and laws? Certainly not! Even the Constitution of India took nearly three years to be formulated and built. It took three years full of dedication, motivation and planning for it to become one of the most successful constitutions in the world.

While building a car, one doesn’t just go about making some random designs and starts building the car instantly. The most successful motor car manufacturers like Ferrari, Lamborghini, Mercedes etc. didn’t become world famous overnight. It took them years or rather decades of planning and dedication. Even the design and production of one of the cheapest motor cars in India, Tata Nano, didn’t happen overnight. It took years of planning and vision.

What do all these examples tell us? That planning and vision in transforming a dream into a successful and satisfactory reality is, without doubt, one of the key elements.

The military organisations of any country are useless without planning. Every attack, every action requires rigorous planning and practise. Without these they would fall apart.

Living a life without planning is like eating meals without cooking, i.e., eating them raw. Planning helps us in organising our lives, set a direction in our lives, and finally, become successful in our lives. Without planning our life is aimless. Planning is as important in our lives as having a vision, aim and a goal.

Topic 11 – Plantation

Objectives :

1) To improve the income pattern of the traditional farmers through sustainable and simple method of farming practice
2) To introduce secondary crops for maximum utilisation of agricultural land and waste land

Duration : 60 minutes

Expected outcome : Participants will learn the importance plantation tree for maximum utilisation of land

Module Plan

Topic	Content	Methodology	Process	Materials Required
Plantation (Coffee, Rubber, Tea, Broom, Arecanut, Oil palm)	* Introduction to plantation * Promotion of healthy nursery * Land preparation * Spacing requirement * Seed quality * Weed management * Diseases and pest management * Harvesting * Post harvest management * Inter cropping * Marketing	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on plantation through powerpoint followed by an interactive session with the participants	LCD projector, Laptop, Leaflet

COFFEE :

Common name : Coffee

Scientific name : *Coffea canephora*

Family : Rubiaceae

Variety : Arabica, Robusta, Dwarf varieties

Coffee is the second most important beverage crop of India next only to tea. It is indigenous to Abyssinia Plateau (Ethiopia) from where it was taken to Arabia in 11th century. From Arabia, its seeds were brought to India by Baba Budan in the 17th Century and were raised in the Baba Budan Hills of Karnataka.

Soil and climate:

Soil should be deep, friable, open textured rich in plant nutrients with plenty of humus and of slightly acidic nature. Coffee plant requires hot and humid climate with temperature varying between 15°C and 28°C and rainfall from 150 to 250 cm. It does not tolerate frost,

snowfall, high temperature above 30°C and strong sun shine and is generally grown under shady trees. Prolonged drought is also injurious to coffee. Dry weather is necessary at the time of ripening of the berries.

Preparation of land :

Selective felling may be done while retaining a number of desirable shade trees. Terracing should be done in deep sloppy areas. After the summer showers, pits of 45 cm x 45 cm x 45 cm are dug at 1.25 - 2.5 m apart. The pits are left open for weathering and then filled and heaped for planting. At the time of filling, apply 500 g of rock phosphate per pit along with top soil. Planting is done along the contour in sloppy areas.

Promotion of healthy nursery :

A gentle sloping land without big shade trees is preferred for raising nurseries. Water should not stagnate in the nursery sites. Stagnant water near the nursery beds cause rotting of seedlings. Suitable water resource should be available near the nursery for timely watering of the nursery beds and seedlings. Any shade trees near the nursery will damage the young nursery seedlings in the beds and poly bags due to water dripping from them.

For sowing the coffee seeds, germination beds of 1 metre width and of convenient length raised to a height of 15 cm from the ground level should be prepared. About 4 bags (10Kgs) of matured farm yard manure or compost well dried under sun light be mixed with 2 kg of fine Agricultural lime and 0.5 kg of Rock Phosphate and thoroughly incorporated in the nursery beds measuring 1x6 metres. In the nursery high clay content should not be used as they restrict the air circulation causing damage to the sprouting seeds. Selected and certified seeds can be sown during December or January in the nursery beds. The seeds be sown with their flat side facing the soil which helps early germination and easy rooting in the soil. After sowing, the seeds are covered with a thin layer of finely sieved soil and mulched with a layer of paddy straw which ensures optimum temperature for seed germination and protects the seeds from desiccation The seeds will germinate in about 40-45 days and attain button or top stage. Once this stage is reached the mulch covering the beds should be carefully removed without damaging the germinated seeds.

Spacing requirement :

Generally square system of planting is found to be ideal in flat to gentle slope areas. The distance between the rows and spacing of plants would depend upon the type of planting material. In general, the recommended optimum spacing for planting the tall Arabica varieties (Sln. 5, Sln. 9, Sln. 795) are 6 x 6 feet or 7 x 6 feet or 7 x 7 feet while that for dwarf Arabica varieties is 5 x 5 feet. The ideal spacing recommended for planting the Robusta variety CXR is 8 x 8 feet and for the other two varieties, viz., S.274, Old 7 Robusta at 10 x 10 feet; 12 x 12 feet respectively. The square planting design accommodates 1742 plants at 5 ft X 5 ft spacing and 1210 plants at 6 ft X 6 ft spacing per acre. Once the plants are established in the field the space between the rows are well covered reducing the accessibility to each plant. Hence this planting design is not a very ideal one for mechanizing the farm operations especially the free movement of the machine.

Seed quality :

There are number of variety of coffee. Of which Arabica Robusta and Dwarf varieties are common. Arabica has verities of Sln. 5, Sln. 9, Sln. 795. Probably the most commonly planted Arabica in India and Southeast Asia is S.795. Arabicas have a delicate flavour and balanced aroma coupled with a sharp and sweet taste. They are typically grown on higher altitudes ranging from 600 to 2000 metres in cool, moisture-rich and subtropical weather

conditions. They also require nutrient-rich soil to be able to conform to the highest international coffee standards. Robustas have twice the level of caffeine as compared to Arabicas. This variant is identifiable with a very strong taste, a grainy essence and an aftertaste that reminds you of peanuts. It is possible to grow this variety at lower heights, and these plants can better withstand the onslaught of unfriendly weather as well as plant pests. They also have a better yield and take lesser time to bear fruit as compared to Arabica. Although the Arabica variety is preferred in international markets, high quality Robustas are also sought after in espressos, due to their strong taste and the crema that they help generate.

Inter cropping :

Intercropping coffee with other crops is a means of reducing cost of production, and ways of diversifying farmers' sources of income. Since coffee plantation requires shade place and free from sun-scorch, it is usually planted under the forest by retaining a number of desirable shade trees. As such, intercropping with rubber will make suitable condition for coffee and will add the value of the plantation and hence more income for the farmer.

Weed management :

If the weeding is not done during October/November months, then weeding operation should be undertaken during December month using slash weeding. Generally during these months, weed growth is very poor due to lack of moisture in the soil. Avoid use of herbicides and weedicides or use them judiciously. This will help in maintaining the soil and environmental health from hazardous chemicals.

Diseases and pest management:

Among pests the most common **are** Berry borer **,** White stem borer, Shot hole borer beetle, Green scales and mealy bugs. Diseases like leaves rust, Black rot or Koleroga, Collar rot, Brown eye spot, Black root rot are also harmful for the plantation**.** Green mealy bug is one of the most important sucking pests of coffee. Various types of ants especially red ant and cocktailed ants are responsible for the spread of these small soft bodied insects from one place to other. Hence control of these ants is important in mealy bug management in the coffee fields. Therefore, control ants by dusting 5% Malathion powder around the base of affected coffee plants and shade trees. Destroy nests of red ants and cocktailed ants. The infested plants should be sprayed with Ekalux 25 EC (120ml) or Metacid 50 EC (120 ml) dissolved in 200 litres of water with 200 ml of any agricultural wetting agent using a gator sprayer. Four litres of kerosene emulsified with 200 litres of water and 200 ml of wetting agent can also be used for spraying.

Harvesting :

When the fruits are mature, from 6 to 8 month after flowering for the Arabica plant, and from 9 to 11 month for the Robusta, the harvest of coffee can begin. There exist two methods for harvesting: The individual collection and the removal of veins. The collection consists of gathering or picking by hand only those cherries which are ripe. This is the more costly method, which requires searching without interruption various days the same plant for ripe cherries. This results in the best coffee qualities. The stripping of the fruits from the branches (despalillado), consists in scraping the branches holding the cherries. This method can be mechanized. Employing this expeditious technique, a heterogeneous mixture of cherries, more or less mature, is gathered which results in coffee with more acids (due to the still green fruits which are gathered together with the ripe cherries).

Fly picking : Small scale picking of ripe berries during October to February.

Main picking : Well formed and ripened berries are harvested during December. Bulks of the yields are obtained from this picking.

Stripping : Picking of all the berries left irrespective of ripening.

Cleanings : This is collection of fruits that have been dropped during harvesting. Unripe fruits should be scrupulously sorted out before using the fruits for pulping. They may be dried separately as cherry. Harvest starts during November and harvesting extends up to February. Coffee fruits should be harvested as and when they become ripe. Coffee is just ripe when on gently squeezing the fruits the beans inside come out easily. Unripe fruits should be scrupulously sorted out before using the fruits for pulping. They may be dried separately as cherry.

Post harvest management :

Coffee fruits should be picked as and when they become ripe to get better quality. Arabica comes for harvesting earlier since they take 8-9 months for fruit development from flowering while robusta takes 10-11 months. Picking is done by hand. The first picking consists of selective picking of ripe berries and is called fly picking. Thereafter, there will be 4-6 main pickings at 10-15days intervals and final harvest Coffee is processed either by wet method to produce 'Plantation / parchment coffee' or by dry method to obtain 'Cherry coffee'. For preparation of both these types of coffee, picking of just ripe fruits is essential. Over ripe or green (unripe) berries result in poor cup quality after processing. If, for any reason coffee could not be harvested as and when it ripens, the over ripe and green fruits should be sorted out and processed separately as 'cherry'. The pulper, washing machines, tank, vat, trays etc., should be kept clean. Prolonged heaping of fruits and delayed pulping should be avoided. Clean water should be used for washing-coffee.

Marketing :

While coffee in India has traditionally been an export-oriented commodity, coffee planters in India are finding significant attraction in the domestic market as well. India’s domestic coffee consumption has increased steadily from around 50,000 MT in 1998 to 115,000 MT in 2011. his has led to the setting up of a number of international and Indian coffee retail chains in the country in recent years like Lavazza, Café Coffee Day, Costa, Gloria Jean’s Coffee, Coffee Bean & Tea Leaf; and Starbucks in a 50:50 JV with Tata Global Beverages. Besides viewing India as a market, these chains are also recognising the fine quality and value proposition that is characteristic to India’s coffee plantations; thanks to a rich legacy that spans more than four centuries. Consequently, they are also looking to develop a deeper and sustainable sourcing relationship with Indian coffee growers. India is witnessing a dramatic evolution of the coffee consuming culture across the Indian market. In India we have extension service of Coffee Board of India. In Mizoram also, there is Central Coffee Board at Bualpui. The principal activity of Extension Service of the Coffee Board is to transfer of coffee technologies standardised by the research department to the coffee growers for achieving better production/productivity vis-a-vis improving the quality of coffee. Thus it helps to bridge the gap between coffee planters and research scientists in implementation of coffee technology in the coffee estates.

BROOM :

Common name : Broom Grass

Scientific name : *Thysanolaena maxima*

Family : Poaceae

Some of the non-timber forest produce species have good potential for generating local employment and can be used for enhancing rural income. Their cultivation is site specific; therefore, selection of a suitable species is very important from ecological and economic point of view. The broom grass is one of such species that can be grown as a cash crop in North East India for its inflorescences that are used for making brooms. It is a multipurpose crop, the inflorescence is used as Brooms, and stems are used as wall building materials. The fibrous root system of the plant is useful in checking soil erosion on steep slopes. The woody stem (culms) can be used for fuel, fencing, pulp and paper or other purposes.

Promotion of healthy nursery:

Broom grass can be propagated artificially through seeds, rhizomes and wild seedlings transplant. The seeds are generally available in March from senescing panicles. Small mother beds 2m x lm are prepared and sowing is done by broadcasting 5 to 10 g seeds in each bed. Seeds are covered with very thin layer of sand and the beds with that grass. Watering is done as and when required. The germination starts after two to three weeks of sowing. The grass cover is removed on germination of seeds and regular weeding and watering is done. After 4 to 6 weeks the seedlings are either transplanted to other beds at spacing of 10 cm x 10 cm. The propagates/rhizomes (roots along with culms) are collected by digging of roots from wild or cultivated plants after harvesting the crop during February or March. The culms are cut leaving 15-20 cm long stem with roots and used for raising nursery as well as for planting in the field. Two to three culms along with bud sprouts and rhizomes are separated from clump and planted in the field. During transplanting the soil should have sufficient moisture for plant establishment. The plants are watered as and when required and kept in shade. The rhizomes are easy to transport to long distances for propagation as well as for plantation. The cut ends of culms can be dipped in melted wax to prevent drying and decaying.

Soil and climate :

Broom grass can be grown in a wide range of agro-climatic conditions and soils up to 2,000 m above sea level. It can be grown on marginal lands, wastelands and Jhum fallow. It grows well on a wide range of soils from sandy loam to clay loam. It is tolerant of harsh environmental conditions such as shallow soil, drought and heavy rainfall. It grows easily on shady slopes, damp and steep river banks, degraded areas and gravelly soil on weathered rock surfaces. Broom grass can grow on land unsuitable for food production. It can be grown as a hedge in an alley cropping system and is recommended as part of a shifting cultivation system. Broom grass is produced in a five-year cycle with the lowest yield in the first and fifth years, and highest in the second and third years. Although the first year of production is labour-intensive, requiring planting and weeding, the crop does not require much attention after that.

Field preparation and planting :

Slash and burn for the initial state : For hill areas digging contour terrace wide of 3 ft with spacing of 9 ft. is most suitable for planting the broom grass. The planting site must be clean and free from weeds. Thorough jungle cutting should be done before or during March and debris should be removed from the field. A spacing of 2.5 m x 2.5 m is the best for plain fertile land and 1600 seedlings are required for planting of one hectare area. While for jhum lands or hilly areas planting in contour lines or on the bunds of terraces at a spacing of 1.5m x 2.0 m is good

and about 2500 to 4000 plants are required for one hectare area. The rhizomes (roots along with culms) so collected should be free from sun-scorch.

Seed quality :

Three varieties of broom grass are available in Mizoram. However, selection of most productive seeds is not possible as there are no farmers who are doing proper nursery in Mizoram. Broom grasses are usually regenerates through seeds under natural condition. The seeds mature during February to March and disseminate by wind to long distances due to their lightweight.

Weed management :

It does not require much care after planting. However, 3 to 4 weeding and soil working in the first year and three similar operations in subsequent years are necessary for obtaining good return. Farmyard manure can be applied in soil during second weeding to get better yield from the first year itself. Fencing is essential to protect the crop from browsing and grazing.

Harvesting :

Brooms (inflorescences) are harvested on maturity during winter season from January to February. The panicles become tough and its colour changes to light green or red. The harvesting should be done carefully when the brooms have matured properly. The culms are harvested by cutting above the ground, panicles and stem are disjoined. The panicles can also be hand pulled and dried in fields. Brooms are made by bundling about 30-35 dried inflorescences and marketed. The leaves are harvested for fodder once in August from the second year onwards.

Post harvest management :

After the panicles are collected, they are loosely tied up and dried in the sun. Then they are tightly bound and sold in the markets. The bamboo-like leaves are used for fodder and the woody stems for fuel. The broom grass is also a tool for the reclamation of wastelands. Apart from checking soil erosion, the plant can also thrive in harsh conditions.

Marketing :

Marketing brooms are required in each house, therefore, it has sufficient demand throughout the country and marketing is not a problem. The majority of the production is from subsistence farming areas and dispersed collection from the forest, which are inaccessible to transport networks and markets. It is a high volume crop and there is glut in the market during the harvesting season which reduces the local price. Whole sale trading of brooms is a highly monopolized activity. Major portion of income goes to the traders and middlemen. The farmer gets very meagre amount i.e, about 35% of the retailers'- price. Further, its demand in the area of production is very less as other alternatives of brooms are also available locally. Therefore, to improve the economy of people and region, the system of cooperative marketing needs to be developed. The Forest Corporation can play a good role in this venture. Broom grass cultivation can be a profitable venture. Total cost of cultivation is estimated at Rs 10000.00/ha for the first year and maintenance cost in the subsequent years is Rs 3500.00/ha. It can generate a profit of approximately Rs 20,000 to 30,000 /ha per year depending upon farming situation.

ARECANUT :

Common Name	: Arecanut
Scientific Name	: *Areca catechu*
Family	: Piperaceae
Variety	: Subamangala, Mangala, Sumangala, Mohitnagar, Hirehalli dwarf, Samruthi, VTLAH 1. 2, Thirthahalli dwarf and Srimangala are the main commercial varieties cultivated in India.

The arecanut palm produces the common chewing nut which is popularly known as betel nut or supari. This nut is consumed in very large extent hence has great demand. In India, areca nut is very much linked with religious practices. India is the largest producer and consumer of areca nut in the world. The areca nut is not a true nut, but rather a fruit categorized as a drupe. It is commercially available in dried, cured and fresh forms. Commercial cultivation of areca nut is more successful in India. Major Production States of Arecanut in India are Karnataka, Kerala, Assam, Tamil Nadu, Meghalaya & West Bengal. Local Names of Arecanut in Mizoram is Kuhva.

Promotion of healthy nursery :

Mother palm, from which we select seed, should be more than ten years old with early bearing nature with good fruit set. Fully ripe nuts weighing more than 35 g should be selected from mother palms. Selected seed nuts are sown 5 cm apart in sand beds with their stalk ends pointing upwards. Beds are to be watered daily.

Three month old sprouts can be transplanted in secondary nursery beds of 150 cm width and convenient length. Apply basal dose of well decomposed cattle manure @ 5 tonnes per ha. Transplant the sprouts at a spacing of 30x30 cm with the onset of monsoon, provide partial shade, irrigate during December to May and provide drainage during rainy season. Periodical weeding and mulching are required. Polythene bags (25x15 cm, 150 gauge) with a potting mixture (top soil: farm yard manure: sand 7:3:2) can also be used to raise secondary nursery.

Soil and climate requirement for arecanut cultivation :

Arecanut can be grown on wide range of soils. Laterite soil, red loam soil and alluvial soil are suitable for Arecanut cultivation. However, this crop thrives best in well drained soils with good organic matter. This crop requires well distributed annual rainfall of 750 mm to 4500 mm. This crop can be grown altitude up to 2475 ft. above mean sea level. The ideal temperature range of 15°C to 40°C is best for its growth and yield.

Land preparation :

Slash and burn for the initial state : Land should be ploughed and harrowed couple of times to bring the soil to fine tilth stage and make the field weed free from previous crops. The plantation site should avoid sun-scorch. In order to avoid sun-scorch, adequate protection from exposure to South-Western sun should be needed. Quick growing shade providing trees should be planted on the southern and western sides well before of planting arecanut seedlings. This palm nut tree is sensitive to moisture deficit and should be grown where adequate irrigation is available. June - December is found to be the good for it's planting.

Planting and spacing requirement :

Plant tall, quick growing shade trees on the Southern and Western sides of the seedlings to provide protection from sun scorching. This helps for better stand of crop hi the initial stage. Dig pits of 1ft. X 1 ft. with spacing of 9 ft. X 9ft. and fill up with rich top soil to a , level of 15 cm from the bottom. Plant seedlings in the center of pit, cover with soil upto collar teal and press around. The planting is to be done during May - June in well drained soils while in ill drained soils (Clayer) planting is done in August - September to avoid the plantation in water logging. Banana is raised between rows to provide shade to the seedlings in the initial stages upto 4 - 5 years.

Seed quality :

Thirthahalli dwarf and Srimangala are the main commercial varieties cultivated in India. Twelve to eighteen month old seedlings with more than five leaves and minimum height should be used for transplanting to the main field.

Planting time :

Planting should be done in May-June in well drained soil.

Weed management :

Regular manual weeding tasks should be carried out to make the nut orchard weed free. Weeding is to be done twice or thrice a year or as per necessary. Light forking or digging after cessation of monsoon should be carried out. Remove any dead or diseased palm leaves. Mulching can be done to prevent weed growth and soil erosion, terracing can also be done to prevent soil erosion in sloppy areas. This also helps in retaining the water from evaporation.

Pest and diseases management :

Pests :

Orange coloured mites can be controlled by spraying the bunches with dimethoate at 0.05 per cent.

Spindle bug (*Carvalhoia arecae*) :The feeding injury is caused on the lamina and petiole. The affected leaves show dry brown patches. Spray crowns with carbaryl 50 WP. The spray should reach the leaf axils. Repeat spraying after 30-35 days if pest incidence continues. Placement of 2 g phorate 10G sachets on the top most two leaf axils prevents the pest attack.

Inflorescence caterpillar (*Batachedra sp.*) : Force open the inflorescence out of the enclosing spathe and spray malathion 50 EC (250 ml in 100 litres of water). Control slugs, which predispose inflorescence to the attack of caterpillar, by using bait of metaldehyde.

Root grub *(Leucopholis burmeisteri*) : Loosen soil around the base of palms to a depth of 10-15 cm and drench with chlorpyrifos 0.04% suspension twice, one in May just before the onset of southwest monsoon and again in September-October towards the close of the monsoon. Repeat application for 2 or 3 years consecutively to secure a complete eradication of the pest. Root grubs can also be controlled by soil application of phorate 10 G around the palms.

Diseases:

1) Koleroga (Mahali or fruit rot) (*Phytophthora palmivora*) : Spray Bordeaux mixture 1% on all bunches three times in a year, one just before the onset of southwest monsoon and the rest at 40 days intervals. If monsoon season is prolonged give a third spray. Use rosin soda adhesive to

ensure tenacity of the spray deposit on treated substrate. Remove and burn all fallen and infected nuts.

2) Bud rot (*Phytophthora palmivora*) : Remove and destroy affected spindle and leaves. In early stages of infection, scoop out affected rotten tissues by making longitudinal side splits and apply Bordeaux paste on the exposed healthy tissues or drench crown with 1% Bordeaux mixture.

3) Basal stem rot (Anabe) (*Ganoderma lucidum*)

1. Isolate affected palms by digging trenches 60 cm deep and 30 cm wide around, one metre away from the base and drench with captan (0.3%), calixin (0.1%) or copper oxychloride (0.3%)

2. Remove and destroy all severely affected palms and stumps of dead palms.

3. Drench the soil with 1% Bordeaux mixture before planting healthy seedlings.

4. Discourage growing of collateral hosts of fungus such as Delonix regia and Pongamia glabra in the vicinity of gardens.

5. Apply 2 kg neem cake per palm.

6. Avoid flood irrigation and water flowing from infected palms to healthy palms.

Harvesting :

The prehearing age of the palm ranges from 4-5 years. he colour of the fruit during its growth changes from green to different shades of yellow and red during ripening. Nut matures after 8-9 months after fertilization 4-5 spadix are produced by the palm per year.

The stage of which-nuts is to be harvested depends upon the type of nuts required for the market. Where tender processed nuts are required as finished product, the tender nuts are harvested from July to December. In places where "Chali" or "Gota" (Sub dried whole nut) is required fully ripe nuts are to be - harvested from December-March or from May to July.

Post harvest management :

Storing the nuts after harvesting is one of the major tasks. There are numbers of insects and mites that can damage the nuts during storage. Hence storing in jute bags soaked in 0.1% Lindane solution is highly recommended. When nuts are stored in such bags, they remain free from insect infestation for up to 5 to 6 months. Phostoxin tablets @ 800 grams /100 m3 are also effective in controlling stored areca nut pests.

Marketing :

Arecanut being a highly profitable commercial plantation crop, it is important to understand the market scenario. Areca nut is mainly grown in nine Asian countries. India is leading the race in terms of area under cultivation followed by Indonesia. Arecanut farmers in India are finding significant attraction in the domestic market as well.

Inter cropping :

Owing to the long pre-bearing age of the palm, practically no income obtained during the first 3-4 years. Intercropping with elephant foot yarn, pineapple, pepper, betel vine, banana, cocoa, ginger and cardamom can be grown. In all the cases, the intercrops should be manure adequately and separately. The cutting out of uneconomic trees and replacing them with good seedlings is important in maintaining a high level of productivity of the garden.

OIL PALM :

Common Name	:	Oil Palm
Scientific Name	:	*Elaeis guineensis*
Family	:	Areacaceae
Varieties	**:**	Tenera, Dura,Pisifera Areacaceae

Oil palm crop is one of the highest oil (palm oil) yielding crops among the all perennial crops. Oil palm tree produces edible palm-oil as well as palm kernel-oil. This oil palm is considered as golden palm due to its high yielding capacity. In India, oil palm crop provides the excellent substitute of importing the oil.

Climate and soil requirement :

Oil palm is a humid tropical crop and thrives best in the areas where temperature ranges from 22°C to 24°C (minimum) and 20°C to 33°C (maximum). Oil palms require at least 5 to 6 hours of bright sunshine per day and 80% of humidity for optimum growth. This crop requires annual evenly distributed rainfall of 2500 to 4000 mm or 150 mm monthly. As Indian climate is not suitable for evenly distribution of the rain, farmers are advised to go for assured irrigated conditions for oil palm cultivate.

Generally, oil palms can be grown wide range of soils. However, they thrive best in well-drained deep loamy and alluvial soils rich in organic matter. These trees require at least 1 meter so depth. Farmers should avoid highly saline, highly alkaline, coastal sandy and water stagnation soils.

Promotion of healthy nursery :

The Propagation in oil palm cultivation is mainly by seeds and seeds are extracted from fruits using depericarper. Preheating of seeds is required for 75 days at 40°C temperature due to their high dormancy. Thereafter, seeds should be soaked in running water and make them cool down for 4-5 days. The seeds start germinating if 10 to 12 days and out germinated, sprouts should be transplanted to poly bags.

In nursery raising, the single stage poly bag system is a very popular propagation method and in this process, a poly bag size 40 35 should be filled with top soil, sand and well rotten manure. Then sprouts should be placed at a depth of 2.5 cm in the center of the poly bag. Regular watering and mulching should be carried for proper growth of seedlings. Use recommended NPK in nursery until they are transferred to the main filed.

Land preparation :

Slash and burn for the initial state. Dig pits of 2ft. X 2 ft. with spacing of 9m X 9m X 9m and left open for weathering and then filled and heaped for planting. Land should be made weed free and couple of ploughings should be given to get the soil fine tilth stage. Supplement the field with good organic matter to make the soil rich field. The best season for oil palm planting is from June to December. However, crops grown during summer should be provided with sufficient irrigation, mulching and growing cover crops in the tree basin is preferred to avoid hot winds in summer season.

Planting and spacing requirement :

Healthy seedling of 12 to 15 months age old with at least 1 meter height and 12 to 13 functional leaves are recommended in the oil palm tree cultivation. In triangular planting method, with a spacing of 9 meter x 9 meter x 9 meters, 143 to 145 oil palm plants can be accommodated in 1 hectare land. Planting should be done in the pits with size of 60 cm x 60 cm x 60 cm.

Seed quality :

There are 3 major varieties of oil palms available.

Tenera- This variety is ruling hybrid type and basically it is a cross of shell-l Pisifera (female) and thick-shelled Dura (male). This variety is thin shelled a cultivated across the globe.

Dura- This variety is not commercially cultivated and it has thick shell of 2 t 8 mm.

Pisifera- This is a shell less fruit bearing variety. Tenera is the most common grown variety and is most productive.

Weed management :

Regular manual weeding or chemical weeding can be carried out in oil palm cultivation. However, chemical weeding should be done only with recommended herbicides. For effective control of weeds, Glyphosate of 700-750 ml/ha/year or 17 ml/basin should be applied. By spraying herbicide mixtures of Paraquat with Atrazine, Diuron and Monuron on ground can effectively control the weeds and this operation should be carried out twice a year. Mulching can be carried out to conserve the soil moisture and control the weed growth. Mulching can be done with dried leaves, coconut husk, male flowers and empty bunches.

Pest and diseases management :

The following are the common pests and diseases are found in oil palm cultivation: Pestalotiopsis leaf spot, Ganoderma butt rot, Bacterial bud rot, Oil palm wilt, Rhinoceros beetle, Mealy bugs. Appropriate control measures should be taken care for these pests and diseases by contacting nearest agriculture department.

Harvesting :

The oil palms will be ready for harvesting in 2.5 to 3 years after the plantation in the main field. Determining harvesting time is very important in oil palm cultivation as it greatly impacts the quality and quantity of oil. Harvesting can be done when the fruits on palm turn into yellowish - orange colour and 5 to 8 fruits drop on their own. The final check would be when pressing the fruits hard with finger, orange coloured oil should extrude from the palm fruits. Harvesting takes place throughout the year and generally done in 10 to 14 days interval with the help of sharp knife or sickle. A stalk length of 5 cm should be left while harvesting the fruit bunches.

Inter croping :

Oil palms are a wide space perennial trees and inter space can be utilized for intercropping during initial 3 year period. Thereafter, shade loving crops can be grown. The care should be taken with intercrops so that it will not compete with oil palms in terms of water, light and nutrients. The most suitable inter-crops during initial 3 year period are any vegetables, flowers, chillies, banana, tobacco, ginger, turmeric, pineapple. As part of the inter-crop process, should not cut the oil palm fronds or tie oil palm fronds close to the stem. Ploughing close to

palm base should be avoided as it may cut the palm roots. For better yield maximum number of green leaves should be retained.

Marketing :

Any crop yield depends mainly on the soil type, variety, climatic conditions and farm management practices. Oil palm is expected to produce 12 tonnes/ha during initial period from 4 to 8 years. After 8^{th} year production is expected to increased 18 to 20 tonnes/ha.

India is basically a net importer of the palm oil. It never had a production history in context of this oil. But it does have a vast palm oil consumption and import background. India produces around 70000 tons of palm oil annually which stands at approximately 0.2% share in the world total production. Thus there is a good marketing scope for oil palm plantation in India.

RUBBER PLANTATION :

Common name : Rubber

Scientific name : *Ficus elastica*

Family : Euphorbiaceae

Variety : Tjir 1, PB 86, BD 5, BD 10, PR 17, GT 1, RRII 105, RRIM 600, PB 28/59, PB 217, PB 235, RRIM 703, RRII 5, PCK-1, 2 and PB 260.

Rubber is used for many purposes which may include erasers to tyres, tubes and industrial products. Rubber tree basically grows up to 30 meter height and begins yielding latex at 6 to 7 years age. India is the third largest producer of rubber in the world followed by Thailand and Indonesia. In India, Kerala is largest state of rubber producer.

Nursery :

Nurseries are required for raising seedlings, budded stumps, bud wood and advanced planting materials like poly bag plants, etc. Mother plants or source bushes for the multiplication of bud wood are also grown in nurseries. Open and level land should be selected for raising nursery. Water should be easily available for irrigation. The soil should be deep, well drained and fertile.

For germination, raised level beds of about 15 cm. Level the germination bed with 5 cm thick layer of river sand. The wide should be 120 cm wide and of convenient length. Partial shade in order to prevent strong sun is necessary. The seeds are sown in a single layer touching one another and germination beds are kept moist, but not wet, by evenly sprinkling water during morning and evening. The seeds are covered with loosely woven coir matting or gunnies.

Germination starts 6 to 7 days after sowing. Seeds sprouted each day should be picked and planted in Secondary nursery beds or in the field as the case may be. About 75 percent germination is considered good. Pickings are done for about 21 days after sowing Germinated seeds will have young roots emerging first. That is the ideal stage for nursery planting. The wide of the secondary bed should be 120cm with an ideal length of 40 ft. The land should be dug to a depth of 75 cm and all stumps, roots, and stones should be removed. Manuring (fertilizing), watering, weeding etc. should be done as and when necessary. Planting distances in secondary nursery should vary according to the type of planting materials to be raised in the nursery. The ideal spacing for seedlings is 30cm X 30cm.

Soil and climate requirement:

Rubber Plants require highly deep weathered soils which consist of laterite and lateritic soils rich in organic matter. They grow best in well drained porous soils with moderate acidic in nature. However, rubber plant also thrives in red alluvial soils, if there is a good organic matter in the soil. The soil pH of 5.0 to 6.0 is best for rubber cultivation. For good aeration and root growth, water table should be below at least 1 meter depth in the soil.

The rubber plantation requires heavy and well distributed rainfall of 2000 mm to 3000 mm having humidity about 75% - 80 %. The best growing temperatures for rubber plant is from 20°C to 35°C. Freezing temperatures will halt the growth of rubber plants and strong wind areas are not suitable for rubber farming. This plantation requires at least 5 to 6 hours of sunlight.

Land preparation and spacing requirement :

The main field should be cleared of wild growth. Contour terrace of 6ft wide and convenient length should be dug with a spacing of 25 ft. interval. Pits with dimensions of 2.5X2.5X2.5 ft.cm should be dug along the contour at 10ft intervals. Usually it takes 300 to 400 pits per 1 hectare land. The rubber planting depends on the type of land, if it is levelled one, square planting is suitable where as slope lands are best for rectangular plantation. In hilly areas, row planting is recommended across the slope along the contour lines. In rubber cultivation, June to July is the best season for its plantation.

Seed quality :

There are numbers of variety of Rubber. These include 86, Tjir 1, PRII 100,PRII 200 PR 17, BD 5, BD 10, GT 1, PB 28/59, PB 217, PB 235, PB 260, RRII 5, RRII 105, RRII 414, RRII 430, RRIM 600, RRIM 703 and PCK-1. Of these varieties RRII 105, PB217 and GT1 are the most common grown in India as they can adapt in a wide range of agro-climatic conditions and soils. Recent research has proved that, PRII 100, PRII 200 and PRIM 600 are the most productive varieties.

Weed management :

In rubber plantation, weeding is usually carried out manually or chemically or through a combination of both. The main weeds commonly found in rubber plantation are Axonopus, Paspalum, Digitaria, Mikania, Sida, Pennisetum, Eupatorium, Chromolaena, Borreria, Lantana, Mimosa, Clerodendron. Weeding and soil working in the first year and three similar operations in subsequent years are necessary for obtaining good return. As a pre-emergence application, chemical herbicides like Alachor, Diuron and Simazina should be applied to control the weeds. Herbicides like Paraquat and Glyphosate can be applied in the post emergent.

Diseases and pest management :

Scale insect, Termite (White ant), Mealy bug. Cockchafer grub and Mites are the main pests in rubber plantation. Rubber tree is subjected to many diseases like abnormal leaf fall, secondary leaf fall, Bird's eye spot. Leaf spot, Powdery mildew, pink disease, patch canker or bark cankers, dry rot, stump rot, collar rot or charcoal rot and brown root disease are the main disease found in rubber farming. Appropriate control measures should be taken care for these pests and diseases by contacting nearest agriculture department.

Harvesting :

In rubber plantation yield depends on the method of propagation. In any method, usually yield increases year by year. The yield reaches peak after 14 to 15 years of planting. A annual average yield of rubber **is** about 375 to 400 kg/hectare from seedlings trees. In budded plants, an average yield of 800 - 1000 kg per hectare can be obtained. The latex that flows out from the rubber trees on tapping is channelled into a container, generally coconut shell cups, attached to them. Latex collected in coconut shell cups in transferred to clean buckets, two to three hours after tapping. The latex which gets dried up on the tapping panel (tree lace) and the collection cups (shell scrap) also form a part of the crop and are collected by the tapper in baskets just prior to tapping. The latex spilt including overflows on the ground (earth scrap), when gets dried up, is also collected once in a month. Normally 10-20 % of the total crop constitutes the tree lace, shell scrap and earth scrap.

Post harvest management :

Rubber can be processed and marketed as Preserved latex concentrates: The latex is collected in the storage tank, from there it is brought to a centrifuge machine, rotating at 1440 rpm. Due to the centrifugal action, liquid portion comes out. The upper layer, the concentrated latex is collected and brought to bulking tank and mixed with chemical and packed in drums. 60% rubber is present in it.

Marketing :

Rubber marketing is a high volatile market and has high political sensitivity-large number of dealers and growers-decides the economic geography of a State**.** Rubber industry in India is dominated by small & medium sector as out of 5500 rubber products manufacturing units, 90% are MSMEs. Rubber units spread across the country manufacture around 35000 different rubber products which find usage in auto, defence, healthcare, agriculture and in various other critical sectors. India's annual demand for natural rubber is more than 10 lakh tonnes, while the domestic production is stagnant at about 5 lakh tonnes. The rubber authority of Thailand is offering about 3 lakh tonnes of natural rubber to India. India is importing 3 lakhs tonnes of natural rubber from Thailand. Hence, rubber production has a good marketing scope and its production need to be increased to meet the increasing domestic demand.

Inter cropping :

In rubber plantation is intercropping will generate good revenue during first two years of cultivation. The suitable intercrops in rubber plantation are like ginger, turmeric, tuber crops, vegetables, pineapple, banana and medicinal or herbal plants. Cover cropping is helpful in sloppy regions to prevent soil erosion. This also helps in enhancing the soil fertility and controls the weed growth along with soil temperature. Intercropping like Leguminous crops will help in nitrogen fixation in the soil. Calopagonium muconoides, centrosema pubescens, pueraria phaseoloides and desmodium evalifolium are common cover crops in rubber plantation.

TEA PLANTATION :

Common name	:	Tea
Sceienctific name	:	*Camellia sinensis*
Family of tea	:	Theaceae
Variety	:	*Camellia sinensis var. sinensis and Camellia sinensis var. assamica.*

Tea is the dried leaf of a bush and contains theine and when added to boiling water along with milk and sugar, it gives an aromatic and stimulating drink. Tea is one the most important beverage crops in India. All types of tea come from the same basic plant, the *Camellia sinensis* plant. The *Camellia sinensis* plant is native to Asia, but is currently cultivated around the world in tropical and subtropical areas The differences between teas arise from processing, growing conditions, and geography and is divided mainly into five basic categories : black, green, oolong, white and Herbal Tea.

Nursery preparation :

The tea nursery should be located near a perennial water source. An over head 'pandal' is raised on which a coir mat with 6 mm2 mesh is spread so as to allow about 33% sunlight at midday into the nursery. The nursery soil should be well drained and deep loam in nature with pH of 4.5 to 5.5. The soil and sand used in the preparation of rooting medium should be tested for pH and nematode infestation For sowing the tea seeds, germination beds of 1 metre width and of convenient length should be raised to a height of 15 cm from the ground level. Single super phosphate (SSP) should be applied to the soil @ 50 g/m2 before sowing the seeds. A nursery bed measuring 30m x 1.5 m or 37.5 m x 1.2 m will accommodate about 1300 seeds when sown at 20 cm x 20 cm (triangular) spacing. Polythene sleeves with a dimension of 30×10 cm are used for filling up the sandy loam/clayey loam soils. Tea seeds are planted on nursery beds in rows at a depth of 1.5 cm.

Climate and soil requirement :

Tea plantation requires a moderately humid and hot and climatic condition. Tea plantation thrives well in humid and hot weather condition. As climate impacts crop yield, crop quality, one should consider the local climate for tea plantation. The optimum temperature range for tea plant growth is 20°C to 33°C and temperatures above 35°C and below 10°C can damage the tea plants growth. Tea plantation requires well distributed rainfall from 150 cm to 300 cm throughout the year. Tea plantation is a shade loving plant and grows more vigorously when it planted along with shady tree areas. The performance of tea is excellent at elevations ranging from 1000 - 2500 m optimum temperature 20°C – 27°C.

Tea plantation thrives well in deep, well drained, friable loamy soils. Virgin forest soils that are rich in humus and iron are the best suited soils for tea plantations and large proportion of potash and phosphorus in the main soil gives special flavour to tea as is the case in Darjeeling. Water logging will damage the plants, so make sure there is easy way of draining the soil. As part of Soil/Land preparation in Tea plantation, good dose of nitrogenous fertilizers like ammonium sulphate and organic matter should be added to soil. Soil acidic pH should be in the range of 4.5 to 5.5.

Land preparation :

Land preparation involves clearance, adoption of soil conservation practices and soil rehabilitation prior to planting of tea. Prior to planting of tea the land must be cleared of existing growth, be it old tea, jungle or bare land. This is followed by deep forking the land to the depth of 18" to 24" by which all old roots and stones are removed and the land levelled. After levelling, lateral and leader drains are cut to prevent erosion caused by heavy rains.

Rehabilitation of the soil is achieved by planting Guatemala or Mana grass which is sustained for at least two years. This grass is fertilised twice a year with a special grass fertiliser and lopped regularly (twice a year) and provide 10 to 15 tons of mulch per lopping which enhances fertilising of tilts of the ground. After 8-10 months in nursery bags, depending on growth, plants are ready to plant in field. Care should be taken not to allow the tap root to reach or penetrate in to nursery soil coming out from the bag.

Planting and spacing :

There are two types of planting : 1) Pit planting- This method is followed when spacing between plants is wide enough to allow digging of individual pits of proper size. 2) Trench planting- This method is adopted for closer spacing and in heavy soils.Tea gardens are set up on the cleared hill slopes where shade trees are planted in advance. Seeds are sown in the germination beds and the saplings transplanted to the garden. The garden is regularly hoed and weeded so that tea bush grows without any hindrance. About 14000-16000 (upto 17000 in hilly areas) plants per hectare have been found to be ideal bush population with spacing of 105-110 cm between rows and 60-75 cm between plants.

Seed quality :

All tea comes from the *Camellia sinensis* species of plant. *Camellia sinensis* is broken down into two varieties : *Camellia sinensis var. sinensis* and *Camellia sinensis var. assamica.* The former is from China with smaller leaves that can adapt to lower temperatures and the latter grows in India with larger leaves, better suited to warmer temperatures.

Weed management :

Regular manual weeding tasks should be carried out to make the nut orchard weed free. Weeding is to be done twice or thrice a year or as per necessary. Planning a year-round weed management programme is advocated if possible, so that all areas are given timely attention. Undertake weeding before the weeds reach a height of 10 - 15 cm. so that they may be removed before reaching the stage of flowering. Keeping the boundaries of tea fields, roadsides, ravines and other areas adjacent to tea fields free of weeds to prevent the continuous dispersal of weed seeds into tea fields is strongly recommended. Manual weeding is a costly operation, but a safer method than chemical weeding. Selective weeding should be advocated, where shallow rooted soft weeds are retained to serve as a live guard cover.

Harvesting :

When the bush develops and a complete ground cover is established (which would take two to three years depending on the climatic conditions and elevation), the tea bushes could be harvested on a regular basis which is approximately once in eight to ten days. The following potential of the tea plant would be achieved only after it receives its second prune and should continue for around 30 to 40 years. Pruning is carried out on a regular basis, once in every three to five years depending on the growing conditions which are related to elevation and climatic conditions.

Post harvesting :

After harvesting, processing of tea leaf starts within an hour since picking when they arrive to the factory Tea processing is the method in which the leaves from the tea plant *Camellia sinensis* are transformed into the dried leaves for brewing tea. The categories of tea are distinguished by the processing they undergo. In its most general form, tea processing involves different manners and degree of oxidation of the leaves, stopping the oxidation, forming the tea and drying it. The innate flavour of the dried tea leaves is determined by the type of cultivar of the tea bush, the quality of the plucked tea leaves, and the manner and quality of the production processing they undergo. After processing, a tea may be blended with other teas or mixed with flavourants to alter the flavour of the final tea. On the basis of processing they undergo teas are categorized mainly into five types : black, green, oolong, white and Herbal Tea.

Marketing :

India is also the leading exporter of tea in the world. India had a long tradition of being the largest exporter of tea in the world, but her predominant position as an undisputed leader of tea exporting country has been severely shattered by fast increasing domestic consumption and by tough competition by some other tea exporting countries in the world market. Despite about three times increase in the production of tea, our exports have been pegged around two lakh tonnes in the last decade. Knowing increasing domestic demand and dwindling exportable surpluses, India has to face tough competition from other tea exporting countries especially from Sri Lanka, China, Japan, Indonesia and some African countries. In order to achieve this goal of meeting the growing demand in the home market and to produce surplus for export, additional land should be converted into tea cultivation land.

Intercropping :

Tea is a light and humid loving but shade tolerant tree species .The light utilization efficiency of a mono-cropped tea plantation is very low due to its low light saturation point. The growth of tea is negatively affected by strong light, high temperature and low humidity. Therefore, the tea is usually grown under shading of trees and there is a high potential of supplementing the necessary shade by inter-planting with other economical tree species. Sri Lanka Rubber Research Institute, after several years of experimentation has found that intercropping can be done with rubber and tea, if rubbers are planted at a spacing of 12m X 12m. Sri Lanka tea small holders in the mid country had been traditionally cultivating tea with pepper, coffee and cloves in an adhoc manner for a long time.

Topic 12 – Fruits

Objectives :

To enhance productivity through best management practices and sales through proper channel of marketing

Duration : 60 minutes

Expected outcome : Participants will learn the importance best management practice for fruit production

Module Plan

Topic	Content	Methodology	Process	Materials Required
Fruits (Pineapple, Orange, Banana, Assam lemon, Gooseberry, Grape, Passion fruit, Papaya, Mango)	* Introduction to fruits * Soil management * Spacing requirement * Pest management * Irrigation * Climate * Healthy seedlings * Harvesting * Post harvest marketing	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on fruits through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

PINEAPPLE :

Common Name : Pineapple

Scientific Name : *Ananas comosus*

Family : Bromeliads

Variety : Kew, Mauritius, Queen , Charlotte, Rothchild, Jaldhup, Desi, Lakhat Smooth Cayenne, Abacaxi, Red Spanish

Soil and climate requirement management :

Pineapple grows in almost any type of soil, provided it is free-draining. Slightly acidic soil with pH range of 5.0 to 6.0 is considered optimum for pineapple cultivation. The soil must be well drained and light in texture. Heavy clay soil is not preferred. It can grow in sandy, alluvial or laterite soil.

Areas with a heavy rainfall are best for pineapple growth. Optimum rainfall is above 1500 mm per year. Pineapple is suitable for cultivation in humid tropics. The fruit grows well near the sea coast as well as in the interior; so long as the temperatures are not extreme. The fruit grows well near the sea coast as well as in inland, so long as temperature ranges from 29°C to 32°C. Low temperature, bright sunshine and total shade are harmful. It can grow successfully up to 3000 ft above sea level.

Land preparation :

In the hills, proper terracing is a necessity.The first step is slash and burn as usual in all type of crops farming in Northeast. The land is prepared for planting by ploughing or digging followed by levelling. Depending on the nature of land, trenches of convenient length, about 1 ft width and 1.5 ft depth are to be prepared at 12 ft interval.

Planting and spacing requirement :

For commercial viability high density cultivation is recommended. Planting density of 20000 plants/ha. with spacing of 45 cm from plant to plant and 60 cm from row to row along with 12 ft from trench to trench is ideal for sub-tropical and mild humid conditions and hilly areas in north eastern states, whereas for hot and humid conditions a plant density of 53,300 plants/ha spacing at 25 cm. from plant to plant within a row, 60 cm from row to row and 90 cm from trench to trench (25 x 60 x 90 cm) provides high yield.

Pest and diseases management :

No serious pest or disease of pineapple is prevalent in India. However, Mealy bug and Heart rot are important pest and disease respectively. Mealy bug: They can be controlled by dipping the basal portion of the planting material in 0.02 to 0.05 % methyl parathion as a prophylactic measure. Application of carbofuran @ 15 to 17 kg per ha in affected plantation can effectively control the pest. Heart rot: Application of Bordeaux mixture (4:4:50) or copper oxychloride @ 2g per litre. Sucker should be dipped in fungicide before planting.

Irrigation :

Pineapple is mostly cultivated under rainfed conditions. Supplementary irrigation helps to produce good sized fruits in areas having optimum rainfall. Irrigation also helps to establish an off-season planting to maintain its year round production. In case of scanty rainfall and hot weather, irrigation may be provided once in 20-25 days.

Healthy seedlings :

It is always advisable to use uniform size of seed lings monotype for getting uniform growth of the plants, enabling uniform cultural operations and getting harvest at 1 time from such a field. Hence selection of right type and size of planting material is essential for commercial planting. Pineapple is commonly propagated from suckers, slips and crown. Suckers arising from the underground parts of the plant are commonly used. Slips arise from the fruiting stem and from the crown on top of the fruit. Plants grown from suckers produce fruits in about 15 months, and slip produce fruits about 18 months, whereas those from suckers propagated from disc cuttings take over two years. Among the various types of seed lings, the farmers can choose which is most convenient to them. If sucker and slip are to be grown, they have to be cut with a length of 45-60 cm, whereas in case of crown 5-10 cm length is enough.

Harvesting :

In Pineapple farming, pineapple plants flower 12-15 months after planting and the fruits become ready 15-18 months after planting depending upon the variety, time of planting, type and size of plant material used and prevailing temperature during the fruit development. Under natural conditions, pineapple comes to harvest during May-August. The fruit usually ripens about 5 months after flowering. Irregular flowering results in the harvesting spread over a long period. In order to get uniform flowering (over 80%) in the main season, Ethrel (@ 100 ppm) solution is applied to plants one month. The fruits are harvested for canning purpose when there is a slight change at the base of developing fruits. The fruits used for table purpose are retained

till they develop golden yellow colour. The average yield is 50-80 tonnes/ha depending upon spacing and cultural practices.

Post harvest management :

Post harvesting management include grading, storage, transportation, packing and marketing. The main channels followed for marketing of pineapple is that the growers usually dispose off their produce at the farm gate to the middlemen. Majority of the cultivators sell their crop either through trade agents at village level or commission agents at the market. There is always a very good demand of Indian pineapples in the internal markets. It is in high demand from the processing industry as well. Indian pineapple is exported to Nepal, U.K., Spain and U.A.E. The main products of export are canned slices, titbits, juice etc.

ORANGE FARMING :

Common Name : Orange

Scientific Name : Citrus

Family : Rutaceae

Variety : Valencia, Hart's Tardiff Valencia, Hamlin, Mandarin Orange.

Mandarin orange (*Citrus reticulata*) is most common among citrus fruits grown in India. It occupies nearly 40% of the total area under citrus cultivation in India. The most important commercial citrus species in India are the mandarin (*Cimis reticulata*), sweet orange (*Citrus sinensis*) and acid lime (*Citrus aurautifolia*). Oranges are mostly grown in the states of Maharashtra, Madhya Pradesh, Tamil Nadu, Assam, Orissa, West Bengal, Rajasthan, Nagaland, Mizoram, Arunachal Pradesh.

Soil and climate requirement :

Mandarins grow successfully in all frost free tropical and sub-tropical regions upto 1,500 m above. An annual rainfall of 200-250cm. and temperature ranging from 14°C-35°C with soil pH of 5.5-6.5 is suitable for cultivation of the crop.

Mandarins are grown in a wide range of soils ranging from sandy loam or alluvial soils of north India to clay loam or deep clay loam or lateritic/acidic soils in the Deccan plateau and north-eastern hills. Citrus orchards flourish well in light soils with good drainage properties. Deep soils with pH range of 5.5 to 6.5 are considered ideal. High calcium carbonate concentration in feeder root zone may adversely affect the growth. It is advised that soil test should be done before getting into orange farming.

Land preparation :

Land needs to be thoroughly ploughed and levelled. In hilly areas, digging contour line with spacing of 18ft is suitable. Planting is done on terraces against the slopes and on such lands, high density planting is possible as more aerial space is available than in flat lands. Since citrus trees are highly sensitive to water logging and water stagnation during rainy season providing drainage channels of 3-4 feet depth along the slopes around the orchard is essential.

Planting and spacing requirement :

Mandarin orange is propagated by seeds and also vegetatively propagated by T-budding. Seedlings are mostly transplanted in the month of July-August after commencement of monsoon. Budding should preferably be done in last week of January or first week of February following the T or shield budding method.

Mandarins are usually planted in pits of 60cm X 60 cm X 60 cm size in a square system with a spacing of 18 ft accommodating 350-450 plants/ha. In north-eastern parts of India, Khasi mandarins are very closely spaced (4.5 m X 4.5 m), accommodating more than 500 plants/ha Digging of pits should be done 5-6 weeks before planting and left for weathering.

Irrigation :

The orange plantation requires critical stage watering in the initial year. Diseases like root rot and collar rot occur in flooded conditions. Light irrigation with high frequency is beneficial. Irrigation water containing more than 1000 ppm salts is injurious. Quantity of water

and frequency of irrigation depends on the soil texture and growth stage. Water requirement of citrus trees is generally higher than most of the other sub-tropical fruits due to recurrent growth and development. The water requirement varies from 900 to 1100 mm per year depending upon the location.

Diseases and pest management :

Disease and pests attack is difficult to control once it becomes established in an orchard. The diseases are caused by fungi, bacteria, virus, virus like pathogens, etc. They cause severe damage to the mandarin orange cultivation. Common Diseases are :

1. Gummosis disease (Causal organism : *Phytophthora palmivora, P.citrophthora, P. nicotianae var. parasitica*)

2. Powdery mildew (Causal organism: *Acrosporium tingitaninum*)

3. Citrus canker disease (Causal organism: *Xanthomonas axonopodis pv. citri*)

4. Citrus Tristeza Disease(The disease is caused by *Citrus Tristiza Virus* (CTV)

5. Citrus Greening disease, Citrus scab (Causal organism : *Eisinoe fawcetti*)

Major insect pests problematic to mandarin orange are :

1.Citrus leaf miner (*Phyllocnistis citrella*)

2. Citrus psylla (*Diaphorina citri*)

3.Citrus Fruit flies (*Bactrocera dorsalis*)

4.Lemon butterfly (*Papilio demoleus*)

5. Fruit sucking moths (*Otheris fullonica, Achaea janata L.*)

6. Aphids (*Toxoptera citricida*)

7. Shoot borer/Trunk borer

Table 1 : Recommended fungicides & pesticides for the management of diseases and insect pests in Mandarin orange**

Target Disease / Pest	**Fungicides/ Pesticides**	**Dose (g/L or ml/L) of most common formulation***	**Method of application**
Gummosis disease	Ridomil MZ	2.0	Foliar spraying
	Copper oxychloride	3.0	Foliar spraying
	Ridomil MZ	20	Apply as paste
Powdery mildew	Sulfex	3.0	Foliar spraying
	Karathane	2.0 - 3.0	Foliar spraying
Citrus canker	Blitox–50 + Streptomycin	3.0 – 1.5	Foliar spraying

	sulphate		
	Mancozeb	2.0	Foliar spraying
Citrus Tristeza Disease	Diamethoate	1.5	Foliar spraying
	Malathion	2.5	Foliar spraying
Citrus Greening disease	Fenvalerate	1.0	Foliar spraying
	Profenophos	3.0	Foliar spraying
Citrus scab	Copper oxychloride	3.0	Foliar spraying
	Carbendazim	2.0	Foliar spraying
Anthracnose/die back	Blitox–50	2.5	Foliar spraying
	Mancozeb	2.0	Foliar spraying
Citrus leaf miner	Dimethoate	2.0	Foliar spraying
	profenofos	2.0-3.0	Foliar spraying
Citrus psylla	Fenvalerate	1.0	Foliar spraying
	Phosalone	1.5 – 2.0	Foliar spraying
	Thiamethoxam	0.2	Foliar spraying
Citrus Fruit flies	Carbaryl	-	Dusting
Lemon butterfly	Chlorpyrifos	3.0	Foliar spraying
	Carbaryl	2.5	Foliar spraying
Fruit sucking moths	Rynaxypyr	0.33	Foliar spraying
	Flubendiamide	0.25	Foliar spraying
Citrus Aphids	Malathion	2.5	Foliar spraying
	Imidacloprid	0.25–0.50	Foliar spraying
Shoot borer /trunk borer	Quinalphos	1.5	Foliar spraying
	Carbaryl	2.0	Foliar spraying
	Dichlorvos	5.0	Swabbing of insect tunnels

Healthy seedlings :

Planting material is produced by 'T' budding on good stalks like Rampur Lime or Sour Orange. Seedlings are also used in many areas. Primary are prepared on light fertile soils. Selection is done by eliminating weaklings, off types and non uniform seedlings in 2-3 stages in the nursery beds. If certified bud wood is not available for propagation, nucellar seedlings may

be selected in the nursery beds as they are more vigorous, uniform and virus free. Seedlings may be grown in polythene bags also. They become ready for plantation in the main field after attaining the height of about 30-40 cm after one year. Cutting and air layering are done in lemons.

Harvesting :

Fruits are harvested when they attain full size, develop attractive colour with optimum sugar and acid blend. Fruits should be harvested preferably with clipper, shears or secateurs. Mature fruits are picked up in 2-3 cycles. Mandarins should not be harvested in wet weather or during rains. Mandarins start bearing from the fourth year but substantial yield can be expected only from sixth year onwards. Mandarin produces 500-800 fruits after about 9-10 years. However, its plants attain the level of full bearing at the age of 10-12 years. The net productive life span of mandarin orchards after deducting the first 5 pre bearing years is only 15-20 years.

Post harvest and marketing :

Post harvesting management include grading, storage, transportation, packing and marketing. The main channels followed for marketing of mandarin fruits include : Growers – Pre-harvest contractors – Commission Agents – Retailers – Consumers. Oranges keep well for a long time under ambient conditions and hence can be transported to distant places for marketing. Citrus fruits are sold throughout the country. Several fruit processing units also purchase citrus fruits in bulk. Indian sweet oranges are exported to France, UK, Belgium, Indonesia, Netherland, Sri Lanka, Bangladesh and many other countries.

BANANA :

Botanical Name : *Musa paradisiacal*

Family : Musaceae

Common Name : Banana

Banana is one of the most commonly grown fruit in Mizoram but is mainly consume within the state. Basic nutrient requirement is hardly meet. In order to send it outside the state we would require to provide many more fold to meet the requirement

Climate and Soil :

Banana, basically a tropical crop, grows well in a temperature range of 20ºC – 30ºC with relative humidity of 75-85%. It prefers tropical humid lowlands and is grown from the sea level to an elevation of 2000 m. In India, this crop is being cultivated in climate ranging from humid tropical to dry mild subtropics through selection of appropriate varieties. Chilling injury occurs at temperature below 12ºC. High velocity of wind which exceeds 80 km/hr. damages the crop. Four months of monsoon (June to September) with an average 650-750 mm. rainfall are most important for vigorous vegetative growth of banana. At higher altitudes, banana cultivation is restricted to a few varieties like 'Hill banana".

Deep, rich loamy soil with pH between 6.5 – 7.5 is most preferred for banana cultivation. Soil for banana should have good drainage, adequate fertility and moisture. Saline solid, calcareous soils are not suitable for banana cultivation. A soil which is neither too acidic nor too alkaline, rich in organic material with high nitrogen content, adequate phosphorus level and plenty of potash is good for banana.

Selection of best sapling :

a) Sapling of around 80-120 cm and around 1-2 kg
b) Nice round bottom and slender stroke
c) The base should have some roots
d) Sapling free of disease

Cultivation :

a) Pit planting is commonly followed in garden system of cultivation. A pit size of 0.5 x 0.5 x 0.5 m is normally required. Small pits are dug in case of ridges and furrows. The pits are to be refilled with topsoil mixed with 10 kg of FYM.
b) A spacing of 3 m between the pit is ideal
c) Plantation starts from March- April. If water is available January – March is ideal.

Nutrition :

Banana requires high amount of nutrients, which are often supplied only in part by the soil. Nutrient requirement (worked out on all India basis) is 10 kg FYM, 200 – 250 gm N; 60-70 gm P; 300 gm K/plant. Banana crop requires 7-8 kg N, 0.7- 1.5 kg P and 17-20 kg K per metric ton yield. Traditionally farmers use more of urea and less of phosphorous and potash. Urea is applied in three to four split doses.

Water requirement :

Banana being a succulent, evergreen and shallow rooted crop requires large quantity of water for increasing productivity. Water requirement of banana has been worked out to be 1,800 – 2,000 mm per annum. In winter, irrigation is provided at an interval of 7-8 days while in

summer it should be given at an interval of 4-5 days. However, during rainy season irrigation is provided if required as excess irrigation will lead to root zone congestion due to removal of air from soil pores, thereby affecting plant establishment and growth. In all, about 70-75 irrigations are provided to the crop.

Banana production should be supported by an efficient irrigation system like drip irrigation. Normal furrows, basin and trench systems are followed. Application of drip irrigation and mulching technology has reported to improve water use efficiency. There is saving of 58 % of water and increasing yield by 23-32 % under drip.

Desuckering :

Removal of unwanted suckers is a critical operation in banana for reducing internal competition with the main plant. Small suckers are removed on regular basis upto 7-8 months.

Propping :

Due to heavy weight of bunch the plant goes out of balance and the bearing plant may lodge and production and quality are adversely affected. Therefore, they should be propped with the help of two bamboos forming a triangle by placing them against the stems on leaning side. This also helps in uniform development of bunch.

Bunch cover and spray :

Covering bunch using dried leaves of the plant is economical and prevents bunch from direct exposure to sunlight and also enhances the quality of fruit. But in rainy season this practice should be avoided. Sleeving of bunch is done to protect fruits against dust, spray residue, insect and birds. Transparent and perforated polythene sheets with 2% (during cool season) – 4% (during summer season) ventilation may be used to cover bunches. This may be combined with neem cake application (1 kg/ha.). It increases the temperature around developing bunch and also helps in early maturity.

Spray of monocrotophos (0.2%) after emergence of all hands is effective in controlling the thrips. Thrips attack discolors the fruit skin and makes it unattractive.

Dehandling of false hands of bunch :

Some incomplete hands in a bunch which are not fit for quality produce should be removed soon after bloom. This helps in improving the weight of other hands, finger size and improved skin : pulp ratio to meet the export standards.

Mulching :

Use of wheat straw and banana straw as a mulch material (12.5 kg/plant) in banana orchards is useful in increasing the bunch weight and conservation of soil moisture. The mulch is applied at the beginning of summer (February).

Inter-cropping :

Root system of banana is superficial and gets easily damaged by cultivation. Therefore, use of intercrop is not desirable. However short duration crops (45-60 days) like mung, cowpea are to be considered as green manuring crops. Leguminous crops, beetroot, elephant foot yam, ginger, turmeric and sunhemp may be grown as an inter-crop during the first 3-4 months. However, growing of cucurbitaceous vegetables should be avoided as they are bearer of viruses. In coastal regions of Karnataka, Kerala and Andhra Pradesh, banana is grown in coconut and arecanut plantations with tall cultivars.

Other farm operations :

Other farm operations include the following :

i) Removal of dry leaves (green leaves should not be removed).

ii) During the winter months if temperature goes below 10^0C, growth of the plant is affected. Under such circumstances, irrigation is to be provided at night or smoking is to be done by inducing fire.

iii) If neem cake of 1 kg per plant is applied during winter months, the formation of bunch becomes easier.

iv) Plantation should be protected from strong winds by growing tall plants along the farm border.

v) Bamboo poles or eucalyptus poles are used for giving support to the banana plant.

Plant Protection Measures :

Insect Pests :

The insect pests mostly observed are root stock/rhizome weevil (*Cosmopolites sordidus*), stem borer (*Odioporus longicollis*), thrips, banana beetle (*Nodostoma subcostatum*), banana aphid (*Pentalonia nigronervosa*) and nematodes. Selection of healthy planting material and suitable intercultural operations apart from application of 0.04% endosulfan, 0.1 % carbaryl or 0.05 % monocrotophos depending upon the type of pest infestation have been found to be effective in controlling the pests.

Diseases :

The main diseases reported are panama wilt (*Fusarium oxysporum*), anthracnose (*Gleosporium musarum*), leaf spot (Sigatoka) [*Mycosphaarella musicola* & *Cercospora musae*], shoot rot (*Ceratostomella paradoxa*) and viral diseases. Disease free planting material should be used and the infected plant parts destroyed. Spraying with 1 % Bordeaux, copper oxychloride or carbendazim in case of fungal infections has been found to give positive results.

Harvesting and Yield :

Banana is harvested when the fruit is slightly or fully mature depending on the market preferences. For long distance transportation, harvesting is done at 75-80 % maturity. The fruit is climacteric and can reach consumption stage after ripening operation.

The planted crop gets ready for harvest within 12-15 months of planting and the main harvesting season of banana is from September to April. Bunches attain maturity from 90-150 days after flowering depending upon variety, soil, weather condition and elevation. Bunch should be harvested when fingers of second hand from top are 3/4 rounded with the help of sharp sickle 30cm above the first hand. Harvest may be delayed upto 100-110 days after opening of the first hand. Harvested bunch should generally be collected in well padded tray or basket and brought to collection site. Bunches should be kept out of light after harvest, since this hastens ripening and softening. For local consumption, hands are often left on stalks and sold to retailers.

GRAPE :

Common Name	:	Grape
Scientific Name	:	*Vitis vinifera*
Family	:	Vitaceae
Variety	:	*Vitis Lubrusca and Vitis vanifera*
		(Each of which had different sub-varieties)

The grape is one of the most important crop grown in the world. Mostly, it grown for making wines, preparation of raisin and then as a table fresh fruit. Grape cultivation is believed to have originated near Caspian Sea, however, India knows grapes since Roman times. Total area under grapes in India is about 40,000 ha, distributed mainly in Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu.

Soil and climate requirement :

The grape is widely adapted to various soil conditions, but the yield and quality reach to the highest on good fertile soils having pH 5.5 to 7.5, free of lime and having a medium water holding capacity. The best soil types for grapes are known to be well drained loam to sandy loam with good organic matter. Grape is cultivated under a variety of climatic conditions in three distinct agro-climatic zones, namely, sub-tropical, hot tropical and mild tropical climatic regions in India. Grapes are grown in both temperate and tropical climate. Grapes perform well where there is no or little rain at the ripening time of the grapes. The ideal temperature for grape growing is 15^0C to 40^0C.

Land preparation :

Land needs to be thoroughly ploughed and levelled. In hilly areas, digging contour line with spacing of 3m of convenient length is an ideal condition. Digging a pit of 2 X 2 X 1 ft with a spacing of 3m X 3m for planting is a must. Digging of pits should be done 5-6 weeks before planting and left for weathering**.** The pit is to be filled with a mixture of soil, cattle manure, single superphosphate, sulphate of potash and micro-nutrients.

Planting and spacing requirement :

Vine plants usually grow upwards along a support structure. Planting a fence or other structure like pandal system in which construction of wire support system should be done before transplanting of seed-lings, that allow the vines to wrap around them, providing a sturdy support system. Spacing for planting is maintained depending on soil type, variety and method of training. The recommended spacing for hilly region is 3m x 3m which will accommodate 1000 - 1500 vines.

Diseases and pest management :

The important grape diseases are anthracnose, downy mildew, powdery mildew and bacterial leaf spot. In recent years, Alternaria is also becoming a serious pathogen. The important pests of grapes in India are flea beetles, thrips, mealy bugs and leaf hoppers. Knowing the management of disease and pests attack is difficult task for the farmers all at once. If Appropriate control measures should be taken care for these pests and diseases by contacting nearest agriculture department.

Irrigation :

Grape is strictly irrigated perennial crop and regularly irrigated. However, it don't prefer heavy water or rain, so after the first watering keep the amount of water you give them to a minimum. Irrigate immediately after planting and on the 3rd day and then once in a week. Withhold irrigation 15 days before pruning and also 15 days before harvest. Keep water near the roots so that the majority of it gets absorbed rather than evaporated by the sun. If your area doesn't get much rain, set up a drip system directly at the roots so that the grapevines get small amounts of water on a regular basis

Healthy seedlings :

Grapevine is most commonly propagated by hard-wood cuttings, though propagation by seed soft wood cutting, grafting and budding is specific to certain situations. Most of the time hardwood cuttings are done during the winter months (December-January) when the plants are dormant. Unlike most cuttings, grape cuttings have to be really long because the buds are so far apart and the cutting should have at least three buds. The hardwood cutting should be done just right the bottom and top of the node and grapevine should be at least one year old. The stem below the bottom and above the top should not be too long from the node we make the cut. The cut grapevine should be planted in the nursery bed at 30cm x 10cm or in the poly-pot.

Harvesting :

Normal grape harvest season starts in February and continuous up to end of April. Grapes must be harvested only when all the berries have developed the unique colour and desired TSS of the cultivar. Grapes are harvested by repeated pickings since bunches do not ripen at one time. Taste is the most valuable indicator of the ripeness of the bunch. The berries at the shoulders ripe first followed by centre and tip of the clusters. Approximately one million tonnes of grapes are harvested annually in India. Grape is harvested almost all the year round. The productivity of grapes in India is very high, particularly in the Hyderabad region. Yields as high as 100 t/ha in Anab-e-Shahi and 75 t/ha in Thompson Seedless were recorded in this region. However, quality of grapes is usually poor as a result of high yields.

Post harvest and marketing :

Post harvesting management include grading, storage, transportation, packing and marketing. The main channels followed for marketing of mandarin fruits include. Harvested grapes are packed in 2 to 4 kg-corrugated boxes. Grape guards, pouches are kept inside the boxes for distant markets. Pre-cooling and use of grape guards are the musts for cold storage and export markets. Mumbai, Delhi, Calcutta, Ahmedabad, Ludhiana, Patna, Jamshedpur, Bangalore, Hyderabad, are the main market places in the country.

More than 80 percent of the total production is consumed as table grapes in India, and more than 70 percent of the total production is harvested in March-April, but the cold storage facilities are inadequate. Therefore, market gluts and fall of prices of grapes in March-April are common. Approximately, 2.5 percent of fresh grapes are exported to the Middle East and European countries. The rest of the produce is marketed within the country. Grapes are exported through three different agencies viz., Grower Exporters, Growers' Cooperatives and the Trader exporters. These agencies have established their own facilities for pre-cooling and cold storage in the vicinity of major production sites.

ASSAM LEMON :

Botanical Name: *Citrus Limon* L. Burmf

Assam lemon is one of the most important crops of Assam and other parts of N.E. region. Fruit is widely used for culinary, beverages, industrial and medicinal uses.

Soil and climate :

Loamy soil with uniform texture up to a depth of 3 m is ideal for cultivation. It thrives well in humid sub tropics of the region.

Propagation :

Assam lemon can be propagated by the following means.

Stem cutting :

The cuttings are usually prepared from fully matured stem. The size of cutting is 18-20 cm in length with a pencil thickness. The upper cut is made l cm above the node and lower cut close below the node in slanting manner. The cuttings are planted with a spacing of 30cm x30cm in a slanting position in the nursery. The bed is prepared with a mixture of 1:1:1 decomposed cow dung, soil and sand, respectively.

Leaf-bud cutting :

Leaf bud cutting should be taken from the branch having healthy well-developed bud and actively growing leaves. The cuttings consist of a leaf blade and short piece of the stem measuring 2 cm.

Air layering :

The first step in air layering is to remove completely a strip of bark 3 cm in width at a point 15 cm or more below the tip end scraping the exposed surface to ensure complete removal of the phloem and cambium is desirable to retard healing. The cut portion is covered with moss or mud pudding with a mixture of well decomposed cow dung, soil and sand with a ratio of 1: 1: 1, respectively. Then a piece of polythene sheet 15-20 cm wide is wrapped carefully around the branch so that the moss and mud is completely covered. Both end of polythene is tied firmly.

Planting :

i) Size of pit and spacing :

Before monsoon, pit size of O.5m x O.5m x 0.5 ml should be prepared at 3 m apart and refilled the pit with soil and FYM at 1: 1 ratio.

ii) Time of planting :

The time of planting of Assam lemon is May to August.

iii) Manure and fertilizer :

Year	FYM	N	P_2P_s	K_2O
1	10 kg	100 g	100 g	100 g
2	10 kg	100 g	100 g	100 g
3	10 kg	100 g	100 g	100 g
4	20 kg	100 g	100 g	100 g

This mixture is to be applied in two split doses i.e. during February-March and October-November.

Intercultural operation :

Weeding should be done frequently at monthly interval, mulching with paddy straw or black polythene can also be used to control weeds.

Irrigation :

Irrigations are to be given only during dry periods, the first being at planting time, subsequent irrigations can be given at 15-20 days interval during December to March if possible.

Insect/Pests :

i) **Leaf mining beetle (*Sebathe fulvipennis*) :** the grubs of this insect feed on the foliage of Assam lemon during new flush.
ii) **Leaf miner :** Caterpillars feed on newly emerged leaf tissues forming zigzag shrinking streak like galleries.
iii) **Aphid :** Nymphs and adults suck the sap from newly emerged leaves, tender parts and flowers. Monocrotophos @ 2.5 g/L of water or Dimethoate (Rogor) @ 1.5 ml/L of water can effectively control these insects.
iv) **Stem borer :** Grubs bore and feed on the bark, making tunnels inside the trunk. Control measure of stem borer is same as discussed in orange.

Diseases :

Twig blight : Plant exhibits drying of twigs and small branches from growing tip. The affected portion should be cut and pasted with Bordeaux paste. Spraying with 1 % Bordeaux mixture or Copper Oxychloride@ 2.5 g/L found effective against this disease.

Harvesting and Yield :

Assam lemon produces two distinct flowering flush in a year viz. Spring (February-March) and autumn (September-October) besides sparse flowering round the year. Fruits should be harvested when they attain full size, develop attractive green to little yellow colour. Fruits are ready for harvesting during the month of June to July and December to January. From 3rd year-old tree about 40-50 fruits may be harvested.

PASSION FRUIT :

Botanical Name : *Passiflora edulis* Sims

Introduction :

The passion fruit (*Passiflora edulis*), family Passifloraceae, is a native of Brazil. In India it is found to be growing wild in many parts of Western Ghat such as Nilgiris, Wynad, Kodaikanal, Shevroys, Coorg and Malabar as well as Himachal Pradesh and North Eastern States like Manipur, Nagaland and Mizoram. The fruit is valued for its pronounced flavour and aroma which helps not only in producing a high quality squash but also in flavouring several other products. The juice of passion fruit with an excellent flavour is quite delicious, nutritious and liked for its blending quality. To enhance the flavour of the final produce, passion fruit juice is often mixed with juices of pineapple, mango, ginger etc. The juice is extensively used in confectionery and preparation of cakes, pies and ice cream. It is a rich source of Vitamin A and contains fair amounts of Sodium, Magnesium, Sulphur and Chlorides. Commercial Processing of yellow passion fruit yields 36% juice, 51% rinds and 11% seeds.

The passion fruit vine is shallow rooted, woody, perennial, climbing by means of tendrils. A single fragrant flower, 5 cm to 7.5 cm wide is borne at each node on the new growth. The fruits are nearly round to oval and have a tough rind which is smooth and waxy. The fruit has an aromatic mass of double walled, membranous sacs filled with orange coloured, pulpy juice and as many as 250 small, hard, dark brown or black seeds.

The leaf of passion fruit is used as a vegetable in the hills of North Eastern India. Boiled extract of fresh tender leaves is prescribed as a remedy for diabetes, hypertension, diarrhoea, dysentery, gastritis, abdominal flatulence and as a liver tonic. The rinds of passion fruit have very low pectin content (2.4 %). The rind residue contains about 5-6 % protein and could be used as filler in poultry and stock feed. The seeds yield 23 % oil which is similar to sunflower and soybean oil and accordingly has edible as well as industrial uses

International scenario :

Passion fruit vines are found wild and cultivated to some extent in many parts of the Old World including the highlands of Java, Sumatra, Malaya, Western Samoa, Norfolk Islands, Cook Islands, Solomon Islands, Guam, the Philippines, the Ivory Coast, Zimbabwe and Taiwan. Brazil has long had a well established passion fruit industry with large-scale juice extraction plants. Passion fruit is grown in North Eastern Region of India. Other countries include Australia, New Zealand, Kenya, Uganda, Rwanda etc.

National scenario :

Passion fruit is commercially cultivated in the North Eastern States of Manipur, Mizoram and Nagaland. It is also cultivated in some parts of Nilgiris and Shevroys.

Organic farming :

Organic farming is a crop production method respecting the rules of the nature. It maximises the use of on farm resources and minimises the use of off-farm resources. It is a farming system that seeks to avoid the use of chemical fertilisers and pesticides. In organic farming, entire system i.e. plant, animal, soil, water and micro-organisms are to be protected.

Organic production :

Climate and soil :

Passion fruit prefers tropical to subtropical humid climate and grows well up to 2000 m altitude with an annual rainfall of 1000 to 2500 mm. The crop requires an optimum temperature of 20^{o}C to 30^{o}C and temperatures below 15^{o}C restricts vegetative growth and flowering. It grows best in light sandy loam soils with pH of 6.0-7.0 and good drainage. A soil having sufficient quantity of moisture, rich in organic matter and low in salts is considered very suitable for its cultivation.

Varieties :

Out of several species, Purple passion fruit (*Passiflora edulis Sims*), Yellow Passion fruit (*Passiflora edulis var. flavicarpa*) and 'Kaveri' Hybrid passion fruit (Purple x Yellow) are of commercial importance in India.

a) Purple Passion Fruit -

Vines are productive at higher elevations. Fruits are 4-5 cm in diameter, deep purple when ripe each weighing 35-45 g. The juice content varies from 31-35 per cent. The variety is known for its quality in terms of flavour and nutrient content. Seeds are black in colour. The variety is susceptible to leaf spot, collar rot, attack by thrips and nematodes.

b) Yellow Passion Fruit -

This variety is suitable for lower elevations and is less productive at higher elevations due to its sensitiveness to low temperature. The fruit is bigger in size than purple variety, each weighing about 60 g, round in shape with yellow mottled spots, turns golden yellow when ripe. Juice is more acidic, its recovery being comparatively less than the purple. Seeds are brown, tolerant to leaf spot and wilt, escapes the damage by thrips and tolerant to nematodes.

c) Kaveri Hybrid Passion Fruit -

It is an hybrid between Purple and Yellow passion fruit developed at Central Horticulture Experimental Station, Indian Institute of Horticulture Research, Chettalli, Karnataka. It is a high yielding variety and each fruit weighs 85-110 g. The fruits are purple in colour, fruit quality comparable to that of Purple variety. The variety is reported to have field tolerance to brown leaf spot, collar rot, wilt and nematodes.

Propagation :

Passion fruit is propagated by seeds, cuttings and grafting on resistant root stocks. Seedlings and grafted plants are more vigorous than cuttings.

a) Seed Propagation

Fruits are collected from superior vines in respect of yield and quality. The pulp after extraction is allowed to ferment for 72 hours and seeds are extracted. The seeds are sown in well prepared seed beds during March-April. The seedlings after attaining 4-6 leaves stage are transplanted in 10 cm x 22 cm polybags filled with a mixture of soil, compost and sand (2:1:1). The seedlings will be ready for transplanting in the main field in about three months.

b) Vegetative Propagation

Semi-hardwood cuttings of about 30-35 cm size with 3-4 nodes are ideal. The cuttings are to be first placed in sand beds/pots for root initiation and then transferred to polybags for better root

development. The rooted cuttings are ready for planting in about three months. However, most farmers raise nurseries from the seeds and vegetative propagation is not popular as it is time consuming.

Spacing and planting :

The spacing will vary depending upon the type of training system being followed and variety. In case of Kniffin system of training the spacing adopted is 2m x 3m, which will accommodate 1666 plants/ha. In bower system, the recommended spacing is 3m x 3m which accommodates about 1110 plants/ha.

Preparation of land :

Planting sites experiencing high winds should be avoided as the wind not only damages the vines but makes it more difficult to train the vines to the trellis. Pits of 45 cm x 45 cm x 45 cm are dug at a spacing of 3m x 2m, on hill slopes/plains. The pits are filled with a mixture of three parts of top soil and one part of compost and planting is done preferably on cloudy days during May-June after onset of monsoon. Seasonal vegetables could be grown as intercrops during the first year. Turmeric and ginger could be grown as intercrops by supplementing the nutrition.

Training and pruning :

Training is quite important in regulating yield and also in supporting the vine during its economic life. Weak and faulty construction of trellis may lead to sagging and loss of vines.

a) Training

The vines are trained to a single unbranched shoot from the base of the plant up to the trellis height and from this point, two vigorous shoots (primaries) are allowed to grow on the trellis in opposite directions. In due course, the laterals that arise from the primaries are trained hanging downwards from the wire and the tendrils that come in the way are to be removed periodically.

These laterals constitute the potential fruit bearing area of the vines. Trellising is important to obtain maximum potential yield of passion fruit. The most economical training method is the kniffin system in which 2.5 m long posts/pillars are erected 3 m apart and four lines of 9 to 11 gauge wire is allowed to run across. The trellis should run across the slope or in North-South direction, to have maximum and even exposure of vines to sunlight. In case, wooden posts are used, they have to be painted with coaltar at the base to avoid insect attack and quick rotting. Telephone system on raisers is also economical as it allows growing intercrops on terraces and suppressing the weed growth. The bower system of training is also followed in many areas.

b) Pruning

Passion fruit bears on current season's growth and hence systematic pruning of vine encourages new growth resulting in regular and higher yield of fruits. After the harvest of the crop, the laterals are cut back to 4-5 buds. Pruning should be done after harvesting of the crop in April and December.

Manuring :

Application of organic manure is very much necessary to have vigorous plants giving regular and optimum yield. It is observed that almost entire plantation of passion fruit in Meghalaya and other parts of North Eastern Region is generally grown by using organic inputs

like farm yard manure, vermin-compost, bio-plus (prepared from organic waste), etc. Application of oil cake is also followed in some area. During the first year of plantation, 10 kg of FYM per vine and from second year onwards 15 kg of FYM per vine is recommended. Mixture of FYM and vermin-compost in the ratio 4:1 or 3:1 and oil cake gives very good result, but due to very limited availability of vermin-compost most of the farmers are not applying it. The manure should be applied in February-March.

Pests and diseases :

a) Pests

The fruit fly (*Daucus sp.)* punctures the immature fruits during development. Fruits become woody, deformed and the pulp content is reduced. Thrips (*Thrips hawaiiensis Morgan*) feeds on buds and developing fruits. Affected fruits are deformed and fruit weight and juice content are reduced. The incidence of this pest is severe in summer crop. Mites (*Tetranychus neocaledonicus Andro*) feed on leaves and tender fruits. It leads to defoliation and formation of undersized fruits.

b) Diseases

Brown spot disease is caused by *Alternaria macrospora Simes*. The disease appears as concentric brown spots with greenish margin. Girdling of branches and premature defoliation occurs in severe cases. The affected branches should be pruned and burnt. Root Rot is caused by *Phytophthora nicotianae var. parasitica*. The roots are affected and ultimately the plants die. Drenching with 1 % Bordeaux mixture helps in checking the disease. The affected plants should be mounded with soil to encourage new root formation. Wilt or Collar rot, is a devastating disease caused by *Fusarium oxysporum/F.passiflorae*. The affected plants die immediately within a day or two. There is no control measure except having tolerant/resistant varieties or use of resistant root stocks.

c) Control Measures

So far ICAR Research Complex for NEH Region, Barapani, Meghalaya & Central Agricultural University has not recommended/finalised the doses/frequency of available organic pesticides/fungicides. However it is observed that spraying of organic pesticides like neem based pesticides/fungicides can control effectively the various pests and diseases. Neem based pesticide contains Azadirachtin as active ingredient. The biological insecticide, Verticel, manufactured from *Verticillium lecanii*, a naturally occurring entomopathogenic fungus is very effective in controlling thrips, mites, aphids etc. The larvocel, a wettable powder formulation of Beauveria bassiana a highly virulent fungus is effective as a versatile broad - spectrum insecticide.

Harvesting :

The vines start yielding fruits after 10 months of planting and bearing reaches optimum by 16-18 months. There are two main periods of fruiting from August to December and March to May. Fruits take 80-85 days to reach maturity. Slightly purple coloured fruits along with a small portion of stem/pedicel should be picked up. The fruits should be marketed quickly to prevent loss in weight and their appearance. The rind becomes wrinkled on drying but the pulp remains in good condition for several days.

Yield :

Average yield of purple variety is 8-10 t/ha and that of the hybrid Kaveri is 16-20 t/ha. A yield of 7 to 9 kg or 200 to 250 fruits per vine is generally obtained every year.

Post harvest management :

Passion fruit is generally not consumed as a table fruit due to numerous (about 250) small, hard, dark brown seeds in fruit and its commercial value lies in its processing in preparation of juice, concentrate, squash, ice cream, confectionery etc. or in blending its juice with other fruit juices to enhance the flavour. There is very good demand of juice/concentrate in foreign markets.

PAPAYA :

Papaya (*Carica papaya*) is a tropical fruit having commercial importance because of its high nutritive and medicinal value. Papaya India leads the world in papaya production with an annual output of about 3 million tonnes. Other leading producers are Brazil, Mexico, Nigeria, Indonesia, China, Peru, Thailand and Philippines.

Agro-climatic requirements :

Papaya being a tropical fruit grows well in the mild sub-tropical regions of the country upto 1,000 m. above sea level. Night temperature below 12^0C-4^0C for several hours during winter season affects its growth and production severely. It is very much sensitive to frost, strong winds and water stagnation.

Deep, well drained sandy loam soil is ideal for cultivation of papaya

Varieties cultivated :

Honey Dew, Washington, Solo sunrise, Pusa Delicious, Pusa Nanha, Hawaiian solo etc.

Land preparation :

A well-drained upland is selected for cultivation. In open and high lying areas plants are exposed to strong winds or storm. Therefore, for proper establishment of papaya plantation, suitable wind break should be planted at the orchard boundary.

Planting :

Papaya is commercially propagated by seed and tissue culture plants. The seed rate is 250-300 g/ha. The seedlings can be raised in nursery beds 3m long, 1m wide and 10 cm high as well as in pots or polythene bags. The seeds are sown 1 cm deep in rows 10 cm apart and covered with fine compost or leaf mould. Light irrigation is provided during the morning hours.

About 15-20 cm tall seedlings are chosen for planting in about two months.

Planting season :

Papaya is planted during spring (February-March), monsoon (June-July) and autumn (October-November).

Spacing :

A spacing of 1.8 x 1.8 m is normally followed. However higher density cultivation with spacing of 1.5 x 1.5 m/ha enhances the returns to the farmer and is recommended.

Planting method :

The seedlings are planted in pits of 60x60x60 cm size. In the summer months the pits are dug about a fortnight before planting. The pits are filled with top soil along with 20 kg of farmyard manure, 1 kg neem cake and 1 kg bone meal. Tall and vigorous varieties are planted at greater spacing while medium and dwarf ones at closer spacing.

Nutrition :

Papaya plant needs heavy doses of manures and fertilizers. Apart from the basal dose of manures (@ 10 kg/plant) applied in the pits, 200-250 g each of N, P_2O_5 and K_2O are recommended for getting high yield. Application of 200 g Nitrogen is optimum for fruit yield but papain yield increases with increase in N upto 300 g.

Irrigation :

The irrigation schedule is fixed on the basis of soil type and weather conditions of the region. Protective irrigation is provided in the first year of planting. During the second year, irrigation is provided at fortnightly interval in winter and at an interval of 10 days in summer. Basin system of irrigation is mostly followed. In areas having low rainfall, sprinkler or drip system can be adopted.

Intercultural Operations :

Weeding should be done on regular basis especially around the plants. Application of Fluchloralin or Alachlorin or Butachlorine (2.0 g/ha) as pre-emergence herbicide two months after transplanting can effectively control the weeds for a period of four months. Earthing up is done before or after the onset of monsoon to avoid water-logging and also to help the plants to stand erect.

Inter-cropping :

Intercropping leguminous crops after non-leguminous ones, shallow rooted crops after deep rooted ones are beneficial. No intercrops are taken after the onset of flowering stage.

Removal of male plants :

About 10% of the male plants are kept in the orchards for good pollination where dioecious varieties are cultivated. As soon as the plants flower, the extra male plants are uprooted.

Plant Protection Measures :

Insect Pests

The insect pests mostly observed are fruit flies (*Bactrocera cucurbitae*), ak grasshopper (*Poekilocerus pictus*), aphids (*Aphis gossypii*), red spider mite (*Tetranychus cinnabarinus*), stem borer (*Dasyses rugosellus*) and grey weevil (*Myllocerus viridans*). In all cases the infected parts need to be destroyed along with application of prophylactic sprays of Dimethoate (0.3%) or methyl demeton (0.05%).

Diseases :

The main diseases reported are powdery mildew (*Oidium caricae*), anthracnose (*Colletotrichum gloeosporioides*), damping off and stem rot. Application of wettable sulphur (1 g/l) carbendazim/thiophanate methyl (1 g/l) and Kavach/Mancozeb (2 g/l) has been found to be effective in controlling the diseases.

Harvesting and Yield :

Fruits are harvested when they are of full size, light green in colour with tinge of yellow at apical end. On ripening, fruits of certain varieties turn yellow while some of them remain green. When the latex ceases to be milky and become watery, the fruits are suitable for harvesting.

The economic life of papaya plant is only 3 to 4 years. The yield varies widely according to variety, soil, climate and management of the orchard. The yield of 75-100 tonnes/ha is obtained in a season from a papaya orchard depending on spacing and cultural practices.

GOOSEBERRY :

Amla or Aonla is also known as Indian Gooseberry and has Scientific name as *Embelica officinalis* (syn. *Emblica officinalis*) and belongs to the family Phyllantheceae has a high medicinal value. The fruits have the richest source of vitamin C (700 mg in 100 gm of fruits). It is a highly prolific bearer without much care.

Amla is a fruit of subtropical region with district winter and summer. Soon after fruit set in spring, the Fruits remain dormant through summer without any growth thus makes it highly suitable crop for arid zone. Grows well in sandy loam to clay soils. It has great tolerance to salinity and solidity and cultivated in pH range of 6.0 to 8.0 successfully. However production shall be highly benefited in deep and fertile soils.

Soil and Land Preparation :

Light as well as medium heavy soils except purely sandy soils is ideal for amla cultivation. The tree is well adopted to dry regions and can also be grown in moderate alkaline soils. The worst of soils upto 9.5 pH are also good enough to grow amla. Soils with red, black with wide range of pH can very well accommodate amla. Prior to planting, the fields should be deeply ploughed, harrowed and levelled. The pits above 1metre cube should be dug during the month of May-June at appropriate distance and after 15-20 days of exposure to sun are filled with surface soils mixed with 10 to 15 kg of decomposed farm yard manure. If depression takes place in the pits with onset of rain, more soil should be added.

Climate :

Amla plants can be grown in both Tropical and subtropical climates. Annual rainfall of 630mm-80mm is ideal for its growth. The young plants up to the age of 3 years should be protected from hot wind during May-June and from frost during winter months. The mature plants can tolerate freezing temperatures as well as a high temperature upto 46 degree Centigrade.

Varieties :

The varieties of aonla recommended for cultivation are Banarasi, chakaiya, francis, NA-4 (Krishna) NA-5 (kanchan),NA-6,NA-7, NA-10,BSR-1, Anand 1,2,3.

Inputs :

Number of seedlings for one acre of area should be 200.The field should be Incorporated with 4 tonnes of Farm yard manure. Fertilizers should be given in the ratio of 90:120:48 of NPK along with elemental sulphur 10 kg and micro nutrients 10 kg per acre 15 kg of FYM and 0.5 kg of phosphorus should be applied to each pit before planting. Also application of 30 gram of nitrogen each year during September-October up to 10 years for each tree is recommended.

The young plants should be given 15-20 kg of well rotten FYM and the mature trees should be fertilized with 1 kg of Super Phosphate and 1-1.5kg of murate of potash. The above fertilizers should be given in two split doses to mature, bearing tree, once during September-October and gain during April-May. After setting of the fruits the plants needs to be irrigated after fertilizer application.

Cultivation of Amla :

Propagation

Amla is generally propagated by shield budding. Budding is done on one year old seedlings with buds collected from superior varieties yielding big sized fruits. Older trees or

poor yielding trees can be changed into superior types by top working. Aonla plant has long been raised from seed and used as rootstock. The seeds attain full maturity by February for which they should be sown in the last week also for getting the higher percentage of germination. The best results were obtained by sowing at the commencement of rainy season and subsequently weeding regularly. Artificial Propagation can also be done by the ripe fruits collected in January and dried in sun dehisce and are swept up and cleaned by winnowing. It is desirable to use fresh seed as the seeds do not retain viability for long. The seeds need hot water treatment(80 degree Celsius) for 5 minutes to hasten germination which takes about 10 days.

Planting :

The pits of 1 sq.mt are to be dug during May -June at a distance of 4.5mt x 4.5mt spacing and should be left for 15-20 days exposing to sunlight. Each pit should be filled with surface soil mixed with 15 kg FYM and 0.5 kg of phosphorus before planting the budded seedlings. Healthy grafts or budded plants are planted during rainy season preferably during the early monsoon in July with square system.

Irrigation :

Young plants require watering during summer months at 15 days interval till they are fully established. Watering of bearing plants is advised during summer months at bi weekly interval. After the monsoon rains, during October-December about 25-30 litres of water per day per tree through drip irrigation should be given.

The schedule can also be done as follows :

Plants up to 2 years of age -at 10 days interval

Plants up to 4 years of age -at 15 days interval.

Plants after 4 years of age -at 20 days interval.

Training and Pruning :

Leaving only 4-5 well shaped branches with wide angle at about 0.75 mt from the ground level, other dead, diseased, week criss cross branches and suckers should be pruned off at the end of December.

Nutrition :

Ten year old trees should be given 1.5 kg, N, 1.0 kg P_2O_5 and 0.7 kg. K20 per year; Spray 0.6% Borax thrice in the month of September-October at about 10-15 days interval to control fruit necrosis which develops due to deficiency of boron.

Irrigation :

Aonla trees are hardy and stand very well against drought. However, the crop shall be benefited by giving two /three irrigations at the time of full bloom and set. During summer the fruit is dormant, hence no irrigation is necessary.

Harvest Commercial crop starts fruiting after 6-8 years of planting. Productive life of trees is estimated to be 50-60 years under good management. Generally Aonla fruits are ready for harvest in November-December. Their maturity can be judged either by the change of seed color from creamy white to black or by the development of transluscent exocarp. Maximum Vitamin C content is observed in mature fruits. Grown up tree yields 100 to 150 kg per annum.

Mulching and intercropping :

During summer, the crop should be mulched with paddy straw or wheat straw at the base of the tree upto 15-20 cm from the trunk. Inter crops like green gram, black gram, cow pea and horse gram can be grown upto 8 years.

Plant protection :

Major insects which affect the aonla plants are Bark eating caterpillars which can be controlled by following methods

1. Injection of Endosulfan at the ratio of 2 ml in 1 litres of water or Monocrotophos 2 ml in 1 litre of water or dichlorovos in the ratio of 1.5 ml in 1 litre of water in holes and plugging with mud is effective in protecting the tree against bark eating caterpiller.

2. Spraying of Mancozeb in the proportion of 3 gm per litre of water twice first in early September and second 15 days after first application controls the spread of rust.

3. Aonla rust can be controlled by spraying blue copper 3 gm per litre of water or combination of Carbendazim and Mancozeb (readilly available in the market)in the ratio of 2gm per litre of water .

4. Weeding

The seedling or vegetative saplings of Aonla require clean weeding, soil working for about two years for successful establishment and fast growth. This can be very well done by spraying glyphosate in the proportion of 6.5ml in 1 litre of water on the weeds grown upto the height of 6-8 inches.

Precaution should be taken that no directed spray should be on the seedlings or the plants which are grown.

Harvesting and yield :

Amla tree starts bearing after about 4-5 years of planting. The fruits of Aonla are harvested during the month of February when they become dull greenish yellow from light green colour. The mature fruits are hard and they do not fall at gentle touch and therefore vigorous shaking is required. Fruits can also be harvested using long bamboo poles attached with hooks. A mature Aonla tree of about 10 years will yield 50-70 kg of fruit. The average weight of the fruit is 60-70 g and 1 kg contains about 15-20 fruits. A well maintained Aonla tree yields up to an age of 70 years. A full grown grafted aonla tree with good bearing habit yields from 187 to 299 kg fruit per year. Average fruit yield is 200kg per grafted tree.

Economics :

The demand of amla fruit by various commercial pharmaceutical companies has taken an upward swing and there is enough incentive for tribals to collect the fruit. The average price offered for green fruits is Rs3 to 4 per kg. Panna aonla is famous for its bold size and absence of fibres

Amla existed by way of Kayakalp in our country for more than 3000 years ago. We should rediscover the goodness of amla especially at a time when people are turning away from alopathy due to various side-effects. India's present production is around 1.5 lakh tonnes. If by spreading awareness, we can get every Indian to eat one amla a day, we will require 2 lakh tones a day. So we can produce 300 times the quantity of Amla we are producing now.

MANGO :

Mango is the leading fruit crop of India and considered to be the king of fruits. Besides delicious taste, excellent flavour and attractive fragrance, it is rich in vitamin A & C. The tree is hardy in nature and requires comparatively low maintenance costs.

Climate :

Mango can be grown under both tropical and sub-tropical climate from sea level to 1400 m altitude, provided there is no high humidity, rain or frost during the flowering period. Places with good rainfall and dry summer are ideal for mango cultivation. It is better to avoid areas with winds and cyclones which may cause flower and fruit shedding and breaking of branches.

Soil :

Mango comes up on a wide range of soils from alluvial to laterite provided they are deep (minimum 6') and well drained. It prefers slightly acidic soils (pH 5.5 to 7.5)

Varieties :

Though there are nearly 1000 varieties of mango in India, only following varieties are grown in different states : Alphonso, Bangalora, Banganpalli, Bombai, Bombay Green, Dashehari, Fazli, Fernandin, Himsagar, Kesar, KishenBhog, Langra, Mankhurd, Mulgoa, Neelam, Samarbehist, Chausa, Suvarnarekha, Vanaraj and Zardalu.

Planting :

Land should be prepared by deep ploughing followed by harrowing and levelling with a gentle slope for good drainage. Spacing varies from 10 m x 10 m in the dry zones where growth is less, to 12 m x 12 m, in heavy rainfall areas and rich soils where abundant vegetative growth occurs. New dwarf hybrids like Amrapali can be planted at closer spacing. Pits are filled with original soil mixed with 20-25 kg well rotten FYM, 2.5 kg single super phosphate and 1 kg muriate of potash.

One year old healthy, straight growing grafts from reliable sources can be planted at the centre of pits along with the ball of the earth intact during rainy season in such a way that the roots are not expanded and the graft union is above the ground level. Plants should be irrigated immediately after planting. In the initial one or two years, it is advisable to provide some shade to the young plants and also stake to make them grow straight.

Irrigation :

Young plants are watered frequently for proper establishment. In case of grown up trees, irrigation at 10 to 15 days interval from fruit set to maturity is beneficial for improving yield. However, irrigation is not recommended for 2-3 months prior to flowering as it is likely to promote vegetative growth at the expense of flowering.

Inter cropping :

Inter crops such as vegetables, legumes, short duration and dwarf fruit crops like papaya, guava, peach, plum, etc. depending on the agro-climatic factors of the region can be grown. The water and nutrient requirements of the inter crops must be met separately.

Harvesting and yield :

The yield of mango varies greatly, depending upon the variety and agro-climatic conditions prevailing in a region.

Grafted mango trees start bearing from the fifth year onward. However, seedling trees may take 8-10 years.

Topic 13 – Training on kitchen gardening

Objectives :

Creating awareness for the need of household food, nutritional security and improve kitchen gardening

Duration : 60 minutes

Expected outcome : Participants will learn the importance of kitchen gardening for household nutritional security

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Kitchen Gardening	* What is kitchen gardening? * Importance of kitchen gardening * Selection of crops * Soil preparation * Crop rotation * Different method of kitchen gardening * Harvesting * Post harvest management	Powerpoint presentation, Interactive learning method	The trainer will give lecture on - Need on household food - Nutritional security - Kitchen gardening -Utilisation of land	LCD projector, Laptop

A kitchen garden is where herbs and vegetables are grown around the house for household use. Since early times a small plot near to the house has been used for growing a variety of vegetables according to the season. Local varieties such as radish, broad leaf mustard, chilli, beans, pumpkins etc. are all grown in the kitchen garden.

Now a days the product from kitchen gardening are even market or sell to local since the increase of production.

Benefits of kitchen gardening :

- to grow healthy, fresh vegetables forself;
- to save the cost of buying vegetables and herbs;
- waste resources such as sweepings, kitchen scraps and dirty water can be recycled onto the garden;
- wasteland around the house can be made productive.

Selection of crops :

Mixed cropping is the most effective method in kitchen gardening. The selections of crops should be based on seasonal and the crops of different types are grown together either mixed or intercropped on the small plot of land.

Crop rotation :

Planting different kinds of vegetables in a different section of your garden each year will help reduce pest infestation. Some insect pests overwinter in the garden soil and emerge in the

spring and begin searching for food. If the plant they prefer to eat is located several yards away, the insect must move to the source. Many will die along the way or fall prey to birds and other insects.

Also, many vegetables may absorb a particular nutrient from the soil. By rotating your vegetable crops each year, the soil in a particular section of the garden will have the opportunity to rest and regenerate. In general, avoid planting crops in the same plant family in the same location in consecutive years. For example, potato, eggplant, and tomato are all in the Solanaceae family, so these crops should be rotated with vegetables in another plant family, such as the squash or cucurbit family, the bean or legume family, etc.

Pest management :

The best way to manage insect pests in the home vegetable garden is to use a combination of strategies, including cultural, mechanical, and biological controls.

Modern pest management relies on "planning before planting" rather than responding to a pest problem after it has occurred. For example, you can prevent many insect pest problems by using what you know about the pest to make the vegetable planting less suitable for pest development. This could mean planting early to avoid high pest numbers that occur late in the season.

Some methods for Pest control :

1. **Healthy soil :** Healthy soil will produce plants better able to resist insects and disease. Before planting your garden, turn over the soil and add organic matter such as manure or compost to supply essential nutrients. Organic nutrients are released slowly, in contrast to synthetic fertilizers which provide "quick-fix" nutrients.

2. **Companion Planting :** Some plants contain or give off compounds that repel insects. Companion planting is the practice of strategically placing insect-repelling plants next to crops that will benefit from their repellent effects. For example, planting garlic among vegetables helps to deter Japanese beetles, aphids, vegetable weevils, and spider mites; basil planted near tomatoes repels tomato hornworms and marigolds interplanted with squash or cucumber repel cucumber beetles and nematodes.

3. **Crop Rotation :** Planting different kinds of vegetables in a different section of your garden each year will help reduce pest infestation. Some insect pests overwinter in the garden soil and emerge in the spring and begin searching for food. If the plant they prefer to eat is located several yards away, the insect must move to the source. Many will die along the way or fall prey to birds and other insects.

4. **Mulching :** Mulching is the spreading of organic matter in the garden and around plants. It is an effective method to control weeds and also serves as a refuge for predatory insects like ground beetles. Mulch also helps the soil to retain moisture and stay cool, which promotes plant vigor and tolerance to insect attack.

5. **Trap plant :** If given a choice, some insects will opt to feed on one plant type over another. For example, pickleworms prefer squash to cucumber, and some tomato worms prefer dill over tomatoes. With a little knowledge of host preferences, you can take advantage of this by placing certain plants where they can lure harmful insects away from the plants you wish to protect. Once the "trap plants" have become infested, the

target insect can be picked off and dropped in soapy water or the entire plant can be disposed of.

Different method of kitchen gardening :

1. **Soil bed-technique :** The soil-bed technique allows for furrow irrigation water to move from furrow ditches into the bed, pushing salts to the center. To avoid salt problems plant near the bed edge. When using furrow irrigation a slight slope is needed so water will run down the furrow.

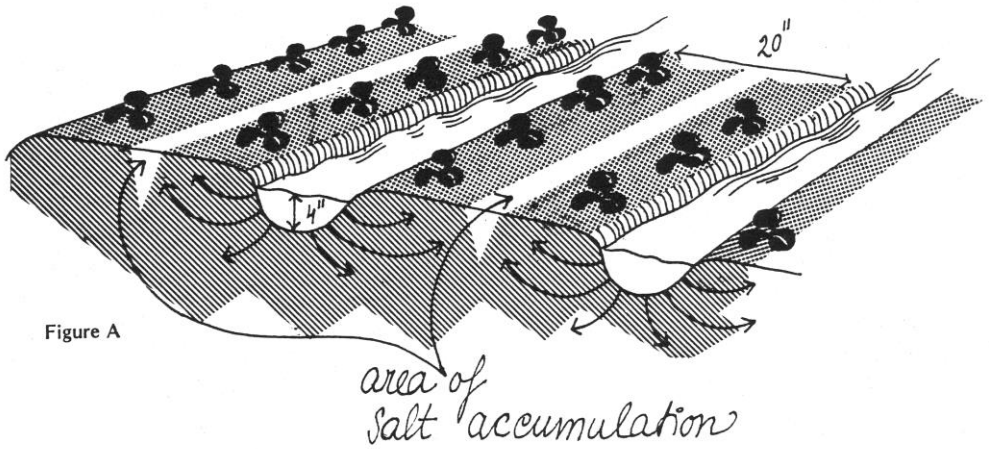


Figure A

2. **Raised bed-technique :** Make raised beds using railroad ties, landscaping wood, lumber, blocks or rocks. The bed is filled with at least one foot of soil, organic matter, sand, perilite and other materials that promote good plant growth. Raised beds should be used when an area does not have good soil.

   In windy areas, sunken beds might be considered to protect young plants and collect water.

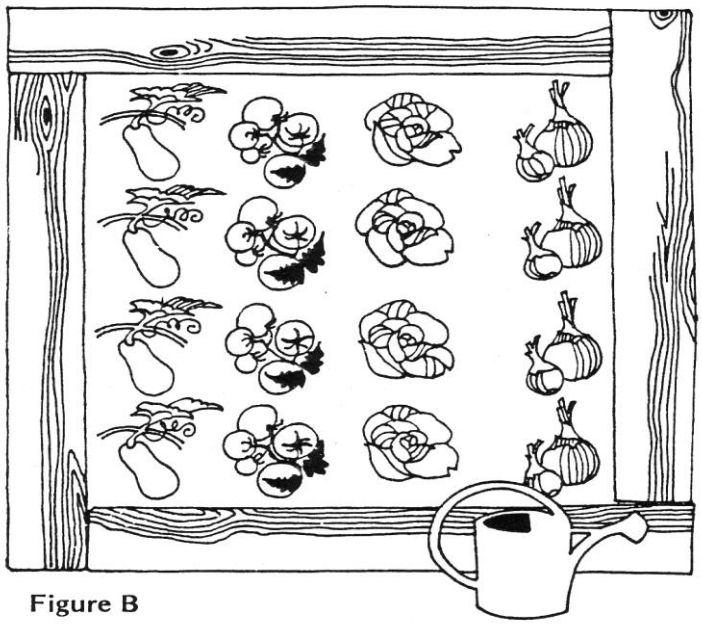
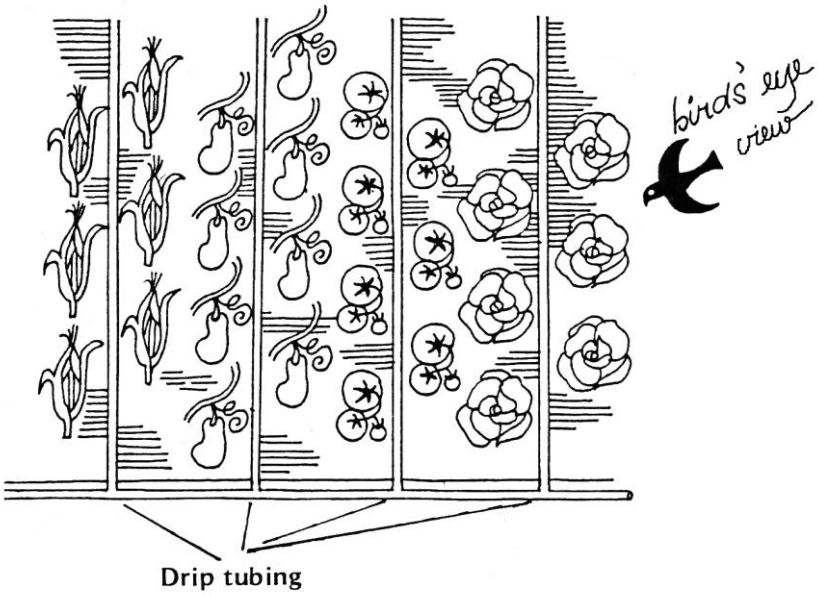


Figure B

3. **Drip tubing :** Water can be applied by drip or soaker hose, furrow, or sprinkler, irrigation. There are many types of systems available that apply water efficiently. Whatever method is used, adequate watering moves salts down and away from the plant roots. Select a system that meets the need and can be managed properly.

Figure C



Topic 14 – Sericulture farming

Objectives :

To impart the knowledge of sericulture practice, value and sales of silk

Duration : 60 minutes

Expected outcome : Participants will learn the importance of sericulture farming practices

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Sericulture farming	* Why sericulture farming? * Disinfection of appliances * Disinfection of rearing house * Maintenance of plantation * Preventive measure of disease * Harvesting of cocoon and transportation technique * Pruning of mulberry leaves	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on sericulture farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

About Silk :

No other fabric has fascinated man so continuously over millennia as silk. It is royal in its splendor, exotic and sensuous in its radiance. An aura of luxury has always surrounded and still surrounds, cloths made of silk. No other fabric drapes more beautifully or flatters the body more than silk. Silken shine, silken soft, and silken smooth – these epithets show that the 'queen of fabrics' is a symbol of beauty, plain and simple. Till today natural fibres (cotton, wool, jute) and synthetic fibres (rayon - viscose, Synthetic - nylon, polyester, etc) could not match the value of silk.

Sericulture :

Sericulture is an art of rearing silkworm for the production of cocoons which is the raw material for the production of silk. Sericulture is an agro based industry which is pretty straightforward and sustainable in the long run. India has the unique distinction of being the only country producing all the five varieties of silk – Mulberry, Eri, Muga, Tropical Tasar and Temperate Tasar. But in Mizoram, mulberry silk is mostly produced. Eri, Muga, Temperate Tasar can also be cultivated.

The larva of mulberry silk moth, *Bombyx mori*, is a domesticated form which feeds on the leaves of Mulberry tree, *Morus alba*. The larva of mulberry silk moth grows for about 20-23 days feeding mulberry leaves. The fully matured larva spins to protect itself just before the pupa stage, a cocoon out of the most expensive and purest of threads, silk.

Silkworm species in India :

Silk Variety	Name	Food source
Mulberry	*Bombyx mori*	Mulberry *Morus sps.*
Tropical Tasar (East & Central India)	*Antheraea mylitta*	Arjun & Asan *Terminalia sps.*
Temperate Tasar/ Oak Tasar	*Antheraea proylei*	Oak *Quercus sps.*
Muga	*Antheraea assama*	Som & Soalu *Machilus/Litsea sps.*
Eri	*Samia cynthia ricini*	Castor *(Ricinus)*, Payam *(Evodia)*, Tapioca (*Manihot*) Kesseru *(Heteropanax sps.)*

Sericulture Activities :

Moriculture :

Cultivation of mulberry plants is referred to as Moriculture. It is an agricultural activity. In Mizoram, mulberry cultivation can be practiced in just about anywhere. Flat, deep, fertile, well drained loamy and clay loamy with good moisture holding capacity soil is ideal for mulberry cultivation. Mulberry can be both cultivated from seeds as well as from cuttings from adult mulberry trees and cuttings are mostly used for cultivation in the state. During the month of Ma and June, mulberry cuttings are acquired from about a year old mulberry trees. These cuttings should be about 8 inches in length for plantation. After a ear, the tree should be able to feed the mulberry silkworms.

Silkworm seed production :

The silkworm seed production centers are referred to as grainages. The silkworm seed known as Disease Free Layings (DFLs) are prepared in their centers and supplied to the farmers for rearing. Both Government and private sector grainages are involved in this activity.

Silkworm rearing :

Silkworm Rearing is considered to be an agro based cottage industry since it involves mulberry cultivation. Silkworms are reared for the production of "cocoons" which is the raw material for silk production. The farmers rear silkworms and produce cocoons. By marketing the cocoons the farmers earn money. It is ideally suited for the rural areas of Sericulture States. Silkworms are reared in well ventilated rearing shed following shoot rearing method.

Marketing of cocoons :

The farmers can sell the cocoon produced by them in the nearest Govt. Cocoon Markets. In the cocoon markets reasonable floor price is fixed by scientific methods and the final selling price is decided in the open auction. Here, silk reelers buy the cocoons produced by the farmers for producing silk.

Silk reeling :

Extraction of silk filament from cocoons by employing a set of processes is known as silk reeling. Presently silk reeling is done using three types of reeling devices viz. Charka, Cottage basins and Multi-end basins. Poor quality cocoons can be reeled economically on charka. About 50% of silk produced is of charka and about 35-40% is at cottage basins and a small quantity of silk is from multi-end reeling.

Charka is a primitive device with which it is not possible to produce quality silk. Even though the cottage basin produces better quality silk compared to charka, it still falls short of gradable silk. Only with multi-end reeling device gradable quality silk can be produced.

The most important version of silk reeling device is the automatic silk reeling machines which are popular in China and Japan. Now, steps are being taken to establish automatic silk reeling machines in Hyderabad.

The silk obtained out of the reeling process is referred to as "Raw Silk". It is the silk reeled by drawing together the filaments from a number of cocoons (6-12) based on the thickness required for weaving sector.

Marketing of raw silk :

The raw silks produced by the silk reelers are marketed directly to the weavers or through Silk Exchanges functioning in the Sericultural States.

In the Silk Exchanges all the raw silk lots brought by the silk reelers are tested for quality. On the basis of quality of raw silk and the price prevailed in major marketing centre, floor price is fixed and then they are auctioned. The Silk Exchange enables the reelers to get immediate cash for the raw silk transacted by them.

Silk weaving :

The raw silk cannot be directly used for weaving. The raw silk is to be twisted before they are fed into looms. The operation of conversion of raw silk into twisted silk, is termed as twisting. The twisted silk is referred to as Ready Silk. Twisting is undertaken either by separate entrepreneurs or by the weavers themselves. The silk weaving is done either on handlooms or power looms. The traditional silk sarees and dhoties are made on handlooms whereas the printed sarees, dress materials, etc., are made on power looms.

Sericulture in India :

In India, Sericulture is essentially a village-based industry providing employment to a sizable section of the population. Although Sericulture is considered as a subsidiary occupation, technological innovation has made it possible to take it up on an intensive scale capable of generating adequate income. It is also capable of providing continuous income to farmers.

India is the second largest producer of silk in the world with an annual silk production of around 20,000 Metric tons. All the known varieties of silk, viz. Mulberry, Eri, Muga and Tasar are produced in India. Mulberry silk is the most popular variety in India, contributing more than 87% of the Country's silk production. Silk and silk goods are very good foreign exchange earners. Export potential of this sector is promising as silk production in Japan is declining and that of China, the largest silk production in the World, it is stagnant or declining.

In India, because of the prevalence of favorable climatic conditions, mulberry is cultivated mainly in five states, viz., Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir. These five states collectively account for 97% of the total area under

mulberry cultivation and 95% of raw silk production in the country. Now, as a result of growing realization, sericulture is gaining ground in non-traditional areas too. Most of the silk produced in the country is from multi x bi hybrids which is inferior in quality and cannot meet the international standard as well as the domestic needs of the power loom sector. Majority of the silk produced in India is consumed for producing sarees mainly on handlooms. Bivoltine silk excels in quality and is mostly produced in country having temperate climate. Hence the power loom weavers prefer imported superior quality silk.

The present global scenario clearly indicates the enormous opportunities for the Indian Silk Industry. The need of the hour is to produce more bivoltine silk with reduced cost of production to meet the growing demands of quality silk. Realizing this, the Govt. of India is taking all out efforts to boost bivoltine production in the country with the technical support from Japan International Co-operation Agency.

Rearing of mulberry silkworm :

Guidelines for mulberry silkworm rearers :

Mulberry :

There are different types and varieties of Mulberry. Among such varieties, S1635 variety is best suited for the soil and climatic condition of Mizoram which has been researched by specialist in his field. For obtaining beer quality output and efficiency in silkworm rearing, cultivation of mulberry plants have o be practiced in a more intensive manner.

- *Mulberry plantation is better explained in the coming pages.*

Rearing House :

- The location of the Rearing house should not be near the home of the rearers. In fact, it should be located in the place of the mulberry cultivation. A well aerated area is best for building a rearing house.
- The Rearing house should be constructed in a proper leveled ground. Proper drainage is also necessary.
- The roof of the rearing house should not be lower than 9 feet.
- Skirting of the house should be constructed so that mice and other vermin.
- The floor of the rearing house which is at least 1 foot above the ground is recommended.
- A front porch of at least 4 feet and another verandah on the west side of the house prevents the rearing house from direct sunlight and also helps in slowing the wear and tear of the house.
- Windows and ventilations should be placed on two sides of the house, preferably the north side and the south side and should be directly opposite to each other.
- Likewise, the front and rear/back doors should be placed in direct opposite to each other.
- If a tin roof is used, ceiling should be constructed so that it prevents the inside of the house from too much heat.
- If too much sunlight and direct heat falls on the rearing house, planting jackfruits can help in shading the house.
- If possible, 2x2 feet square on the ceiling or roof should be made open-able so as to release warm air from inside of the house.
- For a 100 layings, the length of the rearing house should be at least 24 feet and breadth of 15 feet.

Double disinfection :

Disinfection is an integral part of healthy and successful silkworm rearing. It aims at the total destruction of disease causing pathogens. There are no curative methods for any of the silkworm diseases and they are best prevented than cured. This is achieved by adoption of proper and effective methods of disinfection and stepwise maintenance of hygiene during rearing. One important point to remember is that, before the silkworms reached adulthood, new batch should not be reared. This is because it can disrupt the disinfection schedule which poses serious threat for the health of the silkworms.

Besides that, the surroundings of the rearing house and its areas should be cleanly maintained with proper drainage system and the rearers should maintain themselves in terms of cleanliness. One should abstain from cigarettes and other tobacco products and should clean their feet before entering the rearing house.

When to disinfect:

5 days before rearing.

Before rearing :

5 days before: Cleaning of materials and equipments and let it sun-dry.

4 days before: Mix water with 2% bleaching powder and 0.3% slaked lime then spray the rearing house, all materials and equipments.

3 days before: Rearing house and all rearing equipments should be sprayed with Decol/Asthra.

2 days before: Spraying the rearing house and its surroundings with disinfectants. The porches and doors should also be sprayed but windows and ventilations should be opened.

1 day before: Final preparation of rearing house and tools for the next day .

After rearing :

1. Cleaning of rearing house and clearing of melted cocoons.
2. Mix water with 2% bleaching powder and 0.3% slaked lime then spray the rearing house, all materials and equipments.

How it works :

Slaked lime and bleaching powder can kill all viruses, fungi and protozoa which affect the silkworms. Mixing slaked lime and bleaching powder can help in absorbing moisture in the rearing house and also keep the house clean.

Decol/Asthra can also prevent several diseases which are susceptible to silkworms.

Mixing the chemicals :

1. Mix slaked lime and bleaching powder (2% bleaching powder and 0.3% slaked lime in 1 litre of water):
   Mix bleaching powder 20 gram with slaked lime of 3 gram and then add 1litre of water again.

Example: 15 litres.

Bleaching powder :
20gmX15ltr of water
= 300 grams (0.3kg)

Slaked lime :
3gmX15ltr of water
= 45 grams (0.045kg)

Water :
1ltrX15= 15 ltrs of water.

The above solution should be filtered with a piece of cloth upon pouring in the spaer can. This is necessary because small particles can block the pores of the spaer tip.

2. For a kilogram of slaked lime and bleaching powder (5%) :

   Carefully weigh and mix the following.

   Bleaching powder: 0.05 kg

   Slaked lime : 0.95 kg

3. Decol/Asthra :
   Add Asthra 50 gram into 100 lt of water.

Silkworm rearing :

- When transporting the silkworm egg by sumo/bus, it should not be kept in the vehicle's dashboard or on the hot surface of the vehicle. A reusable well-ventilated box should be made/use for transportation of the eggs.

- When farmers brought home the eggs, they should keep in mind that the eggs have to be stored in 25ºC with 80% humidity. Foam pads and wet sacks can help maintain the humidity. 6 hours of light and 8 hours of darkness ensures uniform hatching (normally between 9-12 days from egg laying). Brush newly hatched larvae on to the rearing beds and sprinkle freshly chopped tender leaves of 0.5 to 1 cm. Highly nutritious leaves in adequate quantities at suitable intervals of time to be fed. Top 3-4 full grown leaves immediately below the growing buds are suitable.

	Temperature	**Relative humidity**
1st instar	26-28°C	85-90%
2nd instar	26-28°C	85-90%
3rd instar	24-28°C	80-85%
4th instar	24-25°C	70-75%
Cocooning	23-24°C	70-75%

- **Brushing :**

a) Brush newly hatched larvae on to the rearing beds and sprinkle freshly chopped tender leaves of 0.5 to 1 cm^2. Highly nutritious leaves in adequate quantities at suitable intervals of time to be fed. Top 3-4 full grown leaves immediately below the growing buds are suitable.
b) Egg sheet brushing: Freshly hatched larvae should be sprinkled with freshly chopped tender leaves of 0.5 to 1 cm^2. After 30 minutes of feeding, the larvae should be transferred to a new tray.

- **Feeding :**

  - The silkworms should be fed 4 times a day with a uniform routine/interval. While newly hatched, they should be spread out regularly in the feeding tray. Feeding intervals are as follows:

    4 hour interval: 6 a.m, 10 a.m, 2 p.m and 6 p.m.

- **Bed cleaning :**

Silkworm after moulting leaves the exuviate. All the leaf fed to silkworm may not be consumed. Dried leaves, rejected leaf in the bed, silkworm's excreta, dead worms, diseased larvae all will increase the humidity, fermentation, temperature in the bed. If proper bed cleaning is not done in time it leads to various complications viz. Ill health of larvae, disinterest of the larvae to feed due to unhygienic conditions, ultimately worms becomes weak.

Bed cleaning in silkworm rearing tray is done by various methods like using of paddy husk, straw, and bed cleaning net. During 1^{st} instar bed clearing should be done once during pre-moulting, during 2^{nd} instar – twice, once after moult and before next moult. During 3^{rd} instar thrice i.e. after moult, before next moult and once in the middle. During the 4^{th} and 5^{th} stage once in a day in case of shelf rearing. However, in case of floor rearing or shoot rearing once in each instar.

- **Storing of mulberry leaves :**
  - Mulberry leaves should be collected in the morning or evening, but not on noon when the sun is high. Mulberry leaves should be stored in a wet sack or covered in wet cloth, but should not be stacked too tall. The leaves should not be stored in a refrigerator.

- **Silkworm in trays :**
  - The silkworms should neither be kept too loosened nor too congested, for rearing of 100 dfls with good health, the number of trays needed
    Plastic tray (3 x 2 sq. feet) 120 units.
    Local traditional tray 150 units.

- **Mounting of ripened worms :**

To obtain such quality cocoons, mounting the silkworm larvae at the appropriate time and good quality mountages are essential. In the fifth instar on seventh day silkworms enter into maturation and stop feeding and begin to search place to build the cocoons. Such larvae are picked immediately and mounted on to the mountages. Care should be taken that the number of larvae on mountages must not exceed the capacity of

each mountage. When the larvae are in spinning stage, the room temperature of 24°C and 60-70 % of relative humidity along with good aeration facility are to be provided.

- **Cocooning :**
  - In one plastic mountage (2 x 3 feet) 200-250 silkworms can be accommodated. Blotting paper or newspapers should be placed between the mountage if they are to be stacked.

- **Harvesting :**
  - Harvest cocoons only on the 5^{th} day

- **Transportation :**
  - The harvest should be kept and transport it in a sack or crate and are needed to be loosely packed in preferably 30-40 kg capacity and transported in vehicle having shelves/partitions so that pressing of cocoons can be avoided.

- **Hygiene :**
  - Rearers should maintain their cleanliness and hygiene. Wearing of dirty dress inside the rearing house is not recommended. Rearers should abstain from cigarettes and other tobacco products and should clean their hands feet before entering the rearing house and around their foods.

Important points to remember for successful rearing of silkworms :

- One should not share others his/her materials and equipments to others, equipments and materials should be disinfected.
- Before the silkworms reached the final stage, new batch should not be reared.
- Proper maintenance of rearers and importance of cleanliness.
- If not necessary, entry of rearing house should be restricted.
- The doormat of the rearing house should be disinfected with a mixture of bleaching powder slaked lime after every 2 days.
- Before entering the rearing house, one should wash his/her hands. Doormat should be laid.
- Upon inspection, silkworms which may be susceptible to diseases should be thrown away in a container with 5% bleaching powder.
- After handling the infected silkworms, hands should be properly washed again.
- Ankush powder should also be applied to the silkworms after every instar stage; this prevents them from disease due to exposure after shedding their skin. Besides, after 4^{th} instar, Ankush powder should be applied before every feed in the morning.

MULBERRY SILKWORM DISEASES AND PEST MANAGEMENT :

Mulberry silkworm diseases and their management :

Mulberry diseases are caused b protozoan, virus, bacteria and fungi. This can be prevented however. These diseases hamper the production b 15-20% in India. The following are the common diseases and their management.

1. Pebrine :

Pebrine can occur for a long period of time. It is transmitted by the mother-moth.

Occurrence: Non-seasonal.

Causative agent : *Nosema bombysis, Nosema sp*. NIK-2r, NIK-4m leh NIK-3h

Symptoms :

- Irregular hatching of silkworm eggs.
- Irregular size of the larval body and moulting.
- The infected larva loses its appetite and becomes inactive with wrinkled skin.
- Black pepper-like spots appear on the body of the infected worms.
- White pustules appear on the silk land when examined under microscope with presence of shining oval spores.

Management :

- Disinfect the rearing house, surroundings and with recommended disinfectant as mentioned above.
- Conduct strict mother moth examination and surface disinfection of silkworm eggs to produce and rear disease free layings.
- Follow strict hygiene maintenance during rearing.
- Control mulberry pests in and around the mulberry garden.
- Apply recommended bed disinfectant, Vijetha/Ankush as per schedule and quantity.
- Monitor seed crops constantly to eliminate the microspodian infection.

2. Grasserie :

Causative agent : Nuclear Polyhedrosis Virus

Occurrence :

The disease prevails all through the year but its severity is more during summer and rainy seasons.

Symptoms :

- The skin of infected larvae becomes shining before moult and fails to moult.
- Inter segmental swelling appears and the color of the body becomes yellowish.
- The infected larvae move restlessly in the rearing bed/ along the rim of the trays.
- Infected larval body ruptures easily and turbid white haemolymph oozes out.

Source of infection :

Silkworm gets infected when it feed on contaminated mulberry leaves. The milky white fluid released by the grasserie larvae, contaminated silkworm rearing house and appliances are the sources of infection.

Management :

- Practice thorough disinfection of rearing house, its surroundings and appliances with any recommended disinfectant.
- Conduct an optional disinfection with 0.3% slaked lime solution when high incidence of disease noticed in the previous crop.
- Practice personal and rearing hygiene.
- Collect the diseased larvae and ensure its proper disposal.
- Maintain optimum temperature and humidity in the rearing house.
- Feed quality mulberry leaf and avoid overcrowding.
- Apply recommended bed disinfectant as per schedule and quantity.
- Feed Amruth as per schedule to control grasserie disease.

3. Flacherie :

Causative agent : Infectious Flacherie Virus

Occurrence : April-September

Source of Infection :

Silkworm gets infected by eating contaminated mulberry leaf. Dead diseased silkworm, its fecal matter, gut juice, body fluid are the sources of pathogen contamination. The infection can also take place through injuries/cuts/wounds.

Symptoms :

- The larvae become soft and flaccid.
- The growth of infected larvae retarded, becomes inactive and vomit gut juice. The feces become soft with high moisture content. Sometimes chain type excreta and rectal protrusion also observed.
- Larval head and thorax become translucent.
- When infected with Bacillus thuringiensis symptoms of toxicity such as paralysis and sudden death are observed. After death, larvae turn black in color and gives foul smell.
- Sometimes, the dead larvae turn red when infected with Serratia sp.

Management :

- Disinfect the rearing house, its surroundings and equipments with recommended disinfectant mentioned above.
- Provide good quality leaf grown under good Sunlight and recommended inputs. Do not provide over matured/over stored /dirty leaf to the silkworms
- Rear silkworms under optimum temperature and humidity.

4. Black thorax septicaemia :

Causative agent: *Bacillus spp.*

Occurence: April-July

Symptoms :

- Swollen body.
- The thoracic region of the infected worms become blackish, body shrinks.
- Excretes soft and liquid like excrements, rotting of the body follows with excretion of dark brown fluid.
- Sluggish movement and low appetite.
- Immediately after death, the thoracic region becomes black.

Source of infection : Through wound injury

Management :

- Maintain hygienic condition in and around rearing room.
- Avoid injury to the leaves.
- Avoid overcrowding and accumulation of faeces in the rearing beds.
- Rear silkworm under optimum temperature and humidity.

5. White muscardine :

Causative agent : *Beauveria bassiana*

Occurence : November-April

Symptoms :

- Presence of moist specks on the skin.
- Larvae lose appetite and become inactive.
- Vomiting and diarrhea, hard and stiff body.
- Mummified larvae covered with white woody aerial mycelia and presence of conidia**.**

Source of infection :

Through wound injury

Management :

- Disinfect the rearing room and appliances with 0.5% Bleaching powder solution.
- Avoid low temperature and high humidity during rearing.
- The diseased larvae should be removed from the tray before they get mummified.

6. Uzi fly (*Exorisa bombycis*) :

The uzi fly is a serious endoparasitoid of silkworms inflicting of cocoon yield of 10-20%.

Occurence : July-November

Symptoms :

- The fly lays eggs on the integument of the worms in the dorsal and dorso-lateral side. After hatching from the eggs, the maggots of the fly penetrate into the larval body and feed on the tissue of the worm. The mature maggots come out of the larvae/pupae and undergo pupation in the rearing house.
- The uzi infested mulberry silkworm dies during larval or pupal stage.

Management :

- Drying of commercial cocoons should be made immediately after harvest on the 5th day to kill the maggots inside the cocoons. Regular collection of uzi maggots and puparia in the cocoon markets and reeling establishments and destroying them immediately.
- Regular collection of maggots, infested silkworm larvae and uzi pupae from rearing trays and mountages and destroying them immediately by putting them into hot water.
- Sealing of cracks and crevices in the floor to prevent maggots from getting shelter under the floor for pupation, followed by emergence of adult flies inside the rearing house.
- Fixing of fly-proof wire mesh or nylon nets on ventilators, windows and doors to prevent the entry of uzi flies into the rearing house.
- Use uzitrap, a Chemotrap to attract and kill the adults of uzi fly.

PLANTATION OF MULBERRY TREES :

Important points to remember in mulberry cultivation :

Land preparation :

Generally flat lands are suitable for irrigated mulberry cultivation. If the slope is more than 15%, suitable land development measures such as contour trench, bench terracing, etc. should be adopted.

Land should be prepared by deep ploughing upto a depth of 30-45 cm in order to loosen the soil and thereafter with a country plough to bring the soil to a fine tilth. Weeds, stones should be removed during the preparatory stage. Basal dose of farm yard manure @ 20 tonnes per hectare is recommended, which has to be thoroughly incorporated into the soil.

Plantation in the main field :

Season : April-June (Before monsoon) in low-land

April-September in up-land

Mulberry variety :

- Low-land: S1365, S1, K2, S36
- Up-land : S1635, S1, BC259 & Tr10

Spacing and pit size :

- 90 cmX 90 cm upto waist high.
- 180 cm X 180 cm for more than waist high.
- Pit size – 35x35x35 cm (length x breadth x depth)
- Cow manure of 3 kg in every pit which has to be thoroughly incorporated into the soil.
- 5 gm Titafen to be applied in every pit to protect from ants.

Planting :

- Plantation in mulberry cultivation can be taken up both b cuttings and saplings
- Planting during Sep-Oct in low-lands and during April-September in up-lands is best suitable. Whether cuttings or saplings mulberry plantation should not be done during July-August in hill top region because of heavy rainfall and warm season.
- In hilly areas, 3 cuttings of 20-22 cm length are planted in each pit at a spacing of 15 cm. Cuttings not sprouting in 4-5 weeks need to be replaced by saplings to ensure the required plant density.
- For the soil to retain moisture, dry leaves and hay should be used to cover the soil as mulching.
- It should be irrigated right after plantation.

Mulberry variety and productivity :

- Low-land - S1365, S1, K2, S36
- Up-land - S1635, S1, BC259 & Tr10

Variety	Yield/Kg/ac/yr.	Yield per Mt/ha/yr.	Dfls utilization/ac/yr.
S1	6470	16	-
K2	6470	18	-
S1635	7200	20	850
S36	7200	18	-
BC259	6470	18	-
r10	6470	18	-

Pruning :

In order to get good leaf yield for 15-20 years, it is necessary to give a good and sturdy frame to the plant. After the planting, the saplings need to be cut at 10-15 cm above the ground level within a week. After the growth period of six months, the plants are to be cut at a height of 25cm above the ground level keeping 3-4 strong branches.

In leaf picking method, the first bottom pruning has to be taken up at a height of 20-25 cm from ground level and second bottom pruning is done (after 3 leaf harvests) again at 30 cm height from ground level. Afterwards, in leaf harvest method, the middle pruning at a height of 60-70 cm has to be followed once in a year during Jan-Feb and in shoot harvesting method, each shoot harvest done at 25 cm height which itself acts as pruning.

Manure/fertilizer :

- Nitrogen 150 kg, Phosphorous 50 kg and Potassium 50 kg should be applied in the soil within 20 days, followed by cow manure of 10 Mt in 1 hectare of land every year.
- Dung manure/compost of 10 Mt in 1hectare per year is a must. (FYM: 10 Mt/ha/yr)

a) Nitrofert : 1 hectare with 10 kg for 3 times use.
b) Phosphofert : 40 kg/ha. Should be applied all at once but only after every 4 years.

- Nitrogen, Phosphorous and Potassium (NPK) 75:20:50 kg/ha/yr should be applied after 15 days of applying nitrofert and phosphofert.
- PGR: Seriboost to be applied after 15 to 30 days (750 ml PGR+300 ltr water/ha/crop).

Rain-fed mulberry plantation :

The successful rearing of mulberry silkworm depends upon the availability of a good quality mulberry leaves. Therefore we have to follow the steps and practices of what researchers have asked the farmers to practice. The following table shows the timeline and management practices for rain-fed mulberry plantation:

Sl. No.	Important Activities	Time of year
1.	1st pruning	Oct-Nov
2.	1st weeding applying fertilizer @10 Mt/hectare	From pruning to 2 weeks
3.	1st dose (fertilizer)	From pruning to 3 weeks
4.	2nd weeding	Jan-Feb
5.	1st leaf harvest	Mar-Apr
6.	3rd weeding	From 1st leaf harvest to 1st week
7.	2nd leaf harvest	May-June
8.	2nd pruning	June
9.	2nd dose of fertilizer and 4th weeding	From pruning to 2 weeks
10.	3rd leaf harvest	August
11.	5th weeding	From 3rd leaf harvest to 1st week
12.	4th leaf harvest	October-November

Retaining moisture :

Peas should be planted alongside the mulberry cultivation and before rainfall is over, they should however be taken out along with its roots. This should be scattered around the mulberry plants so that they can help the plants to retain moisture during winter as well as providing essential nutrients for the soil.

Applying fertilizer :

Cow manure and fertilizers are important for the well growth of the plantation, cow manure helps in giving nutrients to the soil as well as help in retaining moisture in the soil. Meanwhile chemical fertilizers help in the growth of mulberry trees. These fertilizers should be applied at a small dose near the plantation in a small pit which should be covered as soon as it is applied. Nitrogen, Phosphorous and Potassium (NPK) should be applied accordingly with respect to the size of the tree.

1. *1st year plantation*
    - NPK 50:25:25ha/ year/ year. To be applied after every 2 months from plantation for two times.

2. *2nd year plantation*
    - Manure should be applied within the 1st week of pruning @ 10 Mt/ha/year to be mixed evenly with soil.
    - Chemical fertilizer NPK @ 150:75:75/ha/year for two times.
    - NPK to be applied again after the 3rd week from pruning, then (2nd dose) to be applied after 2nd leaf harvest but only with nitrogen this time.

Leaf harvesting :

Mulberries are planted because it is the food for silkworms. Therefore leaves are harvested according to the rearing season. Rearing season depends upon the location and climatic condition, so it could be different from place to place. 1st leaf is harvested mostly during dry seasons which are pruned near the lower part of the stem. 2nd and 3rd leaf harvest is mainly done during summer and rain season while 4th harvest is done after rainfall. In Mizoram leaves can be harvested only thrice a year with total output of around 18-22 MT.

Intercropping mulberry with other plants :

The prospect of intercropping mulberry trees with other vegetables and spices is bright and this can boost additional income from the same land aside from silk cocoon production. Some vegetables, spices and crops, including black gram and wheat, could easily be produced in between the spaces of mulberry rows for maximum utilization of land resources.

MULBERRY DISEASES AND THEIR MANAGEMENT :

There are two diseases that commonly occur on mulberry trees and spoil their appearance and usefulness as shade trees — fungal leaf spot and bacterial leaf spot. Leaf loss during several consecutive growing seasons can result in reduced growth and increased susceptibility to opportunistic pests and pathogens.

1. Leaf spot :

Pathogen : *Cercospora moricola*

Symptoms : Brownish necrotic, irregular spots appear on the leaf surface. Spots enlarge, extend and join together leaving characteristic ‘shot hole’. Leaves become yellow and wither off as disease becomes severe.

Occurrence : It is more prevalent during rainy season followed by winter. The disease starts progressing 35-40 days after pruning (DAP)/leaf harvesting and becomes severe on the 70th DAP.

Management :

- Plants should not be too close to each other
- Spraying of 0.2 % Bavistin (Carbendazim 50% WP) solution on the leaves.
- Safe Period: 5 days.

2. Powder Milldew :

Pathogen : *Phyllactinia corylea*

Symptoms : White powdery patches appear on the lower surface of the leaves. The corresponding portions on the upper surface develop chlorotic lesions. When severe, the white powdery patches turn to brownish-black; the leaves become yellow, coarse and lose their nutritive value.

Occurrence : Disease is prevalent during winter and rainy seasons and progresses 40th DAP/leaf harvest become severe on 70^{th} DAP.

Management :

- Follow wider spacing of plantation (90 cm x 90 cm) or paired row planting system [(90 +150) × 60 cm]
- Spraying of 0.2 % Karathane (Dinocap 30% EC) / Bavistin on the lower surface of the leaves. Safe period 5 days
- Spray Sulfex (80WP) 0.2% Safe period 15 days.

3. Leaf rust :

Pathogen : *Cerotelium fici*

Symptoms : Initially, circular pinhead sized brown eruptive lesions appear on the leaves and later leaves become yellow and wither off.

Occurrence : The disease is more prevalent during winter and rainy seasons. It starts progressing 45-50 DAP becoming severe on 70^{th} DAP. The mature leaves are more prone to the disease.

Management :

- Plants should not be too close to each other.
- Pruning should be done all at once
- Follow wider spacing of plantation (90 cm x 90 cm) or paired row planting system [(90 +150) × 60 cm].
- Avoid delayed leaf harvest.
- Spraying 0.2% Kavach (Chlorothalonil 75 % WP) on the leaves.
- Safe period: 5 days.

4. **Bacterial leaf spot** :

Pathogen : *Xanthomonas campestris pv.mori Maji te al.*

Symptoms : Numerous blackish brown irregular water soaked patches appear on the leaves resulting in curling and rotting of leaves.

Occurrence : The disease is more prevalent during rainy and winter seasons and starts progressing 35th DAP becoming severe on 70th DAP. It is particularly common in the north east region

Save period : After 10 days of applying chemicals

Management :

- Remove the infested leaves, collect in a polythene bag and destroy by burning.
- Follow wider spacing of plantation (90 cm x 90 cm) or paired row planting system [(90 +150) × 60 cm]
- Spray 0.2% Streptomycin solution or 0.2% Indofil M-45 (Mancozeb 75% WP) on the leaves.

Mancozeb (Dithane M-45) is available in powder form which is very effective for maintenance of mulberry plants. The powder can be directly applied to the soil or can be used with water. The solution can be applied with a sprayer.

Application :

1. ***Wig blight :*** Black spot on the edges of leave initially which later turns all leaves black as if they were burnt and fall off. The stems develop black cuttings-like which can dry up the branches. New leaves also just wither and die away.

   Mancozeb 0.2% should be sprayed. In serious case 0.5% of mancozeb should be sprayed on the soil near the plants.

2. ***Root rot :*** It is a root disease of the mulberry plant. Due to unknown reason, the plants dry up, lose their leaves and die eventually. If these problems arise, the plant may suffer from root rot disease.

   During plantation, Dithane M-45 (Mancozeb) 5gm-10gm should be applied in the pit. If disease occurs in adult trees, dig a pit and apply 5gm-10gm of Dithane M-45 (Mancozeb) and water. The pit should be 5-6 inches deep. Saplings may be sprayed with 0.2% for prevention.

3. ***Stem canker :*** Stem disease which initially turns green and later black in color which attacks the stem of the plant.

4. ***Collar rot :*** Dark brown color surrounds the area just above soil covering.

5. ***Cutting rot :*** Brown color develops in branch, later turn black which peels and rot.

6. ***Die back :*** The leaves turn black, dry and wither away.

The above diseases can be prevented by soaking the cuttings before planting with 0.1% Dithane M-45. For 0.1% solution, add 1 gm of the powder with 1 ltr of water.

DITHANE M-45 (MANCOZEB) SOLUTION :

- For 0.1% mancozeb solution, add 1 gm of the powder with 1 ltr of water. And for 2 litres of water, add 2.5 gm powder. For each subsequent increase in a litre of water, add 1.5 gm powder.

- For 0.2% mancozeb solution, add 2.5gm of the powder with 1 ltr of water. And for 2 litres of water, add 5gm powder. For each subsequent increase in a litre of water, add 2.5 gm powder.

- For 0.5% mancozeb solution, add 6.5gm of the powder with 1 ltr of water. And for 2 litres of water, add 13gm powder. For 3 litre of waters, add 20gm powder.

5 litres of water	:	33 gm Mancozeb
10 litres of water	:	66.5 gm Mancozeb
16 litres of water	:	106.5 gm Mancozeb
20 litres of water	:	133 gm Mancozeb

Points to remember while applying chemicals :

- The chemicals should be applied to last for 2 days (morning and evening each).

- Always keep the chemical out of reach of children as it is very poisonous.

- Close the cap/lid of the chemicals securely when storing.

- The chemicals should not be used/ touched with bare hands. Also protect eyes, nose and mouth with mask or clothes to avoid direct contact.

Mulberry pest and their management :

There are many pests which can be harmful for the mulberry plants. The harmfulness also depends on the kind and types of pests and bugs. Some pest attacks once a year while other pests can be seen in every generation. These pests consume the leaves of the plants and they hinder the growth of the mulberry trees. The can also live in new leaves which reduce the production of new leaves by the plants.

1. Mealy bug (*Maconellicocus hirsutus*) *:*

Occurrence : April-June

Symptoms : Mealy bug, Maconellicoccus hirsutus (green) causes deformity symptom in mulberry which is popularly called as Tukra. Leaves become dark green, wrinkled & thickened with shortened inter nodal distance resulting in bunchy top appearance/resetting of leaves.

Management :

- Cutting the affected shoots and burning
- Spray 0.2% Rogor on new leaves within 20 days
- Releasing Pullus Bourdillioni Kapoor @ 600 pairs/acre.
- Safety period: 15 days.

2. White fly (*Dialeuropora Decempuncta*) *:*

Occurrence : August-November

Symptoms : Both nymphs and adults pierce and suck the sap from foliage and the damaged leaf become unfit for silkworm rearing. The spiraling of waxy material is the typical symptom of white fly attack. Prolonged dry spell followed by the hot humid weather favors the white fly flare up.

Management :

- Avoid growing other host plants like guava, mango, tomato, hibiscus, rose poinsettia etc., close to mulberry trees and plantations, Remove and destroy weeds which are also affected by the spiraling whitefly from and around mulberry plantations periodically.
- Fix yellow sticky traps @ 75-80 traps/acre to trap the adults.
- Release predatory lady bird beetles Cryptolaemus montrouzieri @ 250 adult beetles or Scymnus coccivora @ 500 adult beetles/acre.
- When the infestation is low, clip the affected portions and destroy them by dipping in 2% soap solution to kill the pests.

3. Thrips (*Pseudodendrothrips mori Niwa*) *:*

Occurence : May-August till November

Symptoms :

It injures the epidermal tissues of leaves and desap. It can cause early maturity, depletion of moisture, reduction in crude protein and total sugar. Leaves become unfit to rear silkworm. In early stage of infestation streaks are observed on leaves. In advanced stages, the leaves become yellowish brown on maturity.

Management :

- Remove and destroy weeds.
- Use polythene sheet (1.5 m x 1 m) of 40-50 units to trap flies.
- Spray with 0.1-0.2 % Dimethoate.
- Release natural predator Micraspis discolor.

Topic 15 – Training on fish farming

Objectives :

To impart the knowledge of productive fish farming

Duration : 60 minutes

Expected outcome : Participants will learn the importance of fish farming

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Fish Farming	* Why fish farming? * Site selection *Transportation of fish seed * Feeding * Pond management during monsoon * Harvesting of fish	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on sericulture farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

What is fish farming?

Fish farming involves raising of fish in a particular enclosure, may be in a cage, tanky, pond or ditch and feed them systematically for their continuous growth and increase**.**

Why fish farming?

• Fish is one of the tastiest and healthiest foods among food items and contains high-protein which gives us energy.

• There is evident that those who eat fish a lot are healthier and have strong and healthy brain.

• Fish is much healthier than other meat.

• The British food expert had proved that eating fresh fish every week is good for heart.

• Fish is a good medicine for number of diseases, pregnant women should eat fish as much as they can.

• Compare to the same size of land, fish farming is more profitable than growing rice or vegetables.

• Fish farmer produces fresh and healthy fish for his family. Besides, if there are surplus productions, it is a good source of income.

Selection of site for fish pond :

• Gentle slope is desirable as it facilitate digging and drainage possibility of water and makes it easy to construct the pond.

• Low and flood-prone area of land should not be selected.

• The pond must received sunlight in abundance as it provides vital energy and vitamin D for fishes.

• It is wise to select the location of the pond where the farmer can do his work easy and efficiently.

Work procedure for construction of pond :

• Identify the selected land

• Mark the expected level of water table

• Calculate the height of the wall of the pond. Digging might may be involved as per required.

•A good water outlet pipe must be buried while preparing the bottom of the pond.

• A strong and reliable barrier (embankment) should be constructed.

• Check the bottom and embankment of the pond and seal the entire possible leak.

Types of pond and its depth :

Sl. No.	Purpose/Usage	Depth of the Pond
Nursery Pond	For newly hatched fish seed	0.75-1.00 m
Rearing Pond	For 15 day old fish	1.00-1.50 m
Stocking Pond	For 2 inches to mature fish	2.00-2.50 m

Construction of fish pond :

Most of the fish pond in Mizoram is river constructed pond. This type of pond is less expensive since it does not involve much digging. However, the embankment is usually cut when harvesting is done, causing bad quality of fish pond. So, the pond has to be planned carefully when it is constructed.

a) Measure the size of the pond, water table level and then clear all the unwanted plants and weeds which are five feet from the water level around the pond.
b) The pond should be 4 ft wide and 3 ft deep. To prevent water from leaking, the pond should be covered with mud and plaster it.
c) This should be used up to the area where the water level will rise. Install the outlet pipe (drain pipe) while preparing the bottom of the pond. A drain pipe of 6-8 inches is suitable for 1 hectare of fish pond.
d) The two side of the dike should be gentle slope. The dry side slope of the dike varies from 2:1 or 5:1 and the wet side should be in the range of 3:1 or 2:1.
e) Soil that contains enough clay could have less slope and thinner of the dike. Whereas soil that contain less clay and more sandy soil usually require more steeper slope of the dike.
f) The bottom of the pond (foundation) should be level and flat.
g) Preparation of the outlet channel should be done carefully. The outlet channel should be covered by strong and reliable net so as to prevent leakages of fish. The channel should be deepen and widen enough to drain out unnecessary water in the pond during rainy season.

Selection of fingerlings :

1. It should a type of fish which can be rear in any type of pond and water.

2. It should be fast growing fish

3. The feeding habit should be different from other types of fish

4. It should be a type of fish that can eat not only their natural food but also the artificial food.

5. The required seed link should be available at the local.

6. There should be a good and constant demand in the market at a good price.

7. Here are some of the example of fish breeds which are suitable for rearing on the same pond. (a)Catla, (b) Lohu, (c) Mrigal,(d) Silver Carp, (e) Grass Carp,(e) Common Carp

Feed for fish :

Food which contains high proteins and carbohydrates

The food should be delicious and easy to digest.

The price of the feed should not be too costly

The feed should be easily available during the production cycle

Some fodders and vegetables are also to be supplied

Some insects like earthworm, white ants, termite, etc are also suitable

Kitchen waste, rice and wheat husk, vegetables having oil, sugarcane and maize and some animal dung can also be used.

Feeding of fish :

When fishes are small in size, feed should be supplied regularly.

Feed should not be given more than 3% of the body weight.

During winter season, feed should not be given regularly, frequent feeding of 2-3 days interval is recommended.

Routine feeding should be practiced. In the morning feeding should be done around 7:00 am and in the evening at around 5:00 pm is suitable for routine feeding.

With the growth of the fish, the feeding amount should also be increased.

Excessive feeding should not be practiced. In order to avoid this problem, the farmer has to plan carefully about the feeds requirement. If not, the remaining feeds may pollute the water.

If the fish do not eat or move slowly during feeding, the water in the pond should be replaced by new and fresh-water. At this point, feeding and fertilizing of the soil should be stop for sometime.

Harvesting and marketing of fish :

Complete harvesting : Catching of all the fish by complete draining or partial draining of the water is complete harvesting. Catching of fish should be done in the morning when the weather is cool.

Avoid swimming or entering into the pond even when there is little amount of water, if it is not important enough.

The harvested fish should be cleaned and kept in shade and cool place. It should be covered by green leaf.

When fish are kept alive, they usually jump and move around causing injury and sore which lead to physical damage. To avoid this problem, the newly harvested fish should be kept in ice-water.

Partial harvesting : When only bigger and mature fish are caught partially and the remaining small fish are still rear to grow for another harvesting.

Fish has different growth rate and are not mature at the same point of time. The mature one should be caught and sell it in the market.

The same amount of fingerling can be release on the pond.

The bigger fish should be caught by using a drag net at 3-4 months interval and the same type of fingerling should be released in the pond again.

Partial harvesting programme should be synchronized with peak market demand when the price is high.

When harvesting is to be done, feeding should be stopped for about 2-3 day.

Topic 16 – Recap of previous day

Objectives :

Knowing the trainees understanding from the previous day training

Duration : 15 minutes

Expected outcome : Participants will learn scope of improvement from previous day learning

Module Plan

Topic	Content	Methodology	Process	Materials Required
Recap of previous day	* Gap analysis * Learning from previous day * Scope for improvement	Group discussion	Small group of 5 members each will be formed where the trainees will discuss the entire previous day topic with his/her partner. Quick recap will be done by representative of each group	Chart paper, Marker

Topic 17 – Documentary film on pig and poultry farming

Objectives :

To motivate the participants through best practice of successful farmer

Duration : 30 minutes

Expected outcome : Participants will learn the best practice done by successful farmer

Module Plan

Topic	Content	Methodology	Process	Materials Required
Documentary Film	Video clips on : * Pig farming * Poultry farming	Audio Visual Aids	Documentary film showing the success story of livestock farmer will be shown to the participants	LCD projector, Laptop

Topic 18 – Poultry farming

Objectives :

To enrich the knowledge and skills of the participants on Poultry farming

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on the scientific method of poultry farming

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Poultry farming	* Why poultry farming? * Record keeping *Procurement *Management : Housing, Feeding, Health, Disease * Vaccination schedule * Feed conversion ratio	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on poultry farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

With the increased in knowledge it seems that the needs for healthy food for humans also increased. We came to realized that we need lots of effort to meet our nutritional needs from chicken and eggs and also to increase our economy. Therefore, rearing poultry is increasing at a greater pace, it is not only a good source of income but also could meet our daily needs. In India among agriculture sector poultry rearing is one of the advanced sector. India is contributing 4% of egg production in the whole world, also 2% of chicken production in the whole world. We might think that our production is sufficient enough but the Nutritional Advisory Committee Government of India recommended 180 nos. of eggs and 111 kg of chicken to be consumed by per person per year. At present it is calculated that a person consumed only 45 nos. of eggs and 1.76 kg of chicken. Thus, this may show that we need to put more effort so that our country could get sufficient nutrition. Because of all these we need to know an overview of poultry management.

If we rear poultry one should be careful and should have a keen interest in it. Record keeping, construction of shed, chick selection, health management (vaccination, deworming, cleanliness and health), management, feeding and evaluation should be kept in mind.

There are different kinds of poultry. The common ones reared by Mizo are broiler and layer. Broiler is a chicken of 8-10 weeks old, 1.5-2 kg of weight, soft meat, reared for meat purposed. Layers are otherwise reared for meat and egg production.

Why poultry farming?

- Chicken contains many nutrients like proteins, minerals and vitamins.
- Chicken provides balanced diet for humans.
- Poultry attain market weight within a short period of time, so, it can be a source of income within a short time span.

- It is one of the important source of income for a family.
- It can add a source of income for a family.
- Eggs is required by all humans therefore, there is no problem for its market.
- Poultry faeces are a good manure.

Advantages of rearing poultry :

- It requires less capital for starting a poultry farm.
- Poultry rearing requires only 8-10 weeks to attain market weight.
- If there is sufficient place broilers and layers could be reared together at large numbers.
- Broilers needs less feeds for body growth so, they required less feeds.
- There is easy return of money in poultry farming.
- As compared to other meat chicken can be consumed by most people.

Selection of site :

- A well levelled place with proper sunlight and having sufficient space.
- It should be away from human habitat so as not to cause problems for others.
- It should have clean supply of water and also sufficient electric supply.
- It should have an easy access to raw materials and market to sell eggs.
- It should have enough space to increase the shed size.

Poultry rearing system :

1. **Deep Litter System :**
   The floor of the shed is covered with litter materials, which is very comfortable for the chicken and the faeces are absorbed by the litter material quickly.

2. **Cage System :**
   Cages with sufficient space for poultry are made where water and feeds can also be given. Suitable place for laying is also made for layers.

3. **Traditional system :**
   Traditional system of rearing is also good if sufficient and suitable place could be provided. The place should safe for the poultry keepers, suitable climatic conditions and should be free diseases.

Floor Space Requirement :

The fore space requirement differs according to the age and size of the poultry. The following are the floor space requirement:

Age	Small size poultry (sq. ft.)	Large size poultry (sq. ft.)
0-8 weeks	0.7	0.7
9-12 weeks	0.95	0.95
13-20 weeks	1.9	2.35
Above 21 weeks	2.5-3	3-4

Preparation of poultry shed :

- Brooder should be prepared before the arrival of the chicks.
- The whole shed should cleaned and disinfected with disinfectant. Eg: formalin ½ litre in 50 litre of water or fumigation should be done(20 $KMnO_4$ and 40 ml formalin).
- The shed should be cleaned before 1 week of the arrival of the chicks.
- Materials to be required should be in placed before the arrival of the chicks.
- The temperature of the shed should be adjusted and maintained at suitable degree for at least 24 hours before the arrival of the chicks.
- A foot dip containing $KMnO_4$ 1 gm in 100 ml water should be made at the entry of the shed to maintain sanitary.

Brooding :

Brooding period is the critical period so proper care should be taken.

Temperature required for brooding :

1 week	95°F (35°C)
2 weeks	90°F (32°C)
3 weeks	85°F (29°C)
4 weeks	80°F (26°C)
5 weeks	75°F (23°C)
6 weeks	70°F (20°C)
7 weeks	65°F (17°C)
8 weeks	65°F (17°C)

Brooding management :

Brooder should be maintained at suitable temperature at all times.

The temperature should be carefully checked during the arrival of the chicks, because they could suffer from deformities, tiredness and others.

The floor should be covered with paper for the first 4-5 days.

Chicks should be given glucose in their drinking water but too much of glucose can cause diarrhoea.

During the first 24 hours vitamin and mineral mixture should be given.

The brooder for the chicks should be placed on a paper and then it should be surrounded with chick guard.

During brooding it is better to use small size waterer and feeder, eg: 3 waterer and 3 feeder for every 100 chicks.

Duration for brooding :

For general broilers need 4 weeks and layers need at least 6 weeks for better result. It can also be change according to the outside temperature.

Care and management of growers :

Chicks from 8 weeks to 18 weeks or to the time they start laying eggs are called grower/pullet. When they start growing the size of the grower house also increases. Eg : For 900 cm^2(3 sq. ft.), 2 ft feeder, 2.5 cm waterer. After shifting of chicks from the brooder it is advantageous to provide light for 1-2 nights. After this, lighting is not required even at night. Grower Mash should be started for the chicks but this should be done gradually, grower mash should be given together with chick mash for about 4 days. Then, grower mash alone can be given. In the grower mash the protein and energy level is lowered to prevent over fattening of the chicks.

Care and management of layers :

At the age of 18 weeks or when the chick start laying the ovary start working, this gives lots of stress to the chick so proper care is required during this period. During this the chicks are more prone to diseases. Therefore, antibiotics, vitamins and calcium should be given. When they reach 18 weeks layer mash should be started to be given to the chicks. When they reach 20 days or when they reach 20 % egg production light should be increases to 16 hours. In a floor space of 100 sq. ft. 40 watt bulb should be kept at a height of about 6-7 feet. This increase in light duration can increase egg production. Layer needs 110 gm/bird/day feeds and 220 ml/bird/day water. In a year a layer approximately consume 40 kg feeds and 80 litres of water.

Feeding :

The health and growth of the chicks highly depends on the type of feds given. The feeds contain-protein, energy, vitamin, minerals in balanced proportion. Depending upon the age, type and breeds of the chicks the feeds are of different types, this should be kept in mind while buying feeds for the chicks. These day there a different types of feeds from different companies available at retail shop. These feeds may be of powder form or in pellet form but this does not effect the quality if the feeds. One have to keep in mind that depending upon the type of feeds and system of feeding the Feed Conversion Ratio can differ. It is necessary to be careful in selecting the type of feed as most of the cost for poultry farming is for the feeds.

Poultry feed is differentiated into two types :

A) Energy sources – eg : Vitamin, Jowar, barley oats etc..
B) Protein source – eg: Vegetable source (Mustard Oil Cake, Groundnut Cake, Soyabean) and animal source (Fish meal/Meat meal)

Different type of feeds :

1. Broiler ration :
    a. Starter ration (1 day-5 weeks)
    b. Finisher ration (5 weeks-market age)

2. Layer ration :
    a. Chick mash (1 day-6 weeks)
    b. Grower mash (6 weeks-20 weeks)
    c. Layer mash (from 20 weeks onwards)

- It is good to give lots of green vegetables, and during laying of eggs calcium should be given.

Age (weeks)	Water requirement (ml)
1	30
2	60
3	95
4	135
5	175
6	215
7	255
8	299
9	290

General signs of diseases :

- Weight loss
- Diarrhoea
- Paralysis
- Swollen leg
- Unable to move
- Dry feather
- Watery eyes and nostrils
- Dyspnoea
- Itchiness
- Falling of feathers

Care and management of sick poultry :

- To prevent spread of diseases the diseased chick should be separated.
- If the causative agent of the disease is a virus treatment is difficult so symptomatic treatment should be done.
- If the disease is of bacterial origin antibiotic should be given for at least 5-7 days.
- If it is of parasitic origin, deworming should be done, deworming should be given again after 21 days, this is necessary to kill all the parasites.
- If it is a deficiency disease, an expert should be approached.
- If they suffer from diarrhoea, they should be given tetracycline powder. Half a teaspoon of tetracycline power should be added in 1 litre of water and should be given for 5-7 days. The dosage differs depending upon the size of the chicks.
- The shed of diseased chick should be clean and tidy.
- The shed should get proper sunlight.
- Expert should be consulted for management of disease chick.

Vaccination Schedule :

Sl. No.	Disease	Vaccine	Time of vaccination	Route of vaccination	Duration of prevention of disease
1	New Castle Disease/Ranikhet Disease	Live virus F.D vaccine (Mild strain)	1-7 days	1 drop, eyes and nostrils	2-4 months
2	New Castle Disease/Ranikhet Disease	Live virus F.D vaccine (virulent strain)	6-8 weeks	0.5 ml S/C or I/M	1 years
3	Fowl pox	Fowl pox vaccine (live strain)	2 weeks	Feather follicle method or wing web method	2-3 months
4	Fowl pox	Fowl pox vaccine (freeze dried)	6-8 weeks	Feather follicle method or wing web method	1 year
5	Marek's disease	Herpes virus vaccine	1 day	S/C	lifetime

Feed conversion ratio :

It is necessary to know the feed conversion ratio of poultry. A stage can be reached where the chicks keep on consuming feeds but does not gain weight anymore, at this point the amount of feed consumed and body weight gain is not proportional anymore.

$$\text{i.e. F.C.R.} = \frac{\text{Total amount of feed consumed}}{\text{Total body weight gain}}$$

Value of less than 2.00 at 6 week of age is preferable.

Prevention of diseases :

Chicks are more prone to disease than other animal and their mortality is also usually high. Moreover, broilers and layers are more prone to diseases so, we should keep in mind that prevention is better than cure.

When poultry suffers from diseases there can be a loss in two ways. One is that if the chick died there is loss of the chicken and also the expense s of the feeds of the chick. The other is the expenses on medicines used during their sickness. So, it is important that one should know the different predisposing factors and causative agent of diseases.

The predisposing factors are :

- Low quality of feeds
- Improper feeding method
- Improper ventilation
- Unhygienic areas and practices
- Congested floor space
- Critical temperature

For prevention of diseases the poultry shed should be disinfected from time to time. The shed should be emptied for disinfection. When a batch of poultry is sold the shed should be disinfected before bringing in new batch. For disinfection the following should be practice:

1. The whole shed should be cleaned, if needed scrapping of the floor should be done and then clean it with water.
2. Feeder and waterer should be taken out.
3. Dust and left over feeds could be a good place for microbes to hide so they should be cleaned properly.
4. 3 days before disinfection the floor should be cleaned by sweeping the dust and faeces away.
5. The walls of the shed should be cleaned with soap/detergent.
6. The floor should be soaked with a mixture of half a litre of formalin and 50 litres of water.
7. After cleaning the shed and materials they should be soaked in disinfectant. after that fumigation should be done by using a mixture of potassium permanganate at the ratio of 2:3. It should then be sprayed with Aerosol, Kohrsolin 2:3
8. If the litter is to be used again it should be treated with disinfectant.
9. During fumigation for about 12 hours the shed should be closed.

For rearing healthy chicken it is our responsibility to take proper care and management. If proper care is not taken it will be just waste of time and money. For this there are some points to be noted, they are:

1. Only healthy and clean chick should be selected for rearing. Before arrival of new batches the shed should be kept vacant for at least 2 weeks, no one should enter the shed 2 days before arrival of the chick, it should be kept warm for 24 hours before arrival of the chicks.
2. For prevention of diseases vaccination should be given on time, the vaccine should also be bought from recognised company. Expire vaccine should not be used. The left over vaccine should be properly disposed.
3. The poultry shed, feeder, waterer should be cleaned thoroughly.
4. Only quality feeds and clean water should be given. Feeder and waterer should be cleaned before using the.
5. Proper observation of chicks, if there is any diseased chick. If there is diseased chick one should consult a veterinary doctor, soon after their recovery they should be sold. If there is a dead chick it should be taken out immediately and the reason should be enquired and post mortem may also be done. The body of the dead chick should not just be thrown away but should be disposed properly.
6. Only the poultry keeper should be allowed to enter the shed. There should be a foot dip at the entry of the shed. If possible there should be boots and apron.
7. The shed should be dry, the litter should also be dry. Birds and rodents should not be able to enter the shed.
8. The shed should be well ventilated and should get proper sunlight.

9. A good drainage system should be made. The faeces should be covered with straw to keep away flies.
10. If there is outbreak of diseases the litter and other materials should be treated with disinfectant. The walls and floors of the shed should also be covered with lime. The shed and the places around and the place where materials a kept should be disinfected at regular intervals.
11. The shed should be disinfected before bringing in new batches of poultry.
12. Record of Mortality rate, numbers of sold chick, medication and vaccination schedule, income and expenditure etc. should be maintained properly.
13. It is always advisable to give medicine according to expert.
14. Isolation shed for diseased chick should be made not very far away from the shed, where sick animals could be kept to prevent spread of diseases.
15. The healthy and diseased chick should not be taken care by one person.

Topic 19 – Pig farming

Objectives :

To improve the knowledge and skills of the participants on Pig farming

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on the scientific method of pig farming

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Pig farming	* Why pig farming? * Record keeping * Procurement * Management : Housing, Feeding, Health, Disease, Sow and Piglet * Vaccination schedule * Feed conversion ratio * Artificial Insemination	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on pig farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Pig is the most important livestock species for tribal population of Mizoram. It provide direct and indirect employment to the poor people, the direct cash return by sale of livestock and its product and the indirect return in terms of organic manure and fuel.

Why pig farming?

- Pig are prolific breeder, one sow can produced around 8-12 litter per farrowing.
- Pork is one of the most prefer meat in this region.
- Kitchen waste can be fed to the pig which reduces the cost of pig feed.
- The growth of pig is proportional to the amount of feed given.
- No part of the meat goes waste, almost all the part can be consumed one way or another.
- Pork contain high amount of protein.
- Labour cost involvement is moderately low.

Record keeping :

- Pig farmer should maintain good record book.
- The farmer should write in his/her diary date of purchase of piglet till the time of slaughter.
- Cost benefit analysis can be calculated if proper record keeping was maintained.
- The farmer should kept record of date of breeding, farrowing and weaning time in the record book.

Selection of piglet :

- The selected piglet should be from good quality breed with history of faster growth rate.
- The pig reared for fattening purpose should have good body conformation.
- Select a female piglet that will produce large litters of fast growing pigs capable of being fattened to marketable weights at the age of eight months.
- A desirable boar is larger for his age and heavier of bone than a gilt, he shows masculinity and ruggedness rather than feminity.
- AH & Veterinary department has piglet multiplication centre located at Selesih and Thenzawl.

Selection of site :

- The selected site should receive maximum sunlight.
- The pig has to get shelter from prevailing direction of the wind.
- There should be proper sanitation with good drainage system.
- The farm should be located nearby the road for easy accessibility.
- There should be sufficient supply of water.
- The site should have access to electricity.
- The farm should not be situated in an areas where there might be objection in future from neighbour.
- There should be sufficient land for plantation of tapioca, sweet potato and banana.

Importance of housing for pig :

- For protection against extreme climate condition.
- For maximum breeding management.
- For prevention of pig mortality.
- For prevention of outbreak of disease.
- For prevention against ecto and endo parasite infestation.

Floor space requirement of pig :

Breed	Floor space requirement (sq. m)	Open space requirement (sq.m)
Breeding boar	6.27 – 7.5	8.8 – 12.0
Pregnant sow	7.5 – 9.0	8.8 – 12.0
Dry sow	1.8 – 2.7	1.4 – 1.8
Fattening pig	0.96 – 1.8	8.8 – 12.0

Feeding of pig :

Proper feeding is an extremely important item of management since feed represents a very high percentage of the total cost of production of a pig. Pig grows at a very faster rate and thus the demand for feed are very high. A baby pig may weigh 1.4 kg when it is born and 163 kg by the time it reaches 18 months of age. Thus in 18 months it multiplies its weight by 120 times.

Pig is omnivorous, i.e. it can eat all types of feed. Although it likes to graze or chew forages but due to its nature of single stomach it cannot live entirely on roughages. The typical mouth and teeth of the pig which is different from ruminants, enable it to pick up feed from the

surface of the soil or to root it out from the ground. Incidentally pigs thrive best on feeds which are commonly used by human.

Pigs require different rations at different stages of life. As the pig grows older, protein, mineral and vitamin requirements in proportion to body weight significantly decrease. Animal protein in particular, is more indispensable for young than for the older animal and the ability of the pig to deal with roughages increases with age.

Different method of feeding pigs :

1) **Pre-Starter ration (Creep Feeding) :** The dry pre-starter feeds also known as creep ration or milk replacer are usually offered to the piglets when they are about of 2 kg body weight or 7-10 days old. This should be continued till piglets are weaned and weigh from 6.5 to 8.5 kg body weight. Piglets are used to encourage dry feed consumption as a means of supplementing the sow's milk.

Creep feed should contain about 20 % protein a major portion of which should be of animal origin. Moreover, the feed should have a more of minerals and vitamins with low fibre content and finally it should be highly palatable.

Creep mixture (Dr S.K. Ranjhan)

Ground yellow maize	40 kg
Skimmed milk	10 kg
Groundnut cake	10 kg
Til cake	10 kg
Wheat bran	10 kg
Molasses	10 kg
Fish meal	6 kg
Brewars yeast	2 kg
Mineral mixture	2 kg
Add. Vitamin (A, B2, D3)	10 gm
TOTAL	**100.00 kg**

2) **Starter ration :** The ration offered to piglets from the day of weaning to about 20 kg body weight. It is almost similar to the pre-starter ration except that the skim milk powder is replaced by either fish meal or meat meal. At some places where skim milk powder is available at cheaper rate, the pre-starter ration is continued.

3) **Grower ration :** After the pig have a good start and weigh about 20 kg, they should be switched from starter to grower diet as by attaining this body weight it has almost passed a nutritional critical period and after that they will do well on relatively simple ration. For some swine, producers use a mixture of starter and grower diet until the pig looks thrifty in appearance. The ration contains about 16% protein, having some percentages of animal protein and fibre.

Ingredients	10 Quintals (kg)
Common Salt	5
GNC	50
Maize	460
Mineral mixture	20
Mustard oil cake	95
Wheat bran	130
Rice polish	180
Meat meal	60

4) **Finisher ration :** When piglets grow about 35 kg body weight they are offered lighter, bulkier finishing ration for production of lean (bacon) carcasses. These ration contain lower level of animal proteins and energy.

Ingredients	10 Quintals (kg)
Common Salt	5
GNC	60
Maize	400
Mineral mixture	20
Mustard oil cake	75
Wheat bran	200
Rice polish	190
Meat meal	50

5) **Gestation ration :** An excellent, well-balanced diet is very important during gestation. Gilts have greater requirements than mature sows because their diet will have to take care of their growth as well as that of the developing foetus. Thus gilt need more feed per 100 kg of body weight.

Method of feeding :

Breeding period : 2 – 2.5 kg
Gestation period : 1.5 kg
3 or 4 week period prior to farrowing : 2.5 kg

If this level of feeding results in the animals becoming over-fat, it should be decreased. If, conversely, this level of feeding results in the gilts and sows becoming too thin, it should be increased accordingly.

Maize	50%
GNC	20%
Molasses	5%
Wheat bran	18%
Fish meal	5%
Mineral mixture	1.5%
Salt	0.5%

6) **Farrowing ration :** It is considered good practice to feed highly and with bulky feeds from 4-5 days before and after furrowing by substituting wheat bran, oats, ground legume hay or dehydrated lucerne meal. Make sure that there is good supply of fresh water at furrowing time.

7) **Lactation ration :** The feed requirements of the sow during lactation are considerably greater than during gestation. This is because the increase of nutrients required by the sow for milk production is greater than for producing young.

Approximate water requirements of pigs

Class of pig	**Water requirements (in litre)**
Growing pigs (weeks of age)	
8-12 13-18 19-24 25	3.5 6.0 7.5 8.0
Pregnant gilts and sows	
First 3 months Last 3 months	10-15 16-20
Lactating sows with	
5-7 piglets 8-10 piglets 11-14 piglets	20-25 22-27 28-35
Boars	20-25

Feeding systems and their effect on performance :

1) **Rationing System :** It can be divided into three types.

a) ***Ad lib* feeding :** This system, which can employ meal, cube and liquid forms, in labour saving in operation and allows the pigs to fulfil their full quicker growth potential. There is rather a lot of food wastage and comparatively lower efficiency of food conversion. The finished carcass tend to be rather fat.

b) **Restricted feeding :** The animals are given a measured amount of food once, twice or thrice a day. In general, the growth is restricted, but the efficiency of food conversion (EFC) is improved. The carcass grade well as there is generally a satisfactory lean:fat ratio compared to animals fed ad lib.

c) **Appetite feeding :** This is compromise between *ad lib* and restricted feeding. The pigs are given as much food as it is thought they can clear up in 15-20 minutes, and if some is left over, the next feed is made smaller. If all is cleared well before the end of 20 minutes, extra food is provided next time.

2) **Form in which the feed is presented :**

a) **Dry foods :** These can be either meals or cubes which may be fed either ad lib or restricted. The advantages of complete pelleted cubes over meals are slightly less waste, less dust in the house and slightly better food conversion rate. The disadvantage in feeding dry cubes is its higher cost.

b) **Wet foods :** The method involves mixing predetermined amounts of feed and water prior to or at the time of feeding. When properly used, this method can practically eliminate feed dust and minimise respiratory diseases.

3) **Ways of presentation of feed :**

a) **Trough feeding :** Trough can be used for restricted feeding of liquid, meal or pelleted feeds. All the pigs fed at one time and hence there should be sufficient trough space.

b) **Floor feeding :** The food material in the form of meal or cubes, is scattered on the floor once or twice a day. The method is recommended for pigs weighing more than 30 kg live weight.

c) **Self feeders :** These are usually constructed in the form of a non-spill trough with cross partitions so that only one pig can be fed in each division.

Feeding of pig should be done on routine basis – morning and evening. The following table shows the amount of feed require to be given in relation to the body weight.

Age (month)	Probable live weight (kg)	Amount of feed consumption per day (kg)
2-3	15-27	1
3-4	27-40	1.25
4-5	40-50	1.50
5-6	50-60	2.00
Above 6	60	2.50

External sign of estrus :

Most gilts reach puberty between at the age of one year or when they attain 80-90 kg body weight. The external sign of estrus include :

- Enlargement of the vulva 2 to 8 days before the onset of heat
- Reddened and swollen vulva associated with mucus discharge
- Behavioural changes including restless activity, mounting other animals both male and female and allowing mounting by other swine.
- Characteristic immobility response when pressure is applied to the back region.
- Reduction in amount of feed intake

Duration of heat : 2-3 days

Estrus cycle : 21 days (19-23 days)

Time of mating :

- Mature gilt : 2nd day of heat
- Young gilt : 1st day of heat

First sign of heat : 6-8 month

Sexual maturity age for boar : 8-12 month

Gestation period : 114 days

Care of pregnant sow :

1) Avoid frequent transfer of sow.
2) Provide adequate vitamins and minerals.
3) Provide 3-5 kg of good quality feed during pregnancy upto 60 days. But from 110 days onward, the amount of feed given should be reduced to 2 kg.
4) Deworm sows 10-14 days before farrowing.
5) Check the farrowing pen one week before the expected date of delivery. Provide guard rails and bedding to the farrowing house.
6) Feeding trough should be clean.
7) Keep close watch on sow.

Care during farrowing :

The average gestation period is 114 days (3 months, 3 weeks and 3 days). Keep close watch on sow prior to farrowing. The signs exhibited by pregnant animals approaching farrowing are :

1) Pregnant females become lethargy during last week of gestation. Most of the time they spend in the closed area. Pregnant female are found lying down in most of time in the chamber.
2) Feed intake goes down in the last week. On the day, pregnant female stop taking feed but consume water frequently
3) Frequent urination and mucus discharge.
4) Volume of mammary glands increases abruptly. Milk secretion starts on the day of farrowing.
5) Expulsion of water bag from the genitalia occurs just before farrowing.

At farrowing time, special attention should be given to the sow while allowing it to farrow by itself if the condition permits. Normally, the farrowing process completes in 3-4 hours. One or few foetus will be delivered in succession and there will be a small period of rest before delivering the next few. The placenta comes out within 1-6 hours of last piglet comes out. The placenta should be removed from the chamber as soon a it expels. Its consumption is detrimental to the health of the female.

Care of piglets just after farrowing :

a) Navel cord cutting : The umbilical cord on newborn piglets is the lifeline of piglets as it supplies oxygen, nutrients etc from mother and removes toxic materials from neonates. An aseptic cotton thread is tied on the navel cord at 2-3 cm away from its root. The loose end is cut and dipped into antiseptic solution like detol and iodine to avoid further spread of infection.

b) Cleaning : Clean the mouths and nostrils of the piglets immediately after their birth with clean cloth. The piglet unable to breath by themselves must be given artificial respiration or hanging upside down.

c) Brooding : The newborn piglet need slightly higher ambient temperature than sow to maintain normal body temperature. Brooding is very necessary during winter when outside temperature goes down. One 75 watt or two 50 watt electric bulbs could be hung from ceiling at the distance of one metre from the floor. The right temperature for piglets is shown by their behaviour. If piglets stay close to the sow or to the heat source or huddle together, the temperature is too low. If piglets stay close to the female but stay away from the heat source, then the heat source might be too high. If piglets are evenly distributed in the pen and in the brooder, then the temperature is just right. The brooder or creep area should always be clean, warm and dry.

d) Colostrum feeding : All of a newborn piglet's immunity (antibodies) comes from the sow through colostrums. These antibodies will be absorbed as such by the piglet and will enter its system forming a readymade antibody, resistance system for the piglet against all the disease. Besides, colostrums is highly nutritious, it is slightly laxative and prevents constipation.

e) Teeth clipping : The needle teeth are often clipped to prevent damage ot the udder of the sow and also to avoid fighting wounds among piglets. This can be done by cutting the sharp points of the teeth (8teeth, 4 in the upper jaw and 4 in the lower jaw) using a tooth clipper or nail cutter. The teeth should not be clipped too close to cause gums injury as this may cause bleeding with subsequent infection.

f) Castration : Castration is done to remove the testicle. It can be done as early as day old or 5-10 days of age when the animal have a good level of antibodies from the dam.

g) Iron injection : Colostrum does not contain all the nutrients require by piglet. So, iron injection must be given on 3^{rd} and 13^{th} days after birth.

Sign of illness :

- Change in physical appearance, behaviour and movement.
- The pig become lethargy. Most of the time they spend in the closed area. They are found lying down in most of time in the chamber.
- Reduction in feed intake.
- Abnormal body temperature.
- Abnormal respiration – rapid and slow.
- The pig makes typical grunting sound.
- Diarrhoea, constipation, blood in faeces and difficulty urination.
- Bleeding from vagina.
- Skin infection, abnormal shedding of hair.
-

Vaccination schedule of pig

Sl. No.	Name of disease	Schedule	
		Primary vaccination	**Regular vaccination**
1	Swine fever	6-8 weeks	Annually
2	Foot and Mouth Disease	4-8 weeks	6 months interval
3	Haemorrhagic Septicaemia	3 months	6 months interval
4	Swine erysipelas	10 weeks Booster : After 3 weeks	Annually
5	Brucellosis	2 months	-
6	Swine influenza	As per requirement	-

Artificial Insemination (A.I) in pig :

It is the deliberate introduction of sperm into a female's uterus or cervix for the purpose of achieving a pregnancy through in vivo fertilization by means other than sexual intercourse. It is a common practice in pig. In Mizoram, around 700 piglets are produced every month through artificial insemination. The success rate in the state is 70%.

The exact time of artificial insemination is one of the most important factor for successful conception.

- After three days onset of heat.
- After mucus discharge.
- Reddening of vaginal lip
- After the swollen vulva return to its normal shape.
- After characteristic immobility response when pressure is applied to the back region.

Advantage :

1) The use of selected superior quality breed through artificial insemination brings about genetic improvement in the herd.
2) Reduced risk of venereal diseases.
3) Low transportation cost.
4) Since the semen are carefully examine in laboratory, only good quality semen are use.
5) Overcoming physical inability.

Disadvantage :

1) Method of treatment of semen and preservation technique may lead to death of spermatozoa
2) Wanting skilled persons.
3) Fast spread of genetic abnormalities.
4) Boar semen can survive only for 4-5 days when stored at 16-17^{o}C.
5) Requiring special facilities.
6) The farmer has to know the exact time of onset of heat.

Topic 20 – Dairy farming

Objectives :

To improve the knowledge and skills of the participants on dairy farming

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on the scientific method of dairy farming

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Dairy farming	* Why Dairy farming? * Record keeping * Procurement *Management: Housing, Feeding, Health, Disease, Fodder, Lactating and Pregnant cow * Vaccination schedule * Feed conversion ratio * Milk hygiene * Artificial Insemination	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on dairy farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

One of the most nutritious foods for human is dairy milk. Our state is a young and backward state, it is poor in natural resources and we hardly have our own production, so, we lack nutritious food to meet our requirements. Therefore, milk is one of the nutritious food which we can produce to meet our nutritional needs.

Agriculture is the main source of income but because of our terrain and soil and for many other reasons the production cannot meet all our needs , so, we need to look for other source to meet our needs for this rearing animals is the other emerging option. Among rearing animals cattle rearing is a good source.

Why dairy farming?

- It is a reliable and good source of income.
- Milk is a nutritious food for humans.
- Cattle manure can be use for agriculture and bio gas production.
- Milk can be a daily source of income.
- Cattle skin can be used for various leather products.

Selection of dairy cattle :

- It should have an appealing and a feminine look.
- Bright and clear eyes, large nostrils and long nose.
- Straight back and wider rump area. Legs should be held strongly to the body and squarely placed.
- The front legs should be straight, the hind legs should be far apart from each other providing more room for the udder.
- The udder should be large and should not be loose from the body. The four quarters of the udder should be equally distributed. The skin of udder should be soft and pliable and should have lots of blood vessels.
- It should be purchased from a good owner.

Housing :

- The place for construction should receive proper sunlight where there is no stagnant water. The shed should be elevated from the ground.
- Construction of shed in north south direction can get better sunlight.
- The roof should be 3-4 metres high.
- The shed should be well ventilated.
- The floor should inclined a bit for easier cleaning.

A good farm record is very essential for a successful farm. It is necessary for rearing healthy cattle. The different farm record which we can keep are :

Farm Register :

Date	Cows		Bulls	Calves		Heifers bullock	Total	Milk yield		Addition during day		Deduction during day	
	Milch	Dry		Males	Females			A.M	P.M	No.	From where	No.	How

Insemination register :

Cow no.	Date of heat	Time of heat	Date and time of insemination	Due date of parturition	Date of parturition

Milk yield register, month :

Cow no./Name	Date of parturition	Date		Date		Date		Date	
		A.M	P.M	A.M	P.M	A.M	P.M	A.M.	P.M.

Vaccination register:

Date	Cow no.	Name of Vaccine	Date of vaccination	Date for booster

Calving register :

Cow no.	Due date of calving	Date of calving	Sire	Calf no.	Calf sex	Weight	Breed	Remarks

Daily feeding register, month :

Date	Cow no.	Concentrate (kg)	Fodder	Others

Floor space requirement :

	Floor space (square meter)
Calf	1
Heifer	2
Cow	3.5
Bull	4

Time of heat :

- Mature at the age of 15-18 months.
- After maturity it comes into heat at 21 days interval.
- If properly managed cows can come into heat after 45-60 days after parturition.

Signs of heat :

- The duration of estrus is 18-24 days. When it comes into heat the following signs take place.
- Restless and makes lots of noise, refuses to eat food.
- The milk production goes down.
- The vagina will be swollen and becomes reddish. Mucous will be secreted and will be moist.
- Sniffing of other cattle and even tries to mount others.
- Stood straight as if ready to be mount.

Timing of insemination :

(AM PM rule)

- If it comes into heat in the morning, it should be inseminated in the evening.
- If it comes into heat in the evening, it should be inseminated in the morning

Detection of pregnancy :

- Recording of time of insemination.
- 2-3 days after insemination, the cattle should be examined whether there is sign of heat or not.
- If there is no signs of heat, signs of pregnancy should be examined after 2-3 days if insemination.
- If the cattle is not pregnant, it should be inseminated again.
- If the cattle is not pregnant consecutively 3 times after insemination, veterinary doctor should be approached.
- Gestation period is 280-285 days.

Feeding :

- Cattle with milk production upto 2.5 litres should be given 1.5 kg concentrate, 10 kg fodder and 1.5 kg straw/hay.
- Cattle with more than 2.5litres of milk production should be given 1 kg concentrate more for every 2.5litres increase of milk production. Fodder can be given upto 30 kg.
- Concentrate should be moistened before feeding.

Care of cows :

Pregnant cattle

- Pregnant cattle should be given 1 kg concentrate more during the last trimester.
- Laxative food should be given 3-5 days before parturition.
- Mineral mixture should be given to prevent from milk fever.
- Should be shifted to calving pen 2 weeks before parturition. The calving pen should be clean and dry.
- The udder should be cleaned with warm water and the teats should be massaged to trigger for milk let down.
- Sufficient drinking water should be given.

Care during parturition

- Colostrum can be secreted from the teats.
- Vagina will be swollen and can be 2-6 times of the normal size.
- Restless and will try to kick its stomach.
- Appearance of vaginal discharge.
- One should be ready to help if there is any problem during parturition.
- If there is no delivery even after 4-6 days veterinary doctor should be approached.

Care after parturition

- Placenta should be discharged within 4-5 hours, if it is not discharged within 12 hour it is called retention of placenta.
- After parturition the vagina, tail and hind area should be washed with warm water mixed with Detol.

- The discharged placenta should be kept away immediately, if it is eaten by the cow it will reduce appetite and also milk production.
- Colostrum should be fed to the new born calf within 12 hours after parturition.
- After parturition feeding should be reduced, and should be increased after 2 days and from 14 days normal amount of feeds should be given.

Care of new born calf

- New born calf should be cleaned with clean and dry cloth.
- The mouth and nose should be checked for the presence of mucous and be cleaned.
- Hind legs should be lifted to let out water retained in the nose, mouth and lungs.
- The naval cord should be cut at 2-3 inches from the stomach and dip in tincture of iodine.
- The newborn calve should be allowed to suckle milk within 12 hours of parturition, it is essential for its immunity.

Care of calf

- Milk should be given 2 times a day.
- It can be given in a bucket also but the bucket should be clean.
- After 1 week of age concentrate and fodder should be given.
- If the calf is female brucellosis (S19) vaccine should be given at the age of 3-8 months.
- At the age of 3-4 months, weaning should be done.

Clean milk production

- Milking should be done 2-3 times a day.
- Should be milked regularly and at fixed timing.
- Milking should be done constantly and should be finished within 8 minutes.
- Milking should be done by the same person.
- Milking should be done in a clean place.
- Before milking the udder should be washed clean with antiseptic solution/warm water and then dry it thoroughly.
- The milker should not suffer from any communicable diseases, he should also wash his hands thoroughly before milking.
- Milking of sick animals should be done at the last.

Vaccination schedule :

Disease	Vaccine	Age	Dose (ml)	Duration of prevention	Booster
FMD	1. IVRI polyvalent cell culture vaccine	4 months	5-10 s/c	6 months	Every 6 months
	2. FMDV (Hoeschst)	4 months	5-10 s/c	6 months	Every 6 months
	3. FMDV (BAIF)	4 months	5-10 s/c	6 months	Every 6 months
	4. Indian Immunologicals	4 months	5-10 s/c	6 months	After 22 days, and again every 6 months
Brucellosis	*Brucella abortus* cotton strain19	4-8 months	5 s/c	Upto 2nd parturition	
Anthrax	Anthrax spore vaccine	4 months	1 s/c	1 year	
Black Quarter (BQ)	BQ vaccine (polyvalent)	4 months	5-10 s/c	1 year	
Haemorrhagic Septicaemia (H.S.)	H.S. oil adjuvant vaccine	6 months	2-3 i/m	1 year	
	M.S. broth vaccine	6 months	5-10 s/c	6 months	
H.S. and B.Q.	H.S. and B.Q. combined vaccine (BAIF)	6 months	4 s/c	1 year	
Rinderpest	1. Freeze dried goat tissue vaccine (GTV)	6 months(local breed)	1 s/c	14 months	
	2. Tissue culture vaccine	6 months (large breeds)	1 s/c	3 years	

COMMON DISEASES OF CATTLE :

1. Milk fever

- Calcium deficiency
- Within 48 hrs before and after parturition
- It is common at 3rd -7th pregnancy
- Cattle of 6-10 months are more prone to the disease.
- It can be differentiated into 3 types :

i) Restless, immobility of hind limb, ultimately lie down.

ii) Unable to stand, kinking of head towards the flank, body temperature drops, dilation of the pupils (mydriasis), reduce pulse, dry muzzle.

iii)Increased im heartbeat, death within 24 hr if left untreated

Treatment : Calcium borogluconate, vitamin B inj.

2. Calf scours

Etiology : *Escherichia coli (E. coli)*, extreme temperature, over suckling, vitamin A deficiency.

Treatment : Neblon powder, antibiotics

3. Bloat

Etiology :

Excess intake of green succulent plants, excess intake of proteins , intake of stale feeds .

Treatment :

- Trocarization can be done at the centre of the paralumber fossa to release the gas.
- Lavaging can also be done, the rumen content should be taken out and a rumen content from healthy animal should be inserted into the rumen.

Treatment : Bloatonil sups. Bloatosil susp. etc.

4. Foot and Mouth Disease (FMD)

Etiology : Virus – picorna virus

- Signs are visible after 12-14 hrs of infection.
- Fever , blister and vesicles in the buccal cavity and hoof area.
- Though it is not fatal it drastically decrease the production rate.

Treatment : Isolation, cleaning of shed with KMnO4, antibiotics, cleaning of the infected area with neem /$KMnO_4$

Prevention : Vaccine

5. Brucellosis

Etiology : *Brucella abortus*

Transmissible to humans (zoonotic)

Transmission : Vaginal secretion, placental discharge, infected milk, aborted foetus

Symptoms :

- Abortion at 5^{th} or 6^{th} month of pregnancy
- Abortion
- Retention of placenta
- The calf born as weak
- Reduce milk production
- No effect on general health
- Arthritis

Treatment : Antibiotics injection

6. Mastitis

Etiology : Bacteria, improper milking clogging of milk duct, excessive milk secretion, old cows.

Symptoms : Inflammation of the mammary gland, fever, presence of pus at the nipple, hardening of udder

Treatment : Intra mammary infusion with antibiotics, heat fomentation, swellnil oinment

Treatment : washing hands before milking, avoid inflammation of udder.

ARTIFICIAL INSEMINATION IN CATTLE :

Advantages :

- Promotion of superior breed quality.
- Safe from contagious diseases.
- Easy record keeping.
- Easy transportation
- Good quality semen can be preserved for future use.
- Good quality semen can be identified easily.
- Eliminates the necessity of rearing bulls.

Disadvantages :

- High chance of damaging semen while handling.
- Expert is needed.
- The vaginal area can be inflammed.
- Materials for preservation is required at anytime.
- It is not applicable in every places.

Topic 21 – Goat farming

Objectives :

To improve the knowledge and skills of the participants on goat farming

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on the scientific method of goat farming

Module Plan

Topic	Content	Methodology	Process	Materials Required
Training on Goat farming	* Why Goat farming? * Record keeping * Procurement *Management : Housing, Feeding, Health, Disease, Pregnant goat and kid * Vaccination schedule	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on goat farming through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Goat is generally considered as 'Poor man's cow' in India and is very important component in dry land farming system. It is a multi-purpose animal which provides milk, meat and hides. Due to its good economic prospects, goat rearing under intensive and semi-intensive system for commercial production has been gaining momentum for the past couple of years. Various banks as well as Government under various schemes provide financial assistance to the farmers and small entrepreneurs for starting goat rearing.

Why goat farming?

- Goat farming needs a low capital investment and quick return.
- Simple and small shed is enough due to small body size and docile nature.
- Goats are friendly animals and enjoy being with the people.
- Goats are prolific breeders and achieve sexual maturity at the age of one year.
- They can be sold and encashed anytime thus can be kept as a source of additional income.
- Goats consumes wide varieties of feeds and vegetation than either sheep or cattle.
- Goats can improve and maintain grazing land and reduce bush encroachment without causing harm to the environment.
- No religious taboo against goat slaughter and meat consumption.
- The goat meat is more lean (low cholesterol) and relatively good for people who prefer low energy diet.
- Goat milk is easy to digest than cow milk because of small fat globules.
- Goat creates employment to the rural poor besides effectively utilising unpaid family labour.

Farming system :

1) **Extensive system :**

- In this system, the goats are allowed to graze in the open yards during the day time and provides shelter during the night.
- It is used by nomadic people, usually in very low rainfall areas or during winter months when crop resides area available.

2) **Semi-intensive system :**

- It is used in places where less grazing lands are available with intensive feeding of goats with green fodders and concentrates after grazing.
- The advantages of this system are increased fertility of land via the return of dung and urine, control of waste herbal growth, reduced fertilizer usage and greater economic income.

3) **Intensive system :**

- The goats are fed in confinement with limited access to land.
- It involves high labour and cash inputs.
- It is preferred in the areas where no grazing land is available.

Intensive system can be divided into two types :

a) **Deep litter system :**

- Litter height should be at least 6 cm.
- Stir the litter material periodically to remove the foul odour in the pen.
- Replace the litter material once in every 2 weeks. Each goat requires about 15 sq. ft area.
- Care should be taken to reduce the external parasitic infestation.

b) **Raised Platform system :**

- Wooden plank or wire mesh is placed about 3-4 ft from the ground level.
- External parasitic infestation is usually less in this method.

Housing types :

- Construct shed on dry, properly raised ground and protected from strong winds.
- The shed should received adequate sunlight and good air circulation is necessary.
- An East-West orientation ensures cooler environment.
- A shed with 6 ft length, 2.5 ft breadth and 6 ft height is enough for rearing two goats.
- Shed for kid must be constructed nearby the goat shed.
- For does and kids, floor space requirement is 7 sq. ft.
- Slatted floors are preferred for easy removal of dung and urine.
- Use locally available inexpensive materials for roofing.
- Avoid over stocking or crowding.
- Provide proper shade and cool drinking water in summer.
- Dispose of dung and urine properly.

Floor space requirement for goat :

Category of goat	Floor space requirement (sq.m)
0 – 3 month	0.5 – 1.0
3 – 6 month	1.0 – 2.5
6 – 12 month	2.5 – 3.5
Adult bucks	5
Adult does	6.5

Breeding management :

For a profitable goat farming, there should be three kidding in 2 years, by adopting optimal management conditions.

- Sound breeding policies are central to the success of any goat enterprise.
- Goats of good conformation will be productive over a long lifetime.
- Use goats with faster growth rate with good conformation for breeding.
- Does of one year of age should be used for breeding.
- Does should be bred after 3 months of kidding to crop 3 kidding in 2 years.
- One buck is suitable for 25 does in one breeding season.
- Goats come into heat at the age of 14-18 months.
- Goats come into heat or estrus approximately every 18-21 days and the heat will last for 24-72 hours.
- Buck can be used for breeding purpose after one year.
- The symptoms of does in heat are – vocal and some bleat very loudly, constant tail wagging, slightly swollen and reddened vulva, wet and dirty look in the area around the tail due to vaginal discharge, decreased appetite, an increase frequency of urination. Doe in heat ay mount another doe or let another doe mount her.
- Breed the animals 12-18 hours after the onset of the firts symptoms of heat for maximum conception.
- Gestation period is approximately 145-150 days.

Feeding practices :

A goat does not like to graze on the ground like a sheep or cow. They prefer browsing on bushes. It is noted that a goat generally produces more milk than a cow from the same quantity of nutrients. If sufficient green fodder is given, goat does not drink much water. The goat can be let loose in grazing land for about 8-6 hours everyday. After the goat return from field, they can be fed salt, wheat, maize and oil cake.

Category of goat	Feed ingredients	Daily amount to be fed
Birth to 3 days	Colostrums	Ad libitum
3 days to 3 weeks	Whole milk or replacer, Water and salt	450 ml Ad libitum
3 weeks to 4 months	Whole milk Creep feed, Water, salt and lucerne hay	450 ml 450 gm daily Ad libitum
4 months to freshening	Concentrate mixture	15-16% Crude Protein @ 450 gm
Dry pregnant	Concentrate mixture Lucerne, hay, water, salt	15% Crude Protein @ 400-500 gm Ad libitum
Milking doe	Concentrate mixture Lucerne, hay, water, salt	15% Crude Protein @ 400-500 gm Ad libitum
Buck	Only pasture Concentrate mixture	Non-breeding season @ 400 gm daily at breeding season

Feeders :

The wastage and contamination of feed with faeces and urine have been the major problems in goat farming. The rectangular and hexagonal feeders are useful for feeding green roughage, straws and concentrates.

Water troughs :

Water troughs must be maintain properly. They should be covered and require regular cleaning as the contaminated water is an important source of infection.

Gestation period and duration of heat :

Goat come into heat at the age of 14-18 months. However, buck should be used for breeding after two years only. The duration of gestation period ranges from 145-150 days. Normally, the average number of kid is two. The life span of goat is twelve years. Adult buck can be used for breeding up to 8-10 years old.

Time of slaughter :

For meat purpose, castration of male should be done at the age of 2-4 weeks. This will enhance the growth rate and body weight. The goat can be slaughter after one year if feeding was done properly. The weight of adult goat differs from place to place. In Mizoram, adult goat weight 10 kg, however, in other place it may ranges from 50-70 kg. Some goat may produce 1-2 litre of milk and some may produced 2-3 litres milk.

Common diseases of goats and its treatment :

1) **Foot and Mouth Disease (FMD) :** This disease have shown mild effect in adult goats. Vesicles on the tongue, lips, cheeks, gums, dental pad and on the skin between claws, occasional blisters on teats. Lameness is also seen in adult goats. Isolate the sick goats and vaccinate the herd at the face of outbreak. Wash the mouth of infected goat with mild detergents like Alum, Potassium permanganate. Apply boroglycerine on the ulcers.

2) **Skin infection :** The disease is mainly caused by mange/mites. The affected animals suffer from severe skin infection, reddening and itching. The disease is associated with decreased appetite and secondary bacterial infection. Apply skin ointment or antibiotic injection is preferable.

3) **Contagious Caprine Pleuro Pneumonia (CCPP) :** The affected animal suffer from pneumonia. Treatment includes antibiotic and antipyretics. Care should be taken regarding construction of shed. Avoid wet location and windy areas.

4) **Contagious Ecthyma :** The disease is caused by pox virus, vesicles appear on the lip. After vesicles containing pus, dry crust is formed. Treatment includes application of ointment in affected areas and antibiotic injection. Wash the mouth of the infected goat with mild disinfectant daily

Vaccination Schedule of Goats

Sl. No.	Name of disease	Route	Time of vaccination	Duration of immunity
1	Haemorrhagic Septicaemia	I/M (single dose)	June/July	1 year
2	Enterotoxaemia	S/C (1st dose then booster dose after 10 days)	On pregnant stock : 1 month before kidding In kids : 3 months of age	6 months
3	Clostridial infection	S/C (single dose)	June/July in adult stock	1 year
4	Black Quarter	S/C (1st dose then booster dose after 14 days)	June/July	1 year
5	Anthax	S/C (single dose)	June/July	1 year
6	Foot & Mouth Disease (FMD)	S/C (single dose)	October/November and April/May	6 months
7	Rinderpest	S/C (single dose)	June/July	5 years
8	Lungworm	Orally (1st dose then 2nd dose after 10 days)	-	1 year

Topic 22 – Mahila Kisan Sashaktikaran Pariyojana (MKSP)

Objectives :

Understanding the vision, concept and objectives of MKSP

Duration : 30 minutes

Expected outcome : Participants will develop understanding and awareness on vision and objectives of MKSP

Module Plan

Topic	Content	Methodology	Process	Materials Required
MKSP	* Background * Objective * Vision * Non-negotiable for MKSP proposal * NTFP * Linkage with SHG's * Impact of MKSP : Economic, Social, Environmental	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on MKSP through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Context & Background :

Finance Minister (FM) announced a scheme "Mahila Kisan Sashaktikaran Pariyojana" (MKSP) in the union budget 2010-11 for empowering the women farmers to be implemented by Ministry of Rural development (MoRD) as a sub component of Aajeevika (National Rural Livelihood Mission), which is a major initiative to strengthen women' institution and capacitate them for empowerment.

The Vision :

MKSP, as a subcomponent of NRLM, primarily aims at empowering women in agriculture and other primary livelihood activities by strengthening community institutions of poor women farmers and leverage their strength to promote sustainable practices in agriculture (NPM/IPM), NTFP and other primary livelihoods. MoRD had organized several rounds of consultations with the stakeholders like NGOs, State Governments and other practitioners at national and regional level to design the program.

The main focus is to strengthen the primary livelihood of poorest of poor households through women led initiatives. In this regard MKSP forms the platform through which some good initiatives by various organizations can be scaled up on ground on a substantial scale. This in turn will give rise to promotion of best practices and creation of trained human resources and social capital from community who can be the agents of change to propagate successful models and practices around primary livelihood activities.

MKSP is envisaged to ensure that a large number of scalable models across the country are created in agriculture livelihoods with the help of NGOs, CBOs and other government agencies. The learning from these models would be scaled up by the SRLMs. It has also been decided that MKSP, as a large size demonstration of sustainable practices, may be seeded in as many states as possible.

MKSP Themes for various livelihood promotion :

MKSP, during inception, was planned for sustainable agriculture alone, but it has been planned to extend the scope of MKSP in new themes. Two themes that have been operationalized so far are Sustainable agriculture and Non Timber Forest Produce (NTFP) based livelihood. Small ruminant based strategies are also being integrated with agriculture and NTFP based livelihoods. However, under all the themes of MKSP, interventions aiming at securing food and nutrition security of poor and poorest of poor households remains as the cross cutting agenda.

The core outcomes expected out of MKSP are :

(i) Linking all poor women farmers to generic institutions of poor (SHG & their federations)

(ii) Sustainable livelihoods institutions of women around agriculture and NTFP

(iii) Sector-specific & geography-specific best sustainable package of practices and

(iv) Wide pool of community resource persons available for scaling up livelihood interventions in the entire country

Out of all these Sustainable agriculture theme is the first one to have been introduced in the year 2010-2011 and envisaged as a core theme as agriculture is a major part of the livelihood basket of rural poor in India. It is also one of the key components contributing to household food security. However with introduction of every new theme it is envisaged that under MKSP it will be an integrated approach for securing the primary livelihood baskets of poorest of poor households and giving recognition to women as farmers and key bread earner of her family.

DESIGN PRINCIPLES AND NON NEGOTIABLES FOR MKSP PROPOSALS

- Strong Community institutions of Women farmers and NTFP collectors
  - **Sustainable Agriculture**
    - Low cost sustainable practices such as NPM/ IPM/ Integrated Nutrient Management
    - Mitigation of risk of exposure to hazardous farm practices
    - Soil Health improvement
    - Soil & water conservation and ground water recharging
    - Bio-diversity enhancement - poly cropping, multi-layer farming etc
    - Use of indigenous knowledge
    - Resource Management
    - Suitability of technology to the local agro-ecology
    - Resilience to climate change – Integrated Natural Farming
    - Promoting and enhancing food and nutritional security at Household and Community level

- Drudgery reduction for women farmers
- Focus on landless, small and marginal farmers as project participants.

NTFP non negotiable

- Ensure a better control of the institutions of the poor women NTFP collectors over the NTFP value chain in a sustainable manner
- Promote regeneration of NTFP species to improve the bio diversity and enhanced productivity
- Build the capacity of the community in modern harvesting and post harvesting techniques to increase their income
- Promote value addition of NTFP to ensure higher returns
- Develop market linkages for NTFP

With the above vision, MKSP is now being rolled out across various geographic pockets of India in partnership with Govt. and Non government agencies.

How is it linked to SHGs?

NRLM envisages bringing all the poor women within the institutional ambit of SHG and MKSP is no exception. Under MKSP all the poor 'Mahila Kisans' who have been covered will be members of SHGs and it is also expected that the Mahila Kisans will form producers' organizations around various livelihoods. The whole idea is to create a strong synergistic relation between the generic institutions (SHG and their federations) and the producers' organizations so that they complement each other.

What impact is it creating?

The major impacts expected out of MKSP are three fold :

Economic Impact :

1. Key focus of MKSP is on increase in income. It is expected that income of each Mahila Kisan would increase by more than 50% by reduction of cost, through improved productivity and through better realization of prices by market linkages.
2. MKSP promotes community managed sustainable agriculture practices where we envisage a substantial reduction in the use of chemical pesticide and fertilizers. The poor communities are subject to a variety of health hazards due to the exposure to chemical pesticide/fertilizer and there is a huge direct and indirect benefit in eliminating such health hazards. The cost of health care would come down drastically by adopting natural methods of farming and plant protection.
3. A large number of Community Resource Persons (CRP) will be made available at the village level delivering extension services to the poor Mahila Kisans which would again have direct impact in productivity and cost reduction. These CRPs would operate through a fee based model and the possibilities for employment generation for rural poor are thus very significant. Each habitation would have several CRPs for sustainable agriculture, livestock, NTFP etc.

Social Impact :

1. This is the first time a concerted effort has been made to recognize the role of women in agriculture and investment is being made to build their capacity to take lead in agriculture activities. The producers' organizations that would emerge under MKSP have women at the helm of affairs and adequately empower them to take critical decisions on important livelihood activities.

2. MKSP would have a very strong impact on gender sensitization of agriculture. UN WOMEN is working with MoRD to develop tools and techniques to bring in gender sensitive approaches in MKSP.

3. MKSP has a clear strategy to include poor and poorest of the poor by promoting land leasing by landless Mahila Kisan. MKSP is also promoting successful models specifically targeted to the poor so that they get an income of Rs 20,000 - Rs 50,000 from half an acre of land.

4. One of the key objectives of MKSP is to reduce the drudgery of women engaged in agriculture by introducing women friendly tools and implements. This will surely bring significant change in the quality of life for Mahila Kisan.

5. MKSP is focused on ensuring food and nutrition security where best practices are replicated in promotion of kitchen gardens, seed banks for locally available vegetables and fruits. Besides, ensuring household food security is an area where MKSP is fully committed and continuous efforts are being made towards sensitizing poor households to grow food crops rather than cash crops.

Environmental Impact :

1. MKSP would go a long way in greening rural development by promoting environmentally sustainable practices in primary livelihoods; preserving bio-diversity and promoting climate change resilience.

Topic 23 – Integrated Farming System (IFS)

Objectives :

To impart the knowledge of Integrated Farming System and generate income through farm and off farm activity and maximum utilisation of all resources available

Duration : 45 minutes

Expected outcome : Participants will develop understanding and awareness on Integrated Farming System for maximum utilisation of all resources available

Module Plan

Topic	Content	Methodology	Process	Materials Required
Integrated farming system	* What is integrated farming system? * Benefit of integrated farming system * Integration of livestock with crops * Integration of fish farming with pig/dairy farming * Construction and management of fish pond * Selection of fingerlings * Construction of pig sty	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on on Integrated farming system through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Meaning of Integrated Farming System :

Fish farming along with rearing of livestock side by side is a low cost practice but a good source of income. Even in Mizoram there are many villages rearing various livestock. Therefore, without much effort and extra space one can practice fish farming in coordination with rearing of pig, poultry, duck, cattle etc. This method of fish farming along with rearing of livestock is known as "Integrated Farming System".

Objective :

The main objective of Integrated Farming System is better utilization of available land without extra manpower and money to bring more fish produce and better income for the farmers. The farmers get maximum amount of production from a plot of land.

Fish farming and piggery farming :

In Mizoram, pork is the most popular meat and the demand is very high, for those farmers who have a suitable land with fish pond this method will be very beneficial. Self help Group members will also be able to practice this method without spending much time and effort. With the increasing population the demand for healthy food also increases, so, this will be very beneficial to meet one's needs.

Fish farming and poultry farming :

Poultry rearing is a low cost investment which could be practice by SHG members. Poultry meat and even egg is very crucial for our everyday meal. Even in Mizoram the number

of SHG members rearing poultry has increased. For those farmers who have a fish pond rearing poultry along with it will be very beneficial for them.

Why practicing fish farming and piggery farming :

- Pig manure contains lots of nitrogen and phosphorus which can make the soil fertile.
- When the pig manure is added to the pond it makes the soil of the pond fertile which further incredibly increases the fish's feeds (plankton) in the pond.
- 70% of pig manure can be directly eaten as feeds by the fishes,
- As pork is highly demanded by Mizo there is no problem for pork market,
- Additional feeding of fishes is not required if fish farming is done along with pig rearing.
- Pig feeds waste could be used as feeds for the fishes so, there is no waste of feeds.
- Fertilizer is not needed to increase the soil fertility.
- 60% of the cost for fish farming can cut down if fish farming is done alongwith pig farming.

Why practicing fish farming and poultry farming :

- Poultry manure contains more nitrogen and phosphorus than pig manure.
- Large amount of poultry manure is not needed to increase the pond's soil.
- If poultry is properly managed they give out more manure which further gives lots of nutrients for the fishes.
- Poultry manure is a good source of feed for the fishes and also the leftover of poultry feeds could be a good source of nutrients for the pond's soil which gradually increases planktons in the pond.
- Feeding of fishes is not required so, the cost for fish farming could be lowered by 60%.

Construction of fish pond :

- For better production is it is necessary to construct the fish pond according to the expert.
- The fish pond should have sufficient amount of water, the source of water should be sufficient and available all the year round.
- The size of the fish pond should be constructed as per the capacity of the SHG members, so, than they can managed it efficiently.
- If the soil of the pond is very acidic or vey alkaline the growth of the fishes will be very slow.
- The pH of the soil of the pond should be 6.5-7.5
- If the acidity if the soil is below 6.5 it should be made alkaline by adding lime to the pond.

Treatment of soil by lime :

pH range	Acidity	Amount of lime to be added
4.0-5.0	Extreme acidic	2000 kg/ha
5.0-6.0	Very acidic	1200 kg/ha
6.0-7.0	Acidic	1000 kg/ha
6.5-7.5	Normal	400 kg/ha

- Lime is good for balancing the acidity of the soil, for water purification and also for killing an unwanted microbes.
- Half of the lime to be added to the pond should be added before releasing the fishes to the pond.
- The remaining lime should be later added 3-4 times.
- The weeds in the fish pond should be removed.
- Fishes of different breeds have different areas of feeding so, it is very beneficial to rear these different breeds of fishes to increase harvest. Fishes which could be reared together are: Silver carp, Catla, Rohu, Mrigal and Common carp.
- In 1 ha of pond 6000 fingerlings could be reared.

Construction of pig sty :

- The pig sty should be constructed near the pond so then the faeces and urine could be easily collected and spread to the pond.
- If the floor of the pig sty is wood a pit should be dug behind the sty for collection of faeces and urine.
- If the floor of the sty is cement the floor should be inclined so that the faeces and urine can be collected easily in the pit.
- The sty should get proper sunlight and it should be properly ventilated.

Construction of poultry shed :

- Poultry shed could be constructed above the pond or on the edge of the pond.
- For construction of poultry shed bamboo or any other cheap materials could be used.
- The poultry shed should not be too closed but should be airy and get proper sunlight.
- The floor can be constructed with a net or bamboo leaving space in between.
- The manure of the poultry should easily fall inside the pond.
- Feeder and waterer should be kept in the shed.
- The shed should be constructed at least half a metre above the water.

Maximum harvest :

- Fish farming along with poultry/piggery farming makes sufficient feeds available for the fishes which increases the growth rate of the fishes.
- The bigger fishes should be caught and sold at the earliest.
- If the bigger fishes are caught the same amount of fingerlings could be added.
- The pigs reared could reached 60-70kg after seven months.
- The practice of rearing pig for over a year should be stopped as it is not profitable anymore to rear pigs after 7-8 months.
- Eggs of poultry could be collected every morning and evening and could be sold to make a daily income.
- Layers could lay eggs upto one and a half year at a profitable rate and it is better to sell the layer after that.

Advantage of fish farming and piggery rearing :

- As the fishes and pigs could rely on each other the cost for fish farming could be reduced to 60% .
- Within a year a farmer can yield matured pigs and in 1 ha of fish pond 3-4 tones of fishes could be yield.

Advantage of fish farming and piggery rearing :

- A layer could lay 250-280 eggs in a year.
- Broilers could be sold after 2-3 months and they could be 1.5-2kg.
- In a year 6 batches of broiler could be reared.
- When fish farming is done together with poultry farming one can yield the following:
    - Fish : 4500-5000 kg
    - Chicken : 1250 kg
    - Eggs : 70000 nos.

Topic 24 – Exposure visit to best practice site

Objectives :

Exposure to best practice site (Livestock, Agriculture, Horticulture) to aware the participants of the best practice within the state/district

Duration : 1 day

Expected outcome : Participants will develop understanding and awareness on best practice on farm and off farmed based activities

Module Plan

Topic	Content	Methodology	Process	Materials Required
Field Visit	* Visit to best practice site on : - Sustainable Agriculture - Farm school - Horticulture - Livestock - Soil testing - Vermicompost unit - Seed treatment - Pest management - Nutrient management - Kitchen gardening - Sericulture - Fish pond	Field trip	Vehicle will be hired to visit the best practice site within the district/state	Vehicle

Topic 25 – Recap of previous day

Objectives :

Knowing the trainees understanding from the previous day field visit

Duration : 45 minutes

Expected outcome : Participants will develop understanding and awareness on best practice on farm and off farmed based activities

Module Plan

Topic	Content	Methodology	Process	Materials Required
Recap of previous day	* Gap analysis * Learning from previous day * Scope for improvement	Group discussion	Small group of 5 members each will be formed where the trainees will discuss the entire previous day topic with his/her partner. Quick recap will be done by representative of each group	Chart paper, Marker

Topic 26 – Documentary on non-farm based activities

Objectives :

To motivate the participant to adopt new technology practice by others

Duration : 30 minutes

Expected outcome : Participants will learn the best practice done by successful farmer

Module Plan

Topic	Content	Methodology	Process	Materials Required
Documentary Film	Video clips on non-farm based activities	Audio Visual Aids	Documentary film showing the success story of non-farm base livelihood will be shown to the participants	LCD projector, Laptop

Topic 27 – Skill enhancement : RSETI & DDU-GKY

Objectives :

To aware the participants of the various training and skill enhancement available under NRLM

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on skills enhancement available under NRLM

Module Plan

Topic	Content	Methodology	Process	Materials Required
Skill enhancement - RSETI, DDUGKY	* Objectives * Trades skill training * Business plan preparation	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on various schemes available under NRLM through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Rural Self Employment Training Institute (RSETI) :

Objectives :

i. Rural BPL youth will be identified and trained for self-employment.

ii. The trainings offered will be demand driven.

iii. Area in which training will be provided to the trainee will be decided after assessment the candidate's aptitude.

iv. Hand holding support will be provided for assured credit linkage with banks.

v. Escort services will be provided for at least for two years soon to ensure sustainability of micro enterprise trainees.

vi. The trainees will be provided intensive short-term residential self-employment training programmes with free food and accommodation.

Concept :

Lakhs of youth are entering the job market every year after completing their school/collegiate education. Non-availability of corresponding employment opportunities in the organised as well as unorganised sector has increased unemployment. The entry of automation and mechanization in every sphere of commerce and administration due to the advent of science and technology has further accentuated the problem.

On the rural side, the employment potential in agricultural economy also appears to have reached a saturation level leading to large scale migration of manpower from rural areas to urban areas adding woes and pressure to already over strained civic infrastructure. Millions of unemployed youth particularly from rural and semi-urban background who could not access

higher professional education but oriented towards white collar jobs are driven to despair for not finding a job.

Of late, these distressed youth are attracted towards antisocial activities for their livelihood. This tremendous waste of human resources and mismatch of potentiality with productive deployment has baffled the planners and administrators. The situation calls for urgent steps to provide increased employment opportunity in the rural and semi- urban areas itself to check the shifting of resources resulting in improved economic status. All these clearly indicate the need for promoting self-employment entrepreneurial ventures among the unemployed youth and women

Of late, Government and Non Government agencies have taken certain initiatives and implementing many schemes to promote micro enterprises. However, the efforts seem to be inadequate against the gigantic unemployment problem. An innovative initiative was taken way back in the year 1982 jointly by Sri Dharmasthala Manjunatheshwara Educational Trust, Syndicate Bank,Canara Bank to motivate unemployed youth to take up self-employment as an alternative career.

The unique experiment of building confidence of the youth by developing skill and positive attitude among them through dedicated training was found effective. The model has proved very successful in building the morale of the youth and empowering them to set up self-employment ventures in their own places. The project reported a success rate of 66 per cent RUDSETI model was appreciated by Government of India, State Governments, SIDBI, and NABARD. Replication of this model was recommended to tackle the unemployment problem successfully and developing entrepreneurship.

Executive Summary :

In the context of the need for promoting self employment for the unemployed rural youth, particularly those below the poverty line, and periodic skill up gradation to keep them abreast of latest technologies, need not be overstated. Once trained appropriately, the youth will launch profitable micro-enterprises and enhance their own standards of living and thereby contribute to the overall national economy.

The joint of Sri Dharmasthala Manjunatheshwara Educational Trust, Syndicate Bank and Canara Bank in 1982 near Dharmasthala in Karnataka suggests that if rural BPL youth are imparted necessary skills and provided hand holding support, a significant proportion of them could set up viable self-employment activities.

Appreciating the rationale to up-scale such development support to rural BPL youth country wide, the Ministry of Rural Development (MoRD) has proposed a new, national scheme called RSETI. Under this, the MoRD will provide a one time grant of Rs. One Crore to the lead bank in every district to set up one RSETI. The public sector / private sector banks will be set up and run these institutions with the active support from state government. The RSETIs will provide intensive short-term residential training in trades that enjoy market-acceptance and extend them hand holding support in availing bank credit.

Land for setting up the RSETIs will be allotted to the concerned Banks, free of cost, by the State Governments. The construction of the building for the RSETIs will be undertaken by the concerned Bank, Trust/Society. In case the banks so desire they may request the State Government for assistance for construction.

A national level steering committee headed by the Secretary, Ministry of Rural Development and a state level sub-committee under SLBC will ensure the grounding of the institutes in all the rural districts of the country.

A 'Local Advisory Committee' (LAC) at the Institute level under the leadership the Chairman and Lead district Manager, District Development manager, and the members of NABARD, GM, District Industries Centre, PD, DRDA, the Employment Exchange Officer, heads of vocational institutes in the district like ETCs, ITIs, Polytechnics, KVKs etc. will guide the RSETI in realizing its objectives.

Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY) :

Deen Dayal Upadhyaya Grameen Kaushalya Yojana or DDU-GKY is a Government of India youth employment scheme.

It was launched by on 25th September, 2014 by Union Minsters Nitin Gadkari and Venkaiah Naidu on the occasion of 98th birth anniversary of Pandit Deendayal Upadhyaya. It aims to target youth, under the age group of 15–35 years. A corpus of Rs 1,500 crore and is aimed at enhancing the employability of rural youth. Under this programme, disbursements would be made through a digital voucher directly into the student's bank account as part of the government's skill development initiative

Enable Poor and Marginalized to Access Benefits :

- Demand led skill training at no cost to the rural poor

Inclusive Program Design

- Mandatory coverage of socially disadvantaged groups (SC/ST 50%; Minority 15%; Women 33%)

Shifting Emphasis from Training to Career Progression

- Pioneers in providing incentives for job retention, career progression and foreign placements

Greater Support for Placed Candidates

- Post-placement support, migration support and alumni network

Proactive Approach to Build Placement Partnerships

- Guaranteed Placement for at least 75% trained candidates

Enhancing the Capacity of Implementation Partners

- Nurturing new training service providers and developing their skills

Regional Focus

- Greater emphasis on projects for poor rural youth in Jammu and Kashmir (HIMAYAT),
- The North-East region and 27 Left-Wing Extremist (LWE) districts (ROSHINI)

Standards-led Delivery

- All program activities are subject to Standard Operating Procedures that are not open to interpretation by local inspectors. All inspections are supported by geo-tagged, time stamped videos/photographs.

Beneficiary Eligibility :

- Rural Youth :15-35 yrs
- SC/ST/Women/PCTG/PWD : upto 45 yrs

Implementation Model :

DDU-GKY follows a 3-tier implementation model. The DDU-GKY National Unit at MoRD functions as the policy-making, technical support and facilitation agency. The DDU-GKY State Missions provide implementation support; and the Project Implementing Agencies (PIAs) implement the programme through skilling and placement projects.

Project Implementing Agencies (PIAs)

Necessary Conditions & Eligibility Criteria :

- Registered under Indian Trust Acts or any State Society Registration Act or any State Cooperative Societies or Multi - State Cooperative Acts or the Companies Act 2013 or the Limited Liability Partnerships Act 2008 OR Government or a semi - government organization at the State and National Level
- Existence as an operational Legal Entity in India for more than 3 financial years (Not applicable for NSDC Partners)
- Positive Net Worth for atleast 2 out of last 3 financial years (Not applicable for NSDC Partners)
- Turnover in excess of at least 25% of the proposed project

In funding projects, priority is given to PIAs offering :

- Foreign Placement
- Captive Employment : Those PIAs or organizations that take up skill training to meet internal ongoing HR needs
- Industry Internships: Support for internships with co-funding from industry
- Champion Employers: PIAs who can assure skill training and placement for a minimum of 10,000 DDU-GKY trainees in a span of 2 years
- Educational Institution of High Repute: Institutes with a minimum National Assessment and Accreditation Council (NAAC) grading of 3.5 or Community Colleges with University Grants Commission (UGC)/All India Council for Technical Education (AICTE) funding willing to take up DDU-GKY projects.

Project Funding Support :

DDU-GKY provides funding support for placement linked skilling projects that address the market demand with funding support ranging from Rs. 25,696 to over Rs. 1 lakh per person, depending on the duration of the project and whether the project is residential or non-residential. DDU-GKY funds projects with training duration from 576 hours (3 months) to 2304 hours (12 months).

Funding components include support for training costs, boarding and lodging (residential programmes), transportation costs, post-placement support costs, career progression and retention support costs. For detailed guidelines, click here.

Training Requirements :

• DDU-GKY funds a variety of skill training programs covering over 250 trades across a range of sectors such as Retail, Hospitality , Health, Construction, Automotive, Leather, Electrical, Plumbing, Gems and Jewellery, to name a few. The only mandate is that skill training should be demand based and lead to placement of at least 75% of the trainees.

• The trade specific skills are required to follow the curriculum and norms prescribed by specified national agencies: the National Council for Vocational Training and Sector Skills Councils.

• In addition to the trade specific skills, training must be provided in employability and soft skills, functional English and functional Informational technology literacy so that the training can build cross cutting essential skills.

Scale and Impact :

• DDU-GKY is applicable to the entire country. The scheme is being implemented currently in 13 States/UTs across 460 districts partnering currently with 82 PIAs covering 18 sectors. To know the project implementation statistics,

Topic 28 – Start-up Village Entrepreneurship Project (SVEP)

Objectives :

To improve the knowledge and skills of the participants on skill enhancement, marketing, and physical infrastructure

Duration : 60 minutes

Expected outcome : Participants will develop understanding and awareness on Start-up Village Entrepreneurship Project (SVEP)

Module Plan

Topic	Content	Methodology	Process	Materials Required
Micro-Enterprise promotion - Start-up Village Entrepreneurship Project (SVEP)	* Objectives * Importance * Statutory compliances * Source of finance & financial linkages * Marketing * Physical Infrastructure * Skill up gradation	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on SVEP through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Background :

During the Budget session of 2014-15 on July 10 2014 Honorable Finance Minister initiated the idea of the Start-up village entrepreneurship programme. As stated, "I also propose to set up a "Start-up Village Entrepreneurship Programme" for encouraging rural youth to take up local entrepreneurship programs. I am providing an initial sum of 100 crore for this."

As per the NRLM mission, enabling households to come out of poverty through creating community based organizations, financial assistance and providing gainful employment and livelihoods support - designing strategies to support the entire portfolio of poor households, is integral to our interventions. The aim is to stabilize the current livelihoods of the poor households, support the necessity and traditional sources of income and also help generate new avenues of livelihoods and markets.

Nature and status of Rural Self- Employment : A statistical perspective

i) Only 9% of India's rural workforce are in regular salaried jobs (3 crore out of 34 crore workers)

ii) Almost half of the rural youth are self-employed 1. Cumulatively, 53% of the rural male and 55.8% of the rural female in the age group of 15-59 years are Self-employed. (19 crore people)

iii) The unemployment rate among rural males in India is 8.02% and 6.05% among rural females. (NSSO 2011).

iv) Rural livelihoods are not only agriculture based. The number of households that depend on rural non-farm employment (RNFE) as their primary source of income has increased from nearly 32% in 1993-94 to over 42% in 2009-10 (NSSO 2011), but still a huge 58% household are dependent on agriculture as their primary source of income.

v) The employment related reasons figure the highest behind migration from rural to urban areas. The migration rate per 1000 persons in rural areas is 26.

vi) Micro Enterprises/constitute a significant proportion i.e. (99.8%) of the existing unregistered 3 enterprises in the country. Currently the Rural Micro Enterprises employ 232.95 lakhs people in 119.60 lakh units.

vii) 93.94% (112.36 lakhs) of the rural micro enterprises have an investment up to Rs. 1 Lakh and below.

viii) 67% (71.7 lakhs) of the rural micro enterprises have an investment below Rs 25,000.

ix) Altogether, 202.86 Lakh persons are employed in Rural Micro Enterprises with investment up to Rs 1 Lakh and below. (Average Employment is 1.80 per unit).

x) Rural Micro Enterprises with Investment size below Rs 25,000 employ 132.42 Lakh people. (Average employment per unit is 1.65).

xi) Manufacturing sector constitutes 61.4%; Services account for 33.8% while Repair and maintenance 4.7% of the total number of rural micro enterprises.

xii) 10.4% enterprises are owned by women in rural areas where as 12.46, 6.9, 45.07% enterprises are found to be owned by SC, ST and OBC in rural areas respectively.

What is the funding pattern under SVEP?

Funding pattern under the scheme is currently 60% center and 40% state. (Exception being 90% central and 10% state for the North eastern states and Himalayan states). However, the same may change in case any new set of guidelines are notified

What is the eligibility criteria for beneficiaries?

Eligibility criteria for selection of beneficiaries: There are 2 types of beneficiaries –

a. The Community Resource Person –Enterprise Promotion (CRP-EP)

b. The entrepreneur

Selection criteria for the CRP-EP beneficiary :

The CRP-EP shall be getting detailed training and the eligibility criteria for selection of the CRP- EP shall be decided jointly between the PIA and the SRLM. Some suggested criteria are – this person should be literate, should be fluent in the local language, ideally should be a resident of the block, should have a working knowledge of/aptitude for mathematics and business understanding, should be willing to travel and interact with potential entrepreneurs, ideally should be a member of, or should be from the family of a member of a SHG. The age criteria can be defined by the SRLM, but ideally should be between 18 to 45 years old.

The process of applying for becoming a CRP-EP is an open process by which any person meeting the base eligibility criteria can apply.

This CRP-EP shall be selected after a due process of selection, which has a written test and some team activities. This CRP-EP post training is expected to clear a certification process, only after which he/she shall be eligible to operate as a CRP-EP.

Selection criteria for the entrepreneur beneficiary :

There shall be 2 stages of the selection of the entrepreneur beneficiary –

1st stage :

i) When the potential entrepreneur expresses interest for starting an enterprise

ii) At this point of time the beneficiary gets only training and support.

This beneficiary selection may be done by the community organization, based on the need and poverty of the person, and also the potential capability of the person to run an enterprise.

There is no age limit nor is the beneficiary expected to be a woman only.

2nd stage :

i) Post the training and completing the viability test by the potential entrepreneur; the potential entrepreneur may seek a loan from the dedicated CIF under this scheme (applicable only for entrepreneur beneficiaries who are part of the SHG eco-system).

ii) This loan shall be recommended by the CRP-EP based on the assessment of the viability of the enterprise and the potential entrepreneur's ability to run the enterprise viably.

Both the selection decisions are to be taken by the community based organizations, after evaluating the recommendation of the Community Resource Person, about the viability of the proposed enterprise and the capability and readiness of the potential entrepreneur for running the enterprise viably.

The guideline specifies that preference should be given to the highly vulnerable beneficiaries under MGNREGA, marginalized sections, women, SC and ST communities and should also include rural artisans.

There is no provision of grant under the scheme, the only benefit the beneficiary shall get are training and a loan for starting/running the business.

Who will borrow money from the CIF under SVEP?

The rate of interest charged by the SHG to the entrepreneur should ideally not exceed 12%. The rate of interest should be decided and agreed by the CBO and CRP-EP facilitated by the SRLM and PIA. The rate of interest should be decided ensuring that the enterprises supported are financially viable at that rate of interest. Ideally the same rate of interest should be charged to all the entrepreneurs in the block. But the rate of interest charged from the enterprise may vary among different blocks in the state.

Period of the program?

The project execution period has been estimated to be 4 years (48 months) from the date of release of the first instalment after the submission report of the baseline and market potential study and DPR. However, the Ministry of Rural Development has the mandate to fund the program for the years

2015-16 and 2016-17 (current plan period) only. After the completion of the first 2 years of the program, there shall be a mandatory review by a third party and the program may be extended post the outcome of this review exercise

Expenses which are not allowed under SVEP :

- No individual assets can be created from the funds under SVEP, apart from the funds specified for the CIF. (CIF funds, which are given to the entrepreneur as repayable loans, can be used to buy individual assets, but which are needed for running the enterprise.)

- No motorized vehicles can be purchased using SVEP funds.

- Any assets created using the funds of the SVEP, (e.g. computer, tablets, printer, office furniture etc.) shall be owned by the community organizations and not by the PIA/ SRLM.

- The SRLM can buy assets for the SRLM from the component of administrative funds only.

Enterprises supported under SVEP?

Any kind of enterprise, be it in trading, manufacturing (including traditional artisanal production – like handloom or handicraft) or service sectors which can be run by a village based individual or village based group, and which is allowed by law, can be supported under SVEP.

Topic 29 –Food safety and security

Objectives :

To understand the needs for food safety and security at household level

Duration : 60 minutes

Expected outcome : Participants will develop understanding on the needs for food safety and security at household level

Module Plan

Topic	Content	Methodology	Process	Materials Required
Food safety and security	*Identification of food * Importance of food safety and security * Household approach * Storing of food	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on food safety and security through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

When we say food or when we heard about food, what first came to our mind may differ to each individuals or maybe quite similar. But here we are going to discuss more detail about food and what measurement and technique are taken for the safety and security of our food. Food is nothing but whatever we consume for satisfies our hunger or for our nutritional needs.

Food :

Food is any substance consumed to provide nutritional support for the body. It is usually plant or animal origin, and contains essential nutrients such as carbohydrates, fats, proteins, vitamins or minerals. The substance is ingested by an organism and assimilated by the organism's cells to provide energy, maintain life or stimulate growth.

Types of Food :

1. **Comfort Food :** Is a food which provides a sentimental value to consumer and its often characterized by its high caloric nature and high carbohydrates level in simple preparation. (Eg: Samosa, Alu puri)

2. **Fast Food :** Fast food is type of mass produced food that is prepared and served very quickly. They are relatively low nutritional value as compared to other food. (Eg: Fried Noodles, Rolls)

3. **Natural foods :** Natural food are those food which are less process and are consume directly from the raw state. (Eg: Apple, Fish)

4. **Organic Food :** Organic foods are those foods produced by method that comply the standards of organic farming. (Eg: Organic vegetables)

5. **Slow Food :** The food which are produced from the grassroots , it is an alternative to fast food which serve mostly of traditional food and regional cuisine. (Eg: Continental, Kitchen Garden)

6. **Whole Food :** Whole foods are those foods that are unprocessed and unrefined or processed and refined as little as possible, before being consumed. (Eg: Egg, milk, vegetables and beans)

Food safety and security :

Food safety is defined protecting the food supply from microbial, chemical and physical hazards that may occur during all stages of food production, including growing, harvesting, processing, transporting, retailing, distributing, preparing, storing and consumption, in order to prevent food borne illnesses like typhoid, cholera, dysentery, diarrhoea, food poisoning etc.

Five important keys for food safety :

1) Keep clean

a) Wash your hand before handling food.

b) Wash raw vegetables thoroughly before cook.

c) Keep work area clean and sanitize.

2) Separate raw and cooked

a) Separate raw meat, poultry and seafood from other food.

b) Store food in a container to avoid contact with contaminated.

c) Used separate utensils and equipment.

3) Cook thoroughly

a) Cook food at a correct temperature in correct timing.

b) Cooked food should be heated thoroughly before consumption.

4) Keep food at safe temperature

a) Keep food below 40^0F (4.4^0C) or above 140^0F (60^0C).

b) Food that are store between 40–140^0F are called danger zone where all the bacterial infection causes.

5) Use safe water and raw material.

a) Use only kitchen clean water for cooking purposes.

b) Raw material use for cooking should be clean and fresh.

FIGURE 5.
Temperature Rules for Safe Cooking and Handling of Foods

Safe cooking and holding temperatures for foods. Bacteria multiply rapidly between 40°F and 140°F, doubling in number in as little as 20 minutes. To keep food out of this danger zone, keep cold food cold and hot food hot. Keep food cold in the refrigerator, in coolers, or on the service line on ice. Set your refrigerator no higher than 40°F and the freezer at 0°F. Keep hot food in the oven, in heated chafing dishes, or in preheated steam tables, warming trays, and/or slow cookers. Use a clean thermometer that measures the internal temperature of cooked food to make sure meat, poultry, and casseroles are cooked to the temperatures as indicated in the figure.

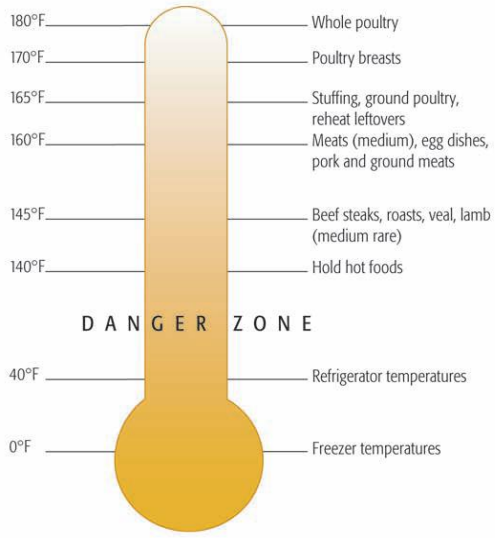
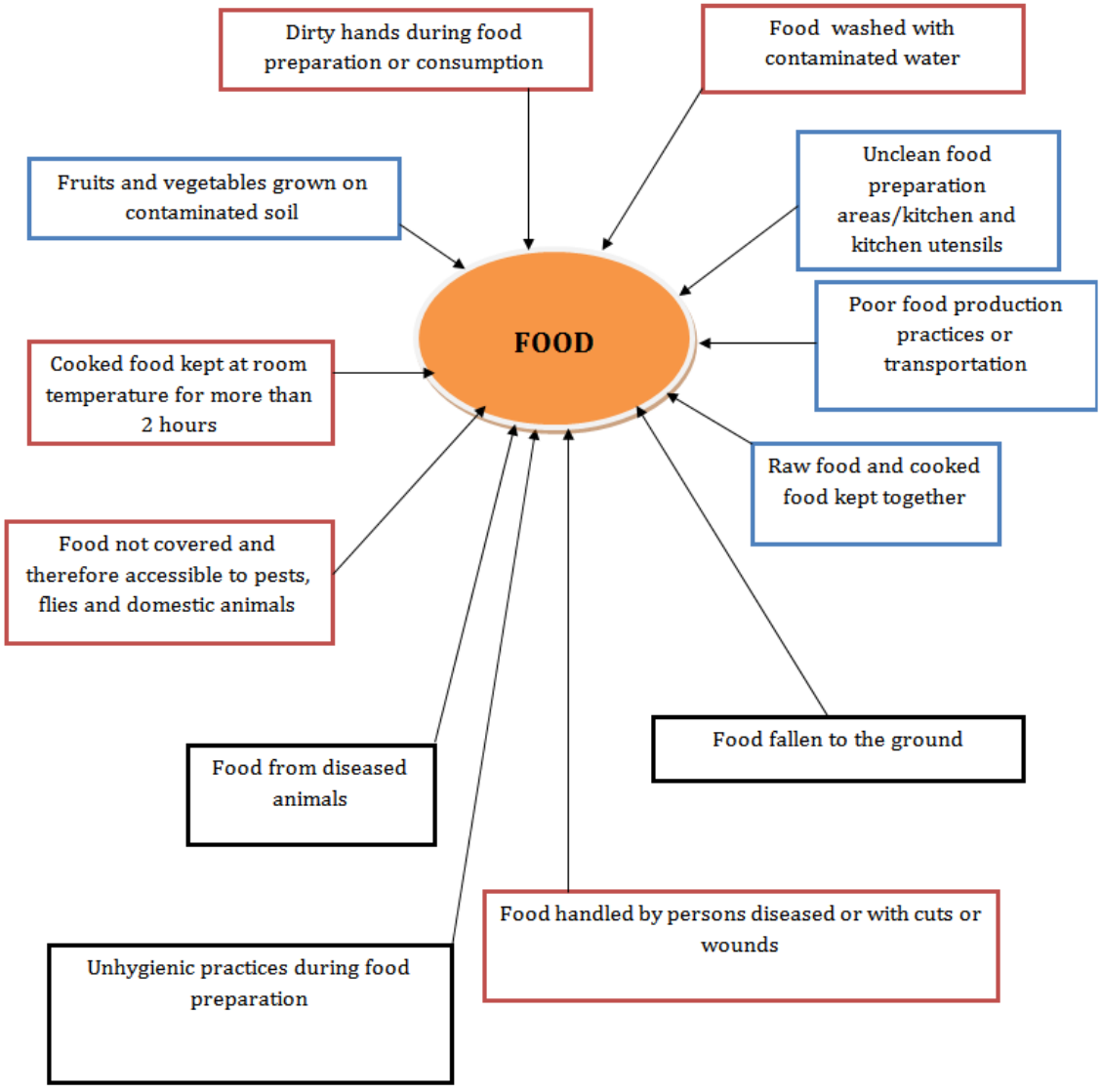


Figure: Possible food contamination and food insecurity



Storage Guidelines :

For best results in maintaining product quality practice the rule, FIRST IN, FIRST OUT. This means you use the oldest products first and the newest products later. A good practice in the home is to place the newly purchased products in back of the same products already on the shelf. It may help to write purchase dates on products without "open dates" on the package. Follow recommended storage times for the refrigerator, freezer and pantry (see charts on following pages).

Freezer :

• Keep freezer temperature at or below 0°F. A good indication of proper temperature is that ice cream will be frozen solid.

• Use moisture-proof, freezer-weight wrap. Examples are heavy duty foil, freezer bags and freezer paper. Label and date all packages.

• Food stored beyond the recommended time will be safe to eat, but eating quality (flavour and texture) and nutritive value will be reduced.

• Keep an inventory of freezer contents.

Refrigerator :

• Use a thermometer to check temperature; it must be between 34°F and 40°F at all times. Avoid frequently opening the refrigerator door, especially in hot weather.

• Wrapping perishable food prevents the loss of flavour and the mixing of flavour and odours resulting in, for example, onion-flavoured milk.

• Raw meat and poultry should be wrapped securely so they do not leak and contaminate other foods. Place the store packages in a plastic bag or place the package on a plate to contain any juices. Clean up leaks with warm soapy water and sanitize with a solution of 1 teaspoon chlorine bleach to 1 quart water.

• Cooked meats and leftovers should be tightly wrapped to prevent leakage and drying out.

Pantry:

• Storage cabinets should be cool and dry. Storage areas near oven ranges, hot water pipes or heating ducts should not be used because heat and moisture can cause a food to lose its quality more rapidly.

• High temperature or humidity may reduce storage time considerably.

• Insect infestation can occur in any home. Susceptible foods include cereals, flour, seeds, baking mixes, spices, candy, dried fruits and dry pet foods. Avoid purchasing damaged packages of foods and keep cupboard shelves clean. Storing food in tightly sealed glass, metal or rigid plastic containers may help.

• Pantry foods will probably be safe beyond recommended storage time, but eating quality (flavour and texture) and nutritive value will be reduced.

Cold storage chart :

These short, but safe, time limits will help keep refrigerated food from spoiling or becoming dangerous to eat. Because freezing keeps food safe indefinitely, recommended storage times are for quality only.

Product	Refrigerator 40°F (4.4°C)	Freezer 0°F(-17°C)
EGGS		
Fresh, in shell	3 to 5 week	Do not freeze
Raw yolk & whites	2 to 4 days	1 year
Hard cooked	1 week	Does not freeze well
Red Meat		
Steak	3 to 5 days	6 to 12 months
Chops	3 to 5 days	4 to 6 months
Roasts	3 to 5 days	4 to 12 months
Variety meat – tongue, heart, liver, kidney.	1 to 2 days	3 to 4 months
Process meat (pre dressing)	1 day	Does not freeze well
Gravy & meat broth	3 to 4 days	2 to 3 months
Process or package meat (sausage, ham, bacon)	1 week	1 to 2 months
Poultry		
Fresh whole	1 to 2 days	1 year
Fresh pieces	1 to 2 days	9 months
Giblets	1 to 2 days	3 to 4 months
Fried chicken	3 to 4 days	4 months
Cook chicken gravy or broth	3 to 4 days	6 months
Leftover foods		
Bread item (hamburger, pizza)	3 to 4 days	1 to 2 months
Soup and stews	3 to 4 days	2 to 3 months
Raw salad or entrees	Week	3 to 4 months
Milk and milk product		

Pasteurized milk	3 days	Does not freeze well
Raw milk (boiled)	2 days	Does not freeze well

Why food preservation?

Food Preservation is basically done for three reasons :

- To preserve the natural characteristics of food
- To preserve the way food looks
- To increase the shelf value of food for storage

Natural Food Preservatives :

- Boiling, freezing and refrigeration, pasteurizing, dehydrating, smoking, pickling are the traditional few and are considered to be the natural ways of preserving food.
- Sugar, salt, alcohol, vinegar are also often used as food preservatives. Sugar and salt are the earliest natural food preservatives that very efficiently drop the growth of bacteria in food. To preserve meat and fish, salt is still used as a natural food preservative.
- Coffee powder and soup are dehydrated and freeze-dried for preservation.

Types of natural food preservatives :

1. **Sugar:** High levels of sugar can preserve against spoilage organisms, this may be seen in jams, preserves, certain sweet pickles and marmalades. This is also an important factor in the preservation of boiled sweets and chocolates etc. Increasingly, it will be noticed that many products now have to be kept in the refrigerator of freezer once opened, because sugar has been replaced by artificial sweetener which is cheaper and healthier to eat, but which compromises the self-preservation of the product.

2. **Alcohol:** Not all organisms are bad! The production of alcohol from sugar by yeast is an industry in its own right. A wine carefully produced using sterilised equipment and fermented to 13% by volume will just about resist further infection from external organisms, once the ferment has completed. It is during the time of the fermentation process that the fermenting must is vulnerable to infection. The naturally produced fermentation grade alcohol can be concentrated by distillation and used as a natural preservative in toners, aftershaves and colognes.

3. **Heat:** Heating, cooking and pasteurisation is another natural form of preservation that will sterilise products, especially where that product is designed as a one-shot use product. For example, a phial or a sachet. Alternatively, once opened, the product can be stored in the fridge of freezer to prevent microbiological degradation.

4. **Salt:** The use of extreme levels of salt as used by the ancient mariners to preserve their meat is effective and it very likely that the preservation of the Egyptian mummies was, in part, achieved by the 40 day treatment in natron (a concentrated brine solution that osmotically drained the tissues of water).

5. **Cold**: Placing a product in the cold merely 'stops the clock' on microbiological growth and this is perfectly fine, provided the product was sterile when it was placed in the cold and/or had sufficient preservative 'mass' to counter any new organisms subsequently introduced.

6. **Acid pH**: The preservative activity can be boosted by operating at as low a pH as possible. Natural acidity could be obtained from one of the many of the alpha hydroxy acids (AHAs) which are obtained from citrus species, where the major components are citric and malic acids.

7. **Dessication:** Removing water from a product or making it totally dehydrated will greatly reduce the possibility of spoilage; however, it must be recognised that the presence of spore-bearing organisms could become active once that water is reintroduced.

Topic 30 – Scientific way of packaging

Objectives :

To upgrade the knowledge and skills of the trainees on packaging and labelling technology

Duration : 45 minutes

Expected outcome : Participants will develop understanding on packaging and labelling technology

Module Plan

Topic	Content	Methodology	Process	Materials Required
Scientific way of packaging	*Introduction to packaging * Types of packaging *Machinery * Product life cycle	Powerpoint presentation, Interactive learning method	The trainer will deliver lecture on scientific way of food packaging through powerpoint followed by an interactive session with the participants	LCD projector, Laptop

Introduction :

Packaging is defined an industrial and marketing technique for containing, protecting, identifying and facilitating the sale and distribution of agricultural, industrial and consumer products.

It is also defined anything which is consumable or non-consumable wrap or put in a container like polyethylene, plastic, glass, steel, tray, cup, paper etc. Packaging is done to prevent the item from damaging and contamination. Nowadays, about 20-30 % of the cost of production was utilize in packaging.

Functions of packaging :

Packaging for food should fulfil the following functions :

Contain: The package must contain and preserve a certain quantity of product as efficiently as possible. The quantity may be measured by volume, by weight or by number. The shape and dimensions of the package often have implications for the cost and strength. Compact packaging, with as little empty space inside as possible, withstands stacking pressure and handling stresses better than loose packaging. A loosely filled package also means a waste of packaging material and unnecessary transport costs. In many countries, environmental and consumer protection organizations campaign against packages that are too big for their contents. Minimum packaging minimizes disposal costs as well as resource the use. Minimizing however does not mean reducing the package to the point where the safety and integrity of the product are at risk.

Protect: The package must protect its contents from external threats including spoilage, breakage, damage from external environmental conditions, pilfering and theft. Primary, secondary and tertiary packaging must be designed so that the product stays in perfect condition

until it reaches the end user. The package must be strong and durable enough to protect the product with a reasonable safety margin. A number of examples of how packaging should protect from external threats are given below (Table 1).

Table 1. How packaging must protect food from external threats

External environmental conditions	Protective packaging functions
Mechanical shock, vibration and compressive loads	Shock and vibration absorption, compressive strength
Biological factors	Resistance
Gases (O, N, CO2)	Low permeability (high gas barrier)
Light	Transmission (low or high as required)
Temperature	Thermal conductivity (low or high as required)
Water	Resistance and absorption (high water vapour barrier)

Promote: Packaging should act as a 'silent salesman' for the product, promoting the product at the point of sale. Visual and graphic design can only work if the package's technical and structural designs have done their job. The information on the label must be correct and conform to the legal and environmental requirements of the target market. Additional information – including the product quality and the way it was produced – can also be conveyed through the packaging. Further, sales fall into two categories: first-time sales and repeat sales. The package must attract first-time buyers and build brand loyalty for repeat sales. The above three basic requirements form the framework within which a package should be designed. The pre-requisite step in fulfilling these requirements is the collection of information on each of the functions. Research therefore is an essential component of packaging design.

The major groups of packaging :

Primary package : Primary packs/containers (also called consumer or retail packs) come in direct contact with the food they contain. These unit packs can be of various sizes, to cater to different market requirements. Consumer packs can act as a marketing and branding tool and its effectiveness depends on the correct choice for the market concerned. Important selection considerations include: legal requirements of the importing market, environmental regulations, distribution network, shelf-life and sales estimates, retail shelf-space limitations, consumer buying preferences, point-of-sale display, reuse, recycling and post-consumption disposal.

Examples : metal cans, glass bottles, jars, rigid and semi-rigid plastic tubs, collapsible tubes, paperboard cartons, and flexible plastic bags, sachets and over wraps.

Secondary package : A secondary container (also called transport packs) is an outer box, case or wrapper that holds a single primary pack – or "unitizes" – several packs together like: cans, jars, or pouches. The main purpose of secondary packaging is to minimize risks to the product in their primary packs during storage, transport, and distribution. Consideration must be given to the stages of the distribution process to foresee and avoid any risks involved. The package chosen should be acceptable throughout the distribution chain.

Examples: Wooden, metal or fibreboard cases, crates and sacks.

Tertiary package: Tertiary packaging (also called unit packs or pallet loads) collects secondary packaging together into pallet loads or shipping units for distribution. The objective is to ease the automated handling of larger amounts of products. Typically, a forklift truck or similar equipment is used to move and transport these tertiary loads. Unitizing is the consolidation of several items into a compact load, secured together and provided with skids and cleats for ease of handling. The particular advantage of pallets is that they are of pre-set sizes and fit the dimensions of containers. Unitized and palletized loads are often shrink wrapped to protect against moisture and pilferage.

Packaging design and selection :

Packaging design sets out to achieve two goals: safe arrival and effective promotion of the product.

Package design consists of structural design, the technical construction of the package from a functional point of view, graphic (or visual) design, the appearance of the package and its promotional value. Packaging is required to keep a product and its components and accessories secure from the beginning of the production process to the time when it reaches the end user. Such containment ensures that the product reaches the consumer in a usable condition. It also ensures that the product itself and other products, people and the environment are safeguarded from any adverse effects of product loss. These effects may be caused not only by the spilling or dispersal of the product itself but also by the egress of moisture, pressure, heat and cold from the product.

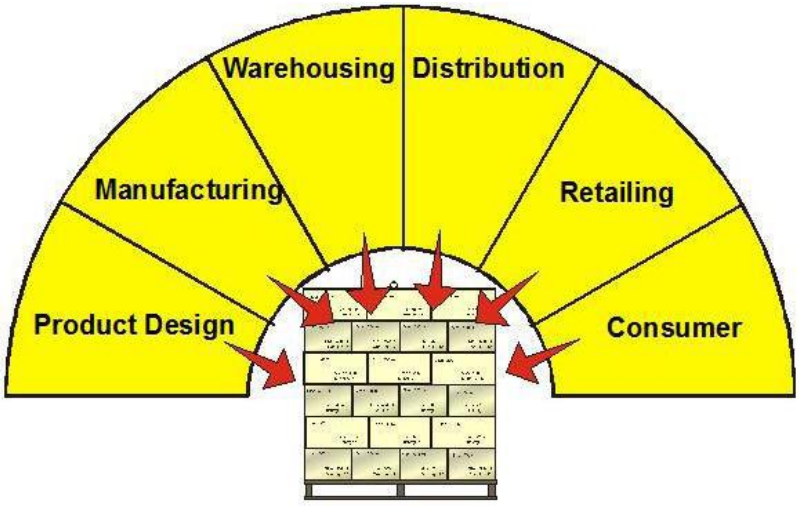
Organic food packaging as an enabler of sustainability :

Consumers, governments and industry recognize that we must look to reduce our global footprint in every area of our lives. From a holistic approach, packaging should satisfy economic, social and environmental requirements related to the production, distribution and consumption of the product. Extra design work must go into the packaging and marketing of organic products to match the characteristics of organic food processing. Organic and natural foods are widely purchased by health conscious consumers, young and old alike. Organic is typically a premium product and the target audience must be able to observe the difference through the packaging. Organic food can be expensive to produce and many consumers are willing to pay more for visually appealing packaged products. Bold graphics, stylish text and the use of organic materials to package organic products can all catch the eye of the consumer.

1. Packaging design :

When buying food or any other consumable item, consumers expect to buy an all-around ecologically friendly product, including the packaging. On top of guaranteeing food safety and quality, offering space for product information, easy packing operation and easy handling in the integrated transport system, the packaging material for food should be environmentally friendly, have a high degree of recyclability and perhaps carry graphic design work characteristic of organic produce for effective advertising. Design inputs that must be considered for food packs are indicated in figure 2.

FIGURE 2 :



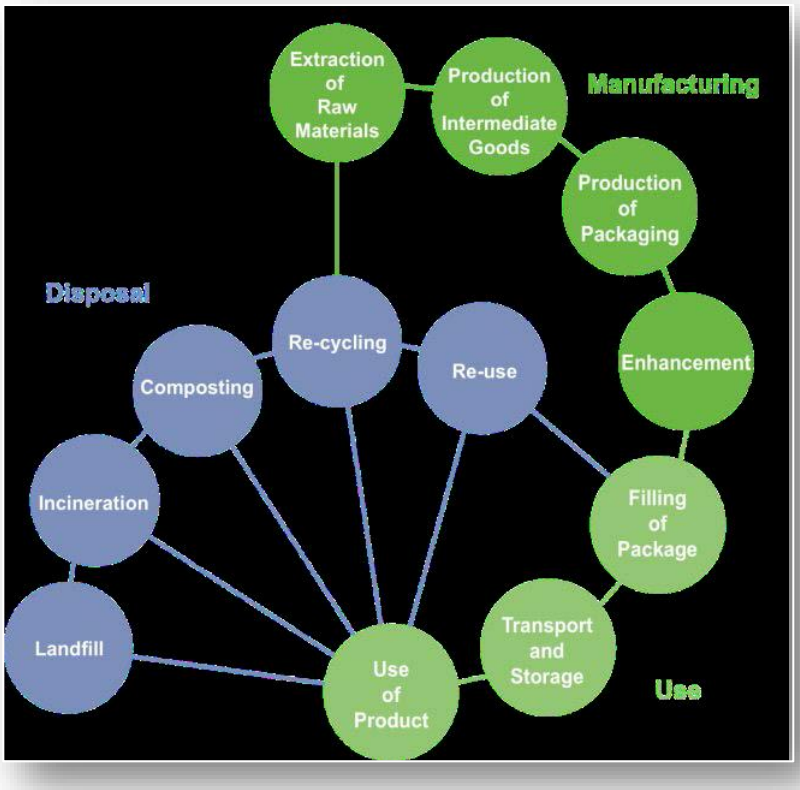
2. Packing life cycle :

The lifecycle of packaging runs from the extraction of raw materials to processing, use and disposal. Every step needs an input of material and energy and involves an output of emissions and waste, and they all have environmental implications.

There are environmental implications in :

- The use of finite, non-renewable resources, such as oil;
- The use of natural resources, such as trees and water;
- Energy use, such as in manufacture and transport;
- Emissions to air, such as gases which contribute to climate change;
- Discharges into water, which can be toxic to plants and animals;
- The creation of hazardous waste by-products including ash and leach ate;
- Extractive industries and landfill sites which affect natural habitats;
- Transport, pollution and littering which hit the natural amenity value of landscapes.

Figure 3. Simplified packaging life cycle



2. Packaging selection – eight steps to consider :

To gain marketing advantages in international markets, the following steps will aid in sourcing the best packaging for organic food products. There are eight steps to consider.

Step 1. Know your product

Find out the physical, chemical and mechanical properties of the product to be packaged. Establish a match between procured and demanded product specifications. E.g. if a product is reactive or acidic, the degree needs to be understood; if it is moisture-sensitive, the extent of this sensitivity needs to be determined. Shelf-life should be considered. Is the food ready to eat? Are the products in aseptic packs? Is the food frozen or dried?

To know your product better you should be able to answer the following questions :

- Is the product fresh, dried, frozen or processed?
- What are the physical, chemical and mechanical properties of the product?
- Can the product be handled/filled/packed by machine, and if so, is suitable equipment available?
- What are the shelf-life and product quality requirements (flavour, colour, moisture, organoleptic, size, form (powder, granule, liquid, etc.) and weight)? This helps in determining the barrier properties (gas, water vapour and light) required for effective protection.
- Is the packaging suitable for the product's intended use (e.g. hot filling, sterilisation)?

Step 2. Check the packaging facilities

The requirements and limitations of the packer's machinery should be checked from the standpoint of good manufacturing practices (GMPs), good handling practices (GHPs), production quantities, packaging materials and pack dimensions.

Automated packing operations often have more strict requirements for the accuracy and consistency of package sizes than manual packing systems. If the packing operation is manual, the package types and materials have to be chosen so that this is feasible at the required speeds. If existing machinery is to be used, the availability of sufficient capacity and space should be checked, as should the availability and skills of the personnel required.

The following questions could be helpful :

- Can the product be handled/filled/packed by machine and, if so, is suitable equipment available?
- Could the product be modified for easier packing without affecting its taste or character?
- Are the available packaging (primary, secondary and tertiary) and packing methods affordable and
- Suitable for the product?
- Are there detailed mechanical and technical specifications for every element of packaging?
- Do the specifications comply with the machine requirements?
- Are good manufacturing and handling practices being followed?

Step 3. Know your target market

Packaging can help a company position its product. In doing so, three questions need to be answered: Who sells, what and to whom? Understanding your target market will require considering the following questions :

- Is the labelling correct?
- Are graphics designed with specific marketing inputs?
- Does the packaging offer a wide range of design options?
- Is the package easy and safe to use?
- Does the packaging design fit the target market?
- Are the packaging's printing inks environmentally friendly?
- Have the target market's standards, laws and regulations (including those related to the environment) been observed?
- Can the packaging and designs used on the domestic market also be used for export?
- Can the same export packaging and designs be used for all the target markets?

Step 4. Choose appropriate packaging materials

Choosing packaging material is important. For consumer packaging, it might be glass, plastic, paper-based or metal.

For transport packs it might be wooden boxes, jute or other kind of knitted bags, corrugated boxes or metal or plastic drums. The chosen materials should be suitable and accepted in the target market as regards, for example, their recycling or disposal.

The choice will depend on the availability of suitable packaging materials, reliable suppliers, price and lead times.

Close coordination with the company's procurement operations is essential to ensure cost-effective selection of materials. However, quality requirements should take precedence over material price concerns. The cheapest material is not always the most economical when production and distribution costs are also considered.

Producers need to understand raw material availability, cost (including taxes if imported) and possible changes in export markets regarding non-recyclable packages.

Food safety aspects also have to be considered. Bear in mind the hazards to which the product is likely to be exposed throughout its life-cycle – for instance if the product is being shipped from tropical countries, remember the implications of the climatic conditions.

Step 5. Optimize logistics and supply chain management processes and costs

If several modes of transport are used for export, as is often the case, all the packaging must be designed to endure the toughest stages of the distribution chain, including the number of transhipments and other handling operations. If goods are normally handled mechanically at the main transhipment points, the packages should be unitized to make this possible. However, cost comparisons may be needed to determine whether manual or mechanical handling on pallets is more economical in each distribution situation. The dimensions of unit loads should be chosen to suit transport modes and handling equipment at the market destination. Many transport modes also have their own package-marking requirements to ensure that packs are correctly handled and safely delivered. Particular product groups such as perishables, fresh fruit and vegetables as well as individual countries often have specific requirements in addition to internationally accepted markings.

Often, in logistics and at point of sale, requirements are different. In logistics, optimal protection and transport capabilities, as well as stable construction, are the decisive factors; at the point of sale, however, the packaging should allow for a sales-promoting attractive presentation with a free view of articles.

Aspects to consider include :

- Types, sizes and dimensions of primary, secondary and tertiary packaging;
- Different modes of transportation (ship, airplane, train, lorry, etc.);
- Quality standards, including both performance and presentation;
- Suitability for shelf display;
- Ease of unpacking and price-marking;
- Recycling or handling of empty transport packaging;
- Knowledge about the climatic conditions throughout the distribution chain and the ability of packaging to protect its contents against climatic hazards such as humidity and changes of temperature;
- Handling methods, number of transhipments, and equipment used throughout the distribution chain;
- The need for palletisation and containerisation in the transport packaging design;
- Common logistics measures (stack ability etc.);
- Transport requirements (e.g. the weight and volume of the packaging);
- Ways to minimize contamination (by impurities, germs etc.).

Step 6. Meet all health, safety and environmental requirements

Consumer health and safety, and environmental protection, are essential considerations in the planning of packaging. The many laws, regulations and guidelines applying to these aspects of packaging, especially in industrialized countries, should be taken into account at the package planning stage, as they may affect the choice of both materials and package types.

Consider the following questions :

- Does all packaging follow existing legal guidelines?
- Are the regulations of the organic associations complied with?
- Are there declarations of conformity or other proofs for all used packaging, which verify that the packaging is suitable for its intended use?
- Can the manufacturer verify the confirmed suitability of the packaging by appropriate analysis and test results along the entire packaging chain?
- Is the safety of consumers guaranteed when they handle the packaging and the food product?

Step 7. Use caution with claims on environmentally friendly materials

Sometimes manufacturers and media promote claims on use of biodegradable packaging for food products as environmental friendly materials on the basis of certain standards. Standards such as IS/ISO 17088: 2008, EN 13432 and fassai (Food certify the compost ability of biodegradable plastics – called compostable plastics.

These standards are not meant for certifying the safe use of any plastic material or for that matter any biodegradable/ compostable plastic material for its safe use in contact with food, drinking water and pharmaceuticals. Due caution needs to be exercised in this regard. Following are some considerations to keep in mind when making claims on environmentally friendly packaging materials:

- Is there data about the life-cycle of the packaging?
- Are minimum consumption of resources and energy and minimum emissions along the life-cycle guaranteed?
- Are the heavy metal contents (if any) within limits in the packaging material?
- Does the manufacturer attempt to use as little packaging material (volume, weight) as possible to pack the product safely, hygienically and in an acceptable manner?
- Is the end-of-life scenario of the packaging known? Does recycling take place?
- Is freedom from genetically modified organisms (GMOs) guaranteed for all raw materials including relevant auxiliary substances, enzymes and micro-organisms?

Step 8. Test your packaging

Test your packaging for its compatibility with your product, for shelf-life and its performance under simulated transport conditions.

Ideally, shelf-life studies for up to two years should be conducted. However, often packaging technologists can use accelerated ageing analysis and their experience to predict performance. In accelerated testing the product is packed and subjected to accelerated storage temperature and humidity conditions then examined periodically.

However, this requires considerable care. Under-staffed labs with inadequate test facilities can make mistakes. Experience gained with previous designs may no longer be appropriate. For example, printed materials may no longer be acceptable if new inks or laminates are used, or if there are new designs.

There have been cases in which ink change caused residual solvents in very minute trace quantities to migrate into the food product and impart an off-flavour. De-lamination may even occur if there is an increase in print although other design conditions remain the same.

3. Package environment

The packaging has to perform its functions in three different environments. Failure to consider all three environments during package development will result in poorly designed packages, increased costs, consumer complaints and even avoidance or rejection of the product by the customer.

3.1 Physical Environment

This is the environment in which physical damage can be caused to the product. It includes shocks from drops, falls and bumps; damage from vibration arising from transportation modes including road, rail, sea and air; and compression and crushing damage arising from stacking in warehouses and during transportation, or in the home environment.

3.2 Ambient Environment

This is the environment which surrounds the package. Damage to the product can be caused as a result of gases (particularly oxygen), water and water vapour, light (particularly UV radiation), and the effects of heat and cold, as well as micro- and macro-organisms which are ubiquitous in many warehouses and retail outlets. Contaminants in the ambient environment such as exhaust fumes from automobiles and dust and dirt can also find their way into the product unless the package acts as an effective barrier.

3.3 Human Environment

This is the environment in which the package interacts with people, and designing packages for this environment requires a knowledge of the vision and strength capabilities and limitations of humans, as well as legislative and regulatory requirements. Since one of the functions of the package is to communicate, it is important that the messages are received clearly by consumers. In addition, the package must contain information required by law such as product description and net weight.

To maximize its convenience functions, the package should be simple to hold, open and use by the consumer. For a product which is not totally consumed when the package is first opened, the package should be able to be resealed and retain the quality of the product until completely used. Furthermore, the package should contain a portion size which is also convenient for the intended consumers; a package which contained too much product that deteriorated before being completely consumed clearly contains too large a portion.

Shelf life is the length of time that foods, beverages, and many other perishable items are given before they are considered unsuitable for sale, use, or consumption. It is the time between the production and packaging of a product and the point at which the product first becomes unacceptable under defined environmental conditions. It is a function of the product, package and the environment through which the product is transported, stored and sold.

Factors influencing shelf life : These include product, package and the environment.

Product: Products differ greatly in their susceptibility to various agents. These agents cause different charges which affect the shelf life. Examples include:

1. Aroma loss as in freshly ground pepper or roasted coffee which results in loss of palatability
2. Pick up of a foreign odour. Ex. Absorption of onion odour by butter when these two items are placed together.
3. Loss of carbonation as in the case of soft drinks or beer
4. Crystallization. Ex. Honey when kept in cold for a long time.

5. Moisture gain as in dry or dehydrated foods such as ready-to-eat breakfast cereals, snack foods which destroys their crisp texture
6. Rancidity of snack items such as potato chips due to the oxidation of the oils absorbed during frying
7. Browning reactions as in case of freshly cut fruits.

Package : A package is meant to protect the product against an agent which degrades the product. The degree of protection is measured a water vapour transmission rate (WVTR) and oxygen transmission rate (OTR) for moisture and oxygen sensitive foods respectively. The critical sensitivity of the product to external agents is determined in part by the package. Ex. A product such as snack food which is susceptible to moisture gain and oxygen can be termed as 'moisture sensitive' if texture degrades before rancidity becomes objectionable. The same product, if packed in a sufficient moisture barrier would become oxygen sensitive.

Environment : Product distribution through various network causes stress on the product under a variety of climates, seasons, shipping and warehouse conditions. Barrier properties of the package are therefore related to the environment conditions. Barrier properties indicate the range of properties which play a part in determining the total protective efficiency of a package.

Government rules and regulation for package food :

1) The Standards of Weights & Measures Act (SWMA) :

The most important rule under SWMA is that the commodities to be packed for retail should be packed in standard specific quantities as given under the rule for each commodity. However, the Central Government can authorize pre-packaging in quantities other than those specified on technical ground.

Some of the important aspects of SWMA are mentioned below.

Standard Units: It states that every unit shall be based on the metric system. The units to be adopted are the International System of units. Eg, Gram, kilogram etc.

Standard Packages: Under the Standards of Weights and Measures (Packaged Commodities) Rules, rules have been framed specifying provisions for the retail sale of packaged goods. One of the most important rules is with respect to the requirements that specific commodities are to be packed and sold only in standard packages.

As per the Third Schedule, food products and their respective package capacities are given in Table.

Table : Commodities to be packed in Specified Quantities (Standard Packages) as per the Third Schedule of SWMA Rules

Commodities	Quantities in which to be packed
Baby Food	200 g, 500 g, 1 kg, 2 kg, 5 kg and 10 kg – Any manufacturer or packer packing baby food in 400 g and weaning food in 500 g
Weaning Food	200 g, 400 g, 1 kg, 2 kg, 5 kg and 10 kg – Publication of this notification in the official gazette
Biscuits	25 g, 50 g, 75 g, 100 g, 150 g, 200 g, 250 g, 300 g and thereafter in multiples of 100 g up to 1 kg
Bread including brown bread	100 g and thereafter in multiples of 100g
Uncanned packages of butter and margerine	25 g, 50 g, 100 g, 200 g, 500 g, 1 kg, 5 kg and thereafter in multiples of 5 kg
Cereal and pulses	100 g, 200 g, 500 g, 1 kg, 2 kg, 5 kg and thereafter in multiples of 5 kg
Coffee	25 g, 50 g, 100 g, 200 g, 500 g, 1 kg and thereafter in multiples of 1 kg
Tea	25 g, 50 g, 100 g, 200 g, 500 g, 1 kg and thereafter in multiples of 1 kg
Milk powder	Below 50 g no restriction, 50 g, 100 g, 200 g, 500 g, 1 kg and thereafter in multiples of 500 g
Rice(powdered), flour, atta, rawa, suji	100 g, 200 g, 500 g, 1 kg, 2 kg, 5 kg and thereafter in multiples of 5 kg
Salt	Below 50 g in multiples of 10 g; 50 g, 100 g, 200 g, 500 g, 750 g, 1 kg, 2 kg, 5 kg and thereafter in multiples of 5 kg
Aerated soft drink and non alcoholic beverages	100 ml, 150 ml, 200 ml, 250 ml, 300 ml, 330 ml (in cans only), 500 ml, 750 ml, 1 litre, 1.5 litre, 2 litre, 3 litre, 4 litre, and 5 litre

1) **The Prevention of Food Adulteration Act (PFA):**

The Prevention of Food Adulteration Act, 1954 (PFA) prohibits manufacture, storage and sale of adulterated food. The violation of law prosecuted before a magistrate's court. The punishment is mandatory imprisonment for a minimum of three months.

2) **Food safety and standards (packaging and labeling) regulations, 2011 :**

1) “Best before” means the date which signifies the end of the period under any stated storage conditions during which the food shall remain fully marketable and shall retain any specific qualities for which tacit or express claims have been made and beyond that date, the food may still be perfectly safe to consume, though its quality may have diminished. However the food shall not be sold if at any stage the product becomes unsafe.

2) “Date of manufacturing” means the date on which the food becomes the product as described.

3) “Date of Packaging” means the date on which the food is placed in the immediate container.

4) “infant” means a child not more than 12 months of age.

5) “Lot number” or “code number” or “batch number” means the number either in numericals or alphabets or in combination thereof, representing the lot number or code number or batch number, being proceeded by the words “Lot No” or “code No.” or “batch no” or any other distinguishing prefix by which the food can be traced in manufacture and identified in distribution.

6) “Multipiece package” means a package containing two or more individually packaged or labelled pieces of the same commodity of identical quantity, intended for retail either in individual pieces or packages as a whole.

7) “Non-Vegetarian Food” means an article of food which contains whole or part of any animal including birds, fresh water or marine animals or eggs or products of any animal origin, but excluding milk or milk products, as an ingredient.

8) “Prepackaged” or “Pre-packed food”, means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.

9) “Principal Display Panel” means that part of the container/package which is intended or likely to be displayed or presented or shown or examined by the customer under normal and customary conditions of display, sale or purchase of the commodity contained therein.

10) “Use – by date” or “Recommended last consumption date” or “Expiry date” means the date which signifies the end of the estimated period under any stated storage conditions, after which the food probably will not have the quality and safety attributes normally expected by the consumers and the food shall not be sold.

11) “Vegetarian Food” means any article of Food other than Non- Vegetarian Food.

12) “Wholesale package” means a package containing a number of retail packages.

Types of Packaging Materials :

1. **Plastics**: Plastics are relatively cheap, light, easily processed and shaped, and easy to seal. Two major drawbacks are their permeability to gases and vapors, and the possibility to their interacting with the product.

2. **Metal (Tin, steel, alluminium)**: Steel, tin, and aluminum are used mainly for canned foods and beverages. The most common use of metals for packaging is in tin-coated steel and aluminum cans. The principal advantages of metal cans are their strength providing mechanical protection, effective barrier properties, and resistance to high temperatures providing stability during processing. it is an advantage for light-sensitive products. The disadvantage in that contents are: invisible, heavy mass, high cost, and tendency to interact with contents and environment (internal and external corrosion).

3. **Glass:** Glass containers used to be and still are considered a prestigious means of packaging, and serve for the most expensive wines, liqueurs, perfumes, and cosmetics. It is highly inert, impermeable to gases and vapors, and amenable to the most diverse shaping. It is an excellent oxygen barrier and completely neutral in contact with foods. It has the advantage of transparency, but where required it can be given different desired colors. It has complete as well as selective light protection properties.

4. **Wood:** Pulp products are widely used in food packaging in the form of different kinds of paper, paperboard, laminates, and corrugated board. The main advantages of paper are its low cost, low mass, relatively high stiffness, and excellent printability; the main disadvantage is its high sensitivity to moisture, reflected in close dependence on the relative humidity of the environment. The basic raw material for papermaking is cellulose.

Topic 31 – Business plan and marketing

Objectives :

To impart the knowledge of business activity, market analysis and importance of making a business plan

Duration : 60 minutes

Expected outcome : Participants will develop the importance of making a business plan

Module Plan

Topic	Content	Methodology	Process	Materials Required
Business and Marketing plan	* SWOT analysis * Producer group * 5 P's * Value chain	Powerpoint presentation, Brain storming	The trainer will deliver a lecture then the participants will be divided into groups and make a business plan	LCD projector, Laptop, Chart paper, Marker

Meaning :

SWOT analysis is an acronym for strengths, weaknesses, opportunities, and threats—and is a structured planning method that evaluates those four elements of a project or business venture. A SWOT analysis can be carried out for a company, product, place, industry, or person. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieve that objective. The degree to which the internal environment of the firm matches with the external environment is expressed by the concept of strategic fit.

- Strengths: characteristics of the business or project that give it an advantage over others
- Weaknesses: characteristics that place the business or project at a disadvantage relative to others
- Opportunities: elements that the business or project could exploit to its advantage
- Threats: elements in the environment that could cause trouble for the business or project

Identification of SWOT is important because they can inform later steps in planning to achieve the objective. First, decision makers should consider whether the objective is attainable, given the SWOT. If the objective is not attainable, they must select a different objective and repeat the process.

Users of SWOT analysis must ask and answer questions that generate meaningful information for each category (strengths, weaknesses, opportunities, and threats) to make the analysis useful and find their competitive advantage.

SWOT analysis is an examination of an organization’s internal strengths and weaknesses, its opportunities for growth and improvement, and the threats the external environment presents to its survival. Though it is framed for organizational usage, it can be applied to family

livelihood activities. It is necessary to know that we face competition in our every activity. For example, in a small village of around 500 people, it may not be profitable for each household to go for poultry farming. Although we may argue that it is possible to export to other villages or town but it is wise to know the intensity of competition prevailing for poultry market.

So, it is important to know clearly what are our strength, weakness, opportunities and threat. Let us look into the steps for performing SWOT analysis:

Step 1 of SWOT analysis involves the collection and evaluation of key data. Depending on the organization, these data might include population demographics, community health status, sources of healthcare funding, and/or the current status of medical technology. Once the data have been collected and analyzed, the organization's capabilities in these areas are assessed.

In Step 2 of SWOT analysis, data on the organization are collected and sorted into four categories: strengths, weaknesses, opportunities, and threats. Strengths and weaknesses generally stem from factors within the organization, whereas opportunities and threats usually arise from external factors. Organizational surveys are an effective means of gathering some of this information, such as data on an organization's finances, operations, and processes.

A practical example of Step 2 of SWOT analysis is illustrated in Exhibit below:

	Helpful	Harmful
	Helpful	Harmful
Internal Origin	Strengths	Weaknesses
External Origin	Opportunities	Threats

Step 3 involves the development of a SWOT matrix for each business alternative under consideration. For example, say a hospital is evaluating the development of an ambulatory surgery centre (ASC). They are looking at two options; the first is a wholly owned ASC, and the second is a joint venture with local physicians. The hospital's expert panel would complete a separate SWOT matrix for each alternative.

Step 4 involves incorporating the SWOT analysis into the decision-making process to determine which business alternative best meets the organization's overall strategic plan.

Strengths

Traditional SWOT analysis views strengths as current factors that have prompted outstanding organizational performance. Some examples include highly competent personnel, a clear understanding among employees of the organization's goals, and a focus on quality improvement.

Weaknesses

Weaknesses are organizational factors that will increase healthcare costs or reduce healthcare quality. Examples include aging healthcare facilities and a lack of continuity in clinical processes, which can lead to duplication of efforts. Weaknesses can be broken down further to identify underlying causes. Weaknesses also breed other weaknesses. Poor communication disrupts the continuity of care, and then this fragmentation leads to inefficiencies in the entire system. Inefficiencies, in turn, deplete financial and other resources.

Opportunities

Traditional SWOT analysis views opportunities as significant new business initiatives available to organization or individual.

Threats

Threats are factors that could negatively affect organizational performance. Examples include political or economic instability.

Usage :

A SWOT analysis is useful for any kind of strategic planning. It is a relatively quick way to look at organizational /individual strengths, weaknesses, opportunities, and threats. The overall purpose of a SWOT analysis is to examine the internal and external factors that help or hinder you in achieving each of your objectives. It can be used as a brainstorming tool or to help focus your attention on key areas.

You can use your SWOT analysis as a means of gathering information from a range of perspectives or you may be able to use your results to strategic advantage by either matching your strengths to opportunities or converting threats or weaknesses into strengths or opportunities.

SWOT analysis can play a valuable role in enabling unusual and non-conformist issues to be raised and discussed. It also has a role to play in developing a strategy objective when it is used as part of the process, but its limitation must be acknowledged.

The most obvious limitations are: the risks of oversimplification; the fact that vested interests can prevent weaknesses and threats from being acknowledged; and the danger of information overload as there are no obvious limits as to what is and is not relevant.

The 4 P's of marketing mix :

1) **Product :**

A product is seen as an item that satisfies what a consumer demands. It is a tangible good or an intangible service. Tangible products are those that have an independent physical existence. Typical examples of mass-produced, tangible objects are the motor car and the disposable razor.

Every product is subject to a life-cycle including a growth phase followed by a maturity phase and finally an eventual period of decline as sales fall. Marketers must do careful research on how long the life cycle of the product they are marketing is likely to be and focus their attention on different challenges that arise as the product moves.

2) **Price :**

The amount a customer pays for the product. The price is very important as it determines the company's profit and hence, survival. Adjusting the price has a profound impact on the marketing strategy .it will affect the demand and sales as well. The marketer should set a price that complements the other elements of the marketing mix.

When setting a price, the marketer must be aware of the customer perceived value for the product. Three basic pricing strategies are: market skimming pricing, market penetration pricing and neutral pricing. The 'reference value' (where the consumer refers to the prices of competing

products) and the 'differential value' (the consumer's view of this product's attributes versus the attributes of other products) must be taken into account

3) **Place :**

Refers to providing the product at a place which is convenient for consumers to access. Various strategies such as intensive distribution, selective distribution, exclusive distribution and franchising can be used by the marketer to complement the other aspects of the marketing mix. The distribution channel which is the location where the delivery the value. The role of the marketing channels is not only focus on the participate in demand satisfaction by offering goods, but also need to stimulate demand through information, creating proximity and promotion by customer. In other words, distribution channels for the product is a system process. Generally, majority of the product need a retail shop. But place also can be a telephone call center or a website.

4) **Promotion :**

All of the methods of communication that a marketer may use to provide information to different parties about the product. Promotion comprises elements such as: advertising, public relations, sales organisation and sales promotion.

VALUE CHAIN ANALYSIS :

Value chain analysis (VCA) is a process where a firm identifies its primary and support activities that add value to its final product and then analyze these activities to reduce costs or increase differentiation.

Value chain represents the internal activities a firm engages in when transforming inputs into outputs.

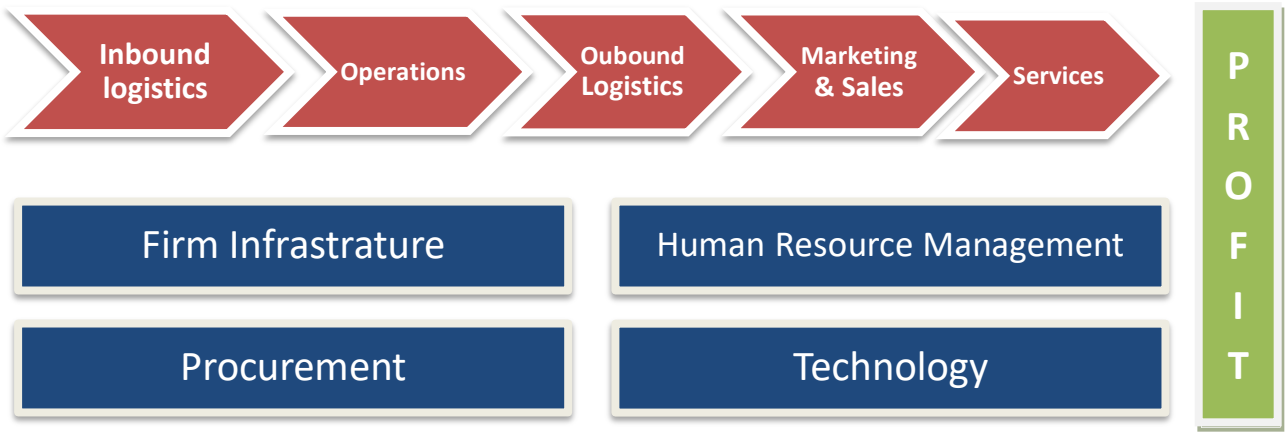
Understanding the tool :

Value chain analysis is a strategy tool used to analyze internal firm activities. Its goal is to recognize, which activities are the most valuable (i.e. the source of cost or differentiation advantage) to the firm and which ones could be improved to provide competitive advantage. In other words, by looking into internal activities, the analysis reveals where a firm's competitive advantages or disadvantages are. The firm that competes through differentiation advantage will try to perform its activities better than competitors would do. If it competes through cost advantage, it will try to perform internal activities at lower costs than competitors would do. When a company is capable of producing goods at lower costs than the market price or to provide superior products, it earns profits.

M. Porter introduced the generic value chain model in 1985. Value chain represents all the internal activities a firm engages in to produce goods and services. VC is formed of primary activities that add value to the final product directly and support activities that add value indirectly.

Porter's Value Chain Model

Primary activities

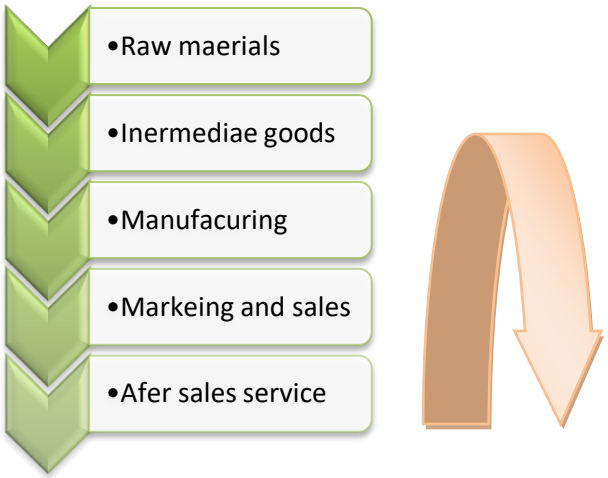


Support activities

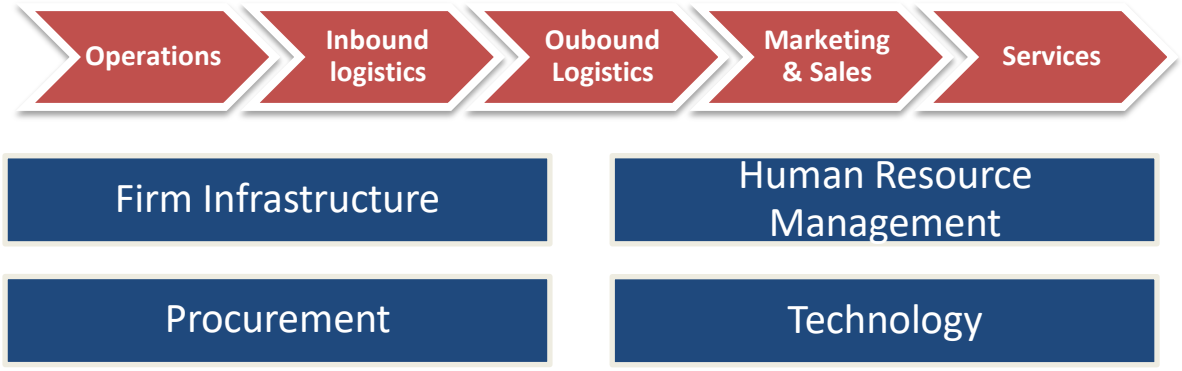
Although, primary activities add value directly to the production process, they are not necessarily more important than support activities. Nowadays, competitive advantage mainly derives from technological improvements or innovations in business models or processes. Therefore, such support activities as 'information systems', 'Research & Development' or 'general management' are usually the most important source of differentiation advantage. On the other hand, primary activities are usually the source of cost advantage, where costs can be easily identified for each activity and properly managed.

A firm's value chain is a part of a larger industry value chain. The more activities a company/producer groups undertakes compared to industry value chain, the more vertically integrated it is. Below you can find an industry value chain and its relation to a firm level value chain.

Industry's value chain :



Company's value chain :



Using the tool :

There are two different approaches on how to perform the analysis, which depend on what type of competitive advantage a company wants to create (cost or differentiation advantage). The table below lists all the steps needed to achieve cost or differentiation advantage using VCA.

Cost advantage :

To gain cost advantage a firm has to go through 5 analysis steps:

Step 1. Identify the firm's primary and support activities :

All the activities (from receiving and storing materials to marketing, selling and after sales support) that are undertaken to produce goods or services have to be clearly identified and separated from each other. This requires an adequate knowledge of company's operations because value chain activities are not organized in the same way as the company itself. The managers who identify value chain activities have to look into how work is done to deliver customer value.

Step 2. Establish the relative importance of each activity in the total cost of the product :

The total costs of producing a product or service must be broken down and assigned to each activity. Activity based costing is used to calculate costs for each process. Activities that are the major sources of cost or done inefficiently (when benchmarked against competitors) must be addressed first.

Step 3. Identify cost drivers for each activity :

Only by understanding what factors drive the costs, managers can focus on improving them. Costs for labor-intensive activities will be driven by work hours, work speed, wage rate, etc. Different activities will have different cost drivers.

Step 4. Identify links between activities :

Reduction of costs in one activity may lead to further cost reductions in subsequent activities. For example, fewer components in the product design may lead to less faulty parts and lower service costs. Therefore identifying the links between activities will lead to better understanding how cost improvements would affect he whole value chain. Sometimes, cost reductions in one activity lead to higher costs for other activities.

Step 5. Identify opportunities for reducing costs :

When the company knows its inefficient activities and cost drivers, it can plan on how to improve them. Too high wage rates can be dealt with by increasing production speed, outsourcing jobs to low wage countries or installing more automated processes.

Differentiation advantage :

VCA is done differently when a firm competes on differentiation rather than costs. This is because the source of differentiation advantage comes from creating superior products, adding more features and satisfying varying customer needs, which results in higher cost structure.

Step 1. Identify the customers' value-creating activities :

After identifying all value chain activities, managers have to focus on those activities that contribute the most to creating customer value. For example, Apple products' success mainly comes not from great product features (other companies have high-quality offerings too) but from successful marketing activities.

Step 2. Evaluate the differentiation strategies for improving customer value :

Managers can use the following strategies to increase product differentiation and customer value:

- Add more product features;
- Focus on customer service and responsiveness;
- Increase customization;
- Offer complementary products.

Step 3. Identify the best sustainable differentiation :

Usually, superior differentiation and customer value will be the result of many interrelated activities and strategies used. The best combination of them should be used to pursue sustainable differentiation advantage.

Example :

Step 1 - Primary activities					
Procuring seeds and fertilizers	Purchasing materials and components	Land preparation & Soil management	Weed and plantation management	Sales and marketing	Distribution and dealer support
Step 2 - Total cost and importance					
Rs. 1000 *less important*	Rs. 5000 *less important*	Rs. 5000 *very important*	Rs. 7000 *very important*	Rs. 2000 *important*	Rs. 1000 *less important*
Step 3 - Cost drivers					
Acquiring best variety of seeds based on local climatic conditions	Order size, average value of purchases per supplier & location of suppliers.	Size of land, labor cost etc.	Size of land, labor cost, technology used etc.	Availability of local market and demand.	Number of dealers, sales per dealer, frequency of sales, etc.

Step 4 - Links between activities

- Higher yielding seeds for more output and productivity
- Application of newer technologies and following best practices.
- Understanding market trends for crops produced.
- Storages for harvested crops.

Step 5 - Opportunities for reducing costs

- Create a robust model design for different regions to cut costs in procuring seeds, fertilizers and machineries/tools required, and to adopt newer technologies for reducing cost
- Transportation cost can be reduced through the producer's group which acts as an important tool for collective bargaining.

Topic 32 – Closure and feedback

Objectives :

1) To recollect and assess the key lessons learnt
2) To get the feedback on the entire training program

Duration : 30 minutes

Expected outcome : The trainer understand the impact of training on the trainees

Module Plan

Topic	Content	Methodology	Process	Materials Required
Closure and feedback	* Rating of training * Rating of trainer * Rating of training content	Group activity	The participants will be given a printed format to write their learning during the training	Foolscap paper, Pen