TOPIC TO BE INCLUDED IN MGNREGA DELIVERABLES COMPONENT TRAINING

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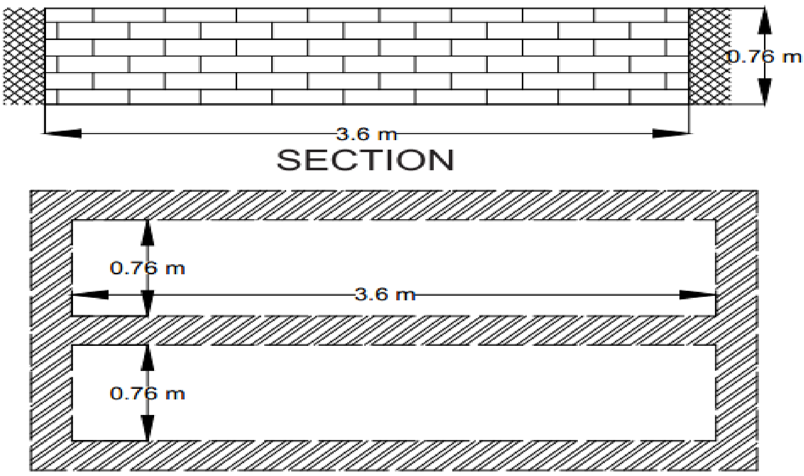
COMPONENT -1-2:

1. **VERMI COMPOST PIT.**

VERMICOMPOST PIT



SECTION

PLAN

One Vermi-compost pit can yield 150 kg of compost, sufficient to enhance the productivity of 0.25 hectare.

Site selection: Important measures for site selection are similar to those adopted for NADEP pit given above.

Design and estimate for Vermicompost pit:

Usually, a twin pit model is used to prepare the Vermicompost pit, each pit having dimensions of 3.6m X 1.5m X 0.76m (length x width x depth). There should be a wall between the two pits comprising of a lattice to allow the worms to move from one pit to another.

Estimated cost:

The unit cost of a Vermicompost pit is estimated to be Rs 9150. The ratio of unskilled labour to material is 25:75.

Instructions for the Beneficiaries:

- Sources of food for earthworms: Crop residues, tree leaves and animal dung are the basic raw materials required for the Vermi-compost pit. Agricultural wastes like sugarcane trash, weeds, hedge cuttings, saw dust, paddy husk, cattle dung, effluent slurry from bio-gas plant, excreta of sheep, horse and pigs, poultry droppings (in small quantity) and vegetable wastes are ideal sources of food for earthworms.

Preparation of Vermicompost bed:

- Step 1: A bed (10cm depth) should be prepared by using a base of raw materials like paddy husk, sugarcane husk and other agricultural wastes. It should be covered with a layer of soil. Water should be sprinkled on it.

- Step 2: Organic waste should be mixed well with equal quantity of cow dung and water. The slurry from bio-gas plant should also be used, if available, as it is considered to be one of the best ingredients used in Vermicompost. The materials should be turned 2 to 3 times within the interval of 4 to 5 days.
- Step 3: Worms should be transferred to the pit and covered with a layer of mixed organic waste. Preferably, 2000 worms should be used for every 400 kilogram of feed material (The rate of application of worms).
- Step 4: The bed should be covered with gunny bags and water should be sprinkled regularly. The worms will convert the feed mix to Vermicompost in 60 days.
- Step 5: Vermicompost would be ready to harvest after 60 days. It has to be spread on a plastic sheet, and kept for drying for 2-3 hours. The worms will move towards and gather at the bottom of the heap. Once the process is complete the Vermicompost should be removed from the top and worms should be collected carefully.

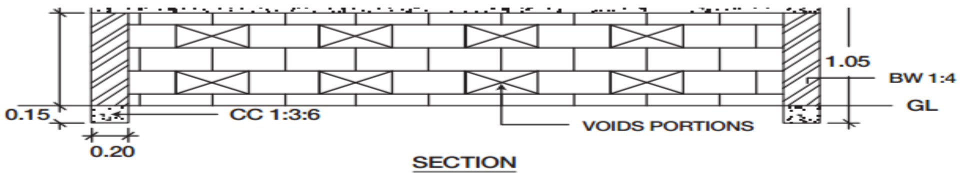
Precautionary measures:

- Water logging in the bed leads to anaerobic condition and change in acid or base level (pH) of the medium. This hampers normal activities of worms leading to weight loss and decline in worm biomass and population. Measures should be taken to avoid water logging (drainage channel or raising the plinth level).
- Bed should be protected from predators like red ants, white ants, centipedes and others like toads, rats, cats, poultry birds and even dogs.
- Fresh cow dung should not be used in the pit as it generates heat affecting the growth of micro-organisms.

VERMI COMPOST

2. **NADEP COMPOST PIT:**

NADEP COMPOST PIT



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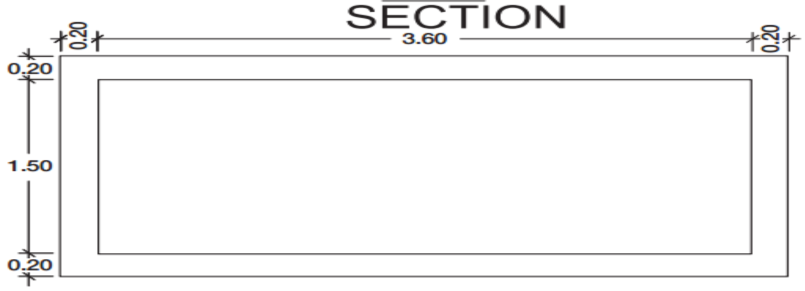
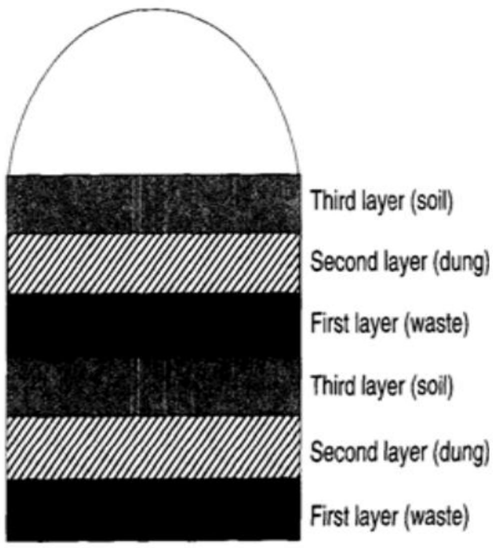


PLAN



Site Selection:

- The site should be located close to a source of water as well as where the farm waste and animal waste are easily available.
- Site should not be a disputed or encroached land and Habitation Sabha or Gram Panchayat should agree to the site proposed by the beneficiary.
- The site should not be located in an area which gets submerged during the rainy season.

Design and estimate for NADEP Pit:

- The NADEP pit is usually constructed with a dimension of 3.6m X 1.5m X 0.9m (length x width x height) having a lattice brick wall to ensure proper aeration for composting.
- Estimated cost: The unit cost of a NADEP pit is estimated to be around Rs. 8000. The unskilled labour to material ratio of this work is 25:75.

Instructions for the Beneficiaries:

- Collect 4 to 5 bullock carts (1300 to-1500 kg) of farm waste (dry and green) material, 100 kg of cattle dung or biogas slurry, 150 to 180 kg of fine sieved soil and 1200 to 1400 liters of water.
- Pit Filling: Layers of agricultural waste, dung and soil are successively heaped upon each other in the pit. The given below figure provides illustrations:
- Once successively heaped material begins to decompose, and within 20 to 30 days of pit filling, the material gets compressed. The pit has to be filled again in the same way as earlier. It should be allowed to decompose for three months and water should be sprinkled at a regular interval of 7 to 10 days.

Precautionary Measures:

- The pit should have a thatched roof over it to prevent excessive evaporation.
- Before filling the pit, it should be plastered on all the sides by diluted cattle dung slurry. It would activate microbial population.
- Under no circumstances should any cracks be allowed to develop. If they do, they should be promptly filled up with slurry.
- The entire pit should be filled in one go, within 24 hours and shouldn't go beyond 48 hours, as this would affect the quality of the compost.

3. AZOLLA :

AZOLLA as Cattle-Feed Supplement

Azolla is a floating fern which resembles to algae, can serve as livestock feed. It acts as a potential source of protein and amino acid. Livestock can easily digest it, owing to its high protein and low lignin content. It also enhances quality and quantity (up to 15-20%) of milk and meat. It is also used as compost. A bed having dimensions of 5 ft. x 8 ft. can yield 1 to 1.25 Kg of Azolla. Yield of one bed would be sufficient for one animal.

Site Selection: The proposed site should be close to the source of water and livestock shed.

Design and estimate for Azolla Tank: The outer side wall should have a dimension of

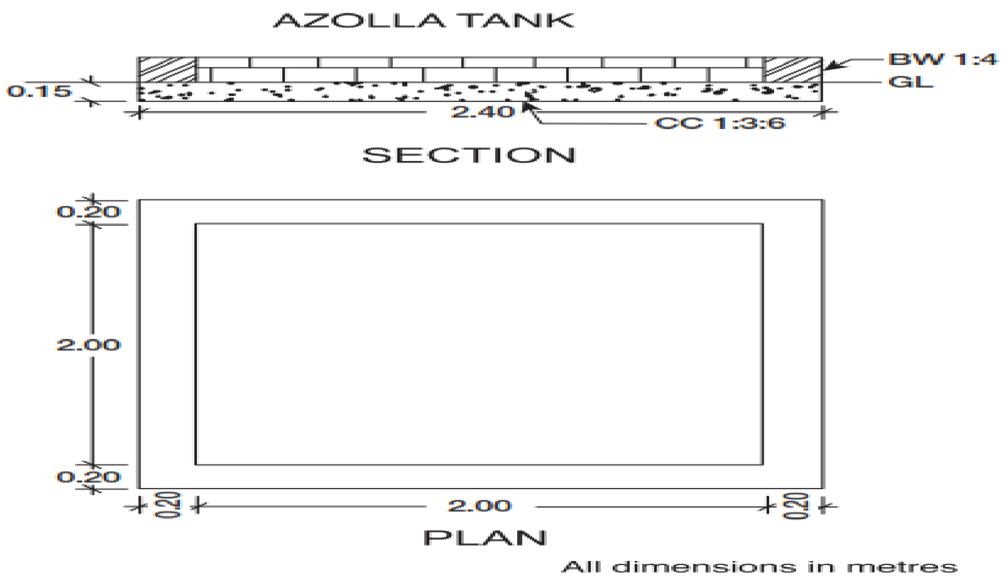
2.75mX1.75mX0.75m while the inner side wall should have a dimension of be 2.5mX1.5mX0.6m.

Estimated cost: The unit cost of one azolla pit is estimated to be Rs 2,200. The unskilled labour to material ratio is approximately 30:70.

Instructions for the beneficiaries: The steps to be followed for construction of the Azolla tank are given below:

• About 10 to 15 kilogram of sieved fertile soil should be uniformly spread over the bottom surface of the pit.
• 5 kilogram of cow dung, 40 grams of azophos and 20 grams of azofert should be mixed well in 10 liters of water. The slurry prepared should be poured into the pit. More water should be added to the pit to make up the volume.
• One to two kg of fresh, disease free azolla seed culture should be inoculated into the pit.
• At an interval of 10 days, one fourth of the water should be removed from the bed and replaced with fresh water.
• Likewise, at an interval of two months, one fifth of the soil should be removed and
replaced with fresh one.

Precautionary measures
• Azolla should not be cultivated under direct sunlight or incomplete shade.
• Proper water level should always be maintained at least half an inch above the sand.
• In case the crop of Azolla is infested with pests it should be completely removed and replaced with fresh azolla. Plant should not be allowed to enter the stage of maturity stage or spore formation.
• To get rid of the smell of cow dung, azolla should be properly washed before feeding it to any livestock. To avoid overcrowding, biomass of azolla should be removed regularly.



COMPONENT – 3 – 4

1. **FARM POND/DUG OUT / FISH POND:**

Site Selection:

- A DOP can be made on any and every field. The capacity of the DOP should be determined on the basis of the rainwater that is estimated to flow out of the farm.
- A DOP should be made in a farm or near it, so that protective irrigation can easily be given.
- The site where the DOP is built should not have a slope more than 2%.
- The catchment area of the site where the DOP is to be located should not be more than 5 ha.
- The site should have an impermeable underground strata up to a depth of around 3 metres.
- If we want to provide 10 cm of protective irrigation to the crop over 1 hectare, we need 1000 cum of water. Volume of water required = Area to be irrigated x depth of irrigation = 1 hectare x 10 cm. = 10,000 sq.m. x 0.1m. = 1000 cum. A DOP whose dimensions are 25m x 20 m x 2.5 m will yield this amount of water. Such a DOP will occupy 25m. x 20m. = 500 sq.m. in 1 hectare, i.e., 5% of the area to be irrigated (500/10,000 = 5%). That is why this is sometimes referred to as the 5% model.

How to make a DOP:

- Select an appropriate site on the basis of the considerations outlined above.
- make the layout for the excavation of the DOP at the chosen site.
- leave a gap of about 2 to 3 m between the excavated portion and the mud piled up after excavation. This gap is known as a berm.
- if the mud excavated is fertile, spread it in the farm.

Special Precautions:

- Proper catchment area treatment should be done upstream of the DOP to reduce the rate of siltation within the DOP
- A DOP should never be built on the main stream of the watershed
- Farmers who do not have any other source of irrigation should be chosen as beneficiaries

- For a given storage capacity, deeper DOPs are better than shallower ones since they occupy less of the farmer's land and are less prone to evaporation losses
- The base and sides of the exit should be pitched with stones. This ensures that there is no soil erosion when the water flows out of the exit.

Planning a DOP:

Question: If a farmer has 2 ha of land and all other factors are favourable, then how should a DOP be planned to ensure protective irrigation to the kharif crop?

Answer:

We know that the plot size is: 2 ha

Now, 1 ha= 100m   100m

= 10,000sqm

Thus, 2 ha= 20,000sq.m

If in order to provide protective irrigation to the kharif crop, we need 10 cm (0.1 m) of water, then we need 2,000 cum of water for this:

20,000sqm.   0.1m= 2,000cum

The dimensions of this DOP could be varied. For instance, we could have a DOP with length 40 m   breadth 20 m   depth 2.5 m

2. COMMUNITY FISH:

FISHERIES IN SEASONAL WATER BODIES ON PUBLIC LAND

Fisheries as a livelihood activity for the poor have immense scope. Many small reservoirs, tanks, water harvesting ponds created under MGNREGA are ideally suited for fish production. In the floodplains, there are a large number of small water bodies with potential for fisheries development. These water bodies are mainly fed by surface run-off from local catchments. Varying water spread area, pronounced seasonality of filling, high dependence on rainfall and competitive claims on stored water for irrigation are some of the characteristics of these water bodies. There is a large gap in the potential and actual yields in these rainfed water bodies. There is scope for enhancing the fish production by 3 to 5 times from the current productivity levels. Adopting culture based fisheries with advanced fingerlings (100 mm and above) at stocking rates of 500-1000 fingerlings per ha can substantially increase productivity in the water spread area in small reservoirs, estimated at 1.2 million ha in the country. The activities involved include digging and landscaping of the bed of the water body to suit fish production, ensuring year round dead-storage, protecting the spill-ways and provision of small fish nursery ponds with assured water for rearing fingerlings. A 500cu.m. fish nursery pond and excavation of 15,000 cu.m. in an existing tank bed, along with a fish drying platform of 30 sq.m., will cost around Rs. 11 lakhs. The approximate unit cost of this activity is Rs. 75 per cubic metre of excavation and the unskilled labour : material ratio works out to 80:20.

The common pool nature of these water bodies makes fish production in them a complex task. This will need to be tackled through appropriate arrangements at the local level, which may require facilitation, especially in the initial stages.

3. STOP DAM:

Stop dams are constructed on streams with big catchments. They are designed to capture the post monsoon flows. Usually, the gates of the stop dam are kept open during the monsoon season to let out runoff water. This also ensures that there is little or no siltation in the stop dam. After the monsoon, the gates are closed and the dam gets filled up with post monsoon flows. Hence, such dams should be constructed only in streams with perennial flows so that the stop dam gets several re-fills during the post monsoon season.

For a stop dam with a catchment area of 1000 hectares, length of 20m, maximum height of 2.7m, top width of 1.5m and side slopes of 1:1, the cost works out to around Rs. 5 lakhs. In general the unit cost works out to Rs. 90-100 per cum. of water stored. Stop dams are masonry dams either using bricks or stone. Where hard stones (compact basalt or granite) are available in sufficient quantity, it is good to use random rubble stone masonry. Also used are pre-fabricated metal sheets of 1.5 mm thickness for the gates of stop dams. The unskilled labour : material ratio works out to 25:75.

COMPONENT – 5 – 6

1. TERRACE:

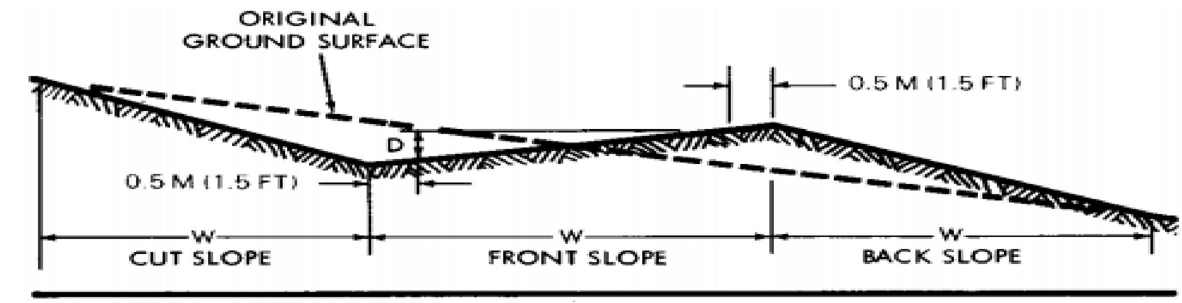


Figure 1 – Broadbase terrace cross section†

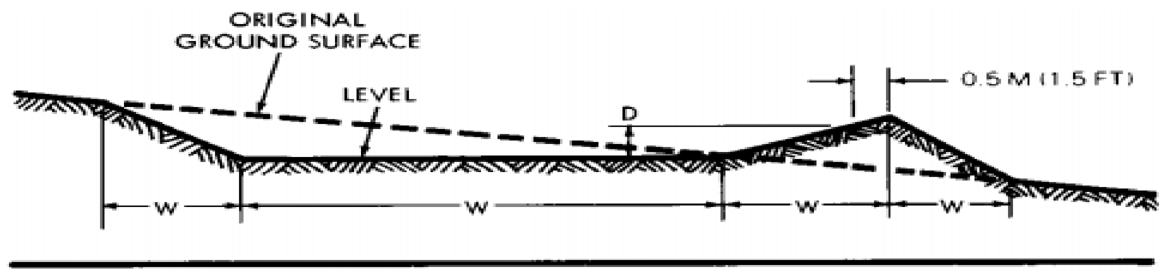


Figure 2 – Conservation bench terrace cross section†

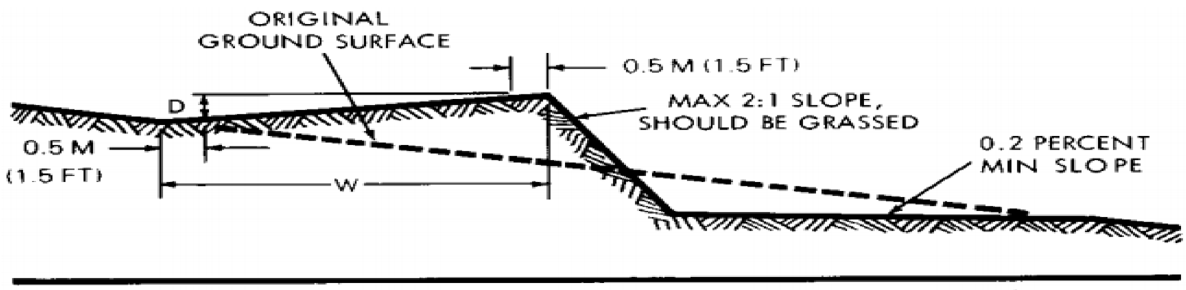


Figure 3 – Steep-backslope terrace cross section†

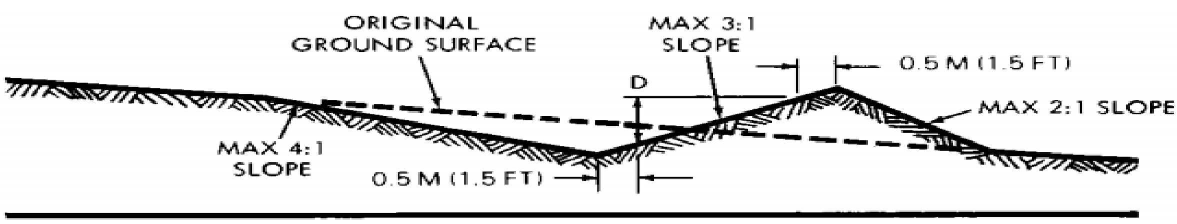


Figure 4 – Narrow-base terrace cross section†

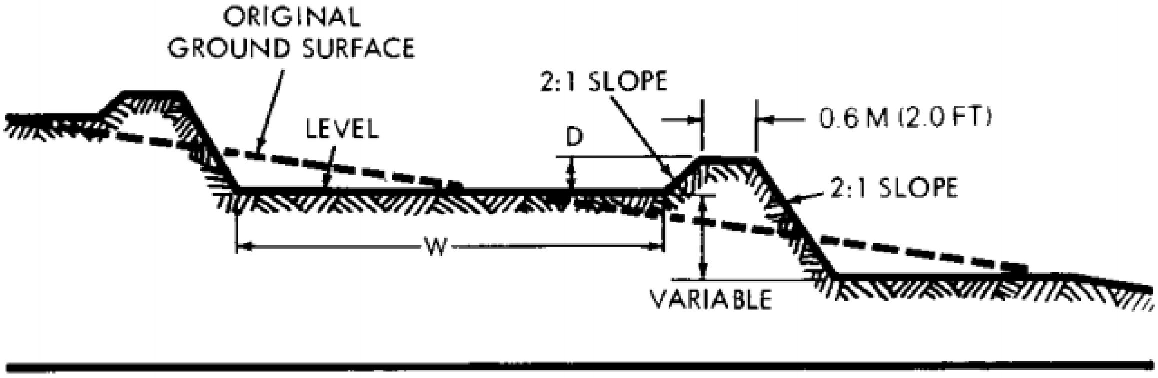


Figure 5 – Bench terrace cross section†

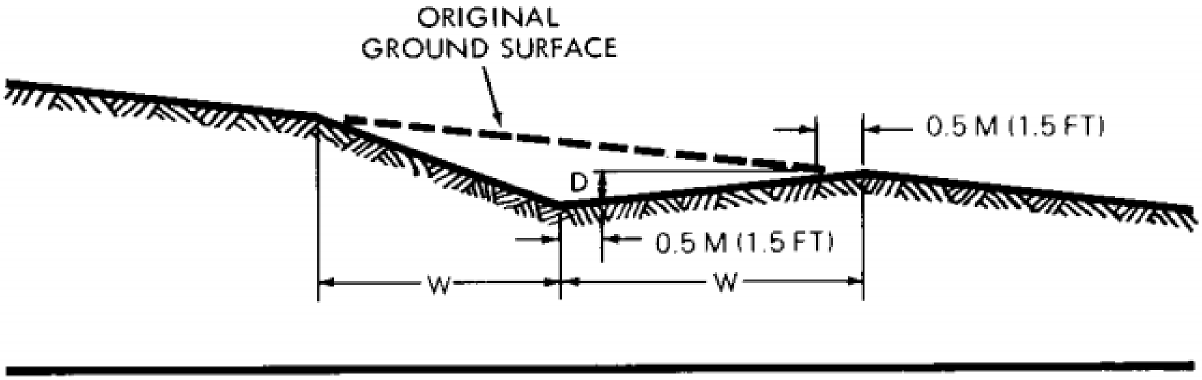


Figure 6 – Ridgeless-channel terrace cross section

The slope limit for bench terracing in hilly areas is generally recommended not to exceed 33%. However, looking into the topographical and socio-economic conditions in the Himalayan region bench terracing is being practiced up to 50% land slope. Bench terraces may be:-

a) Table top for paddy cultivation

b) Inward sloping.

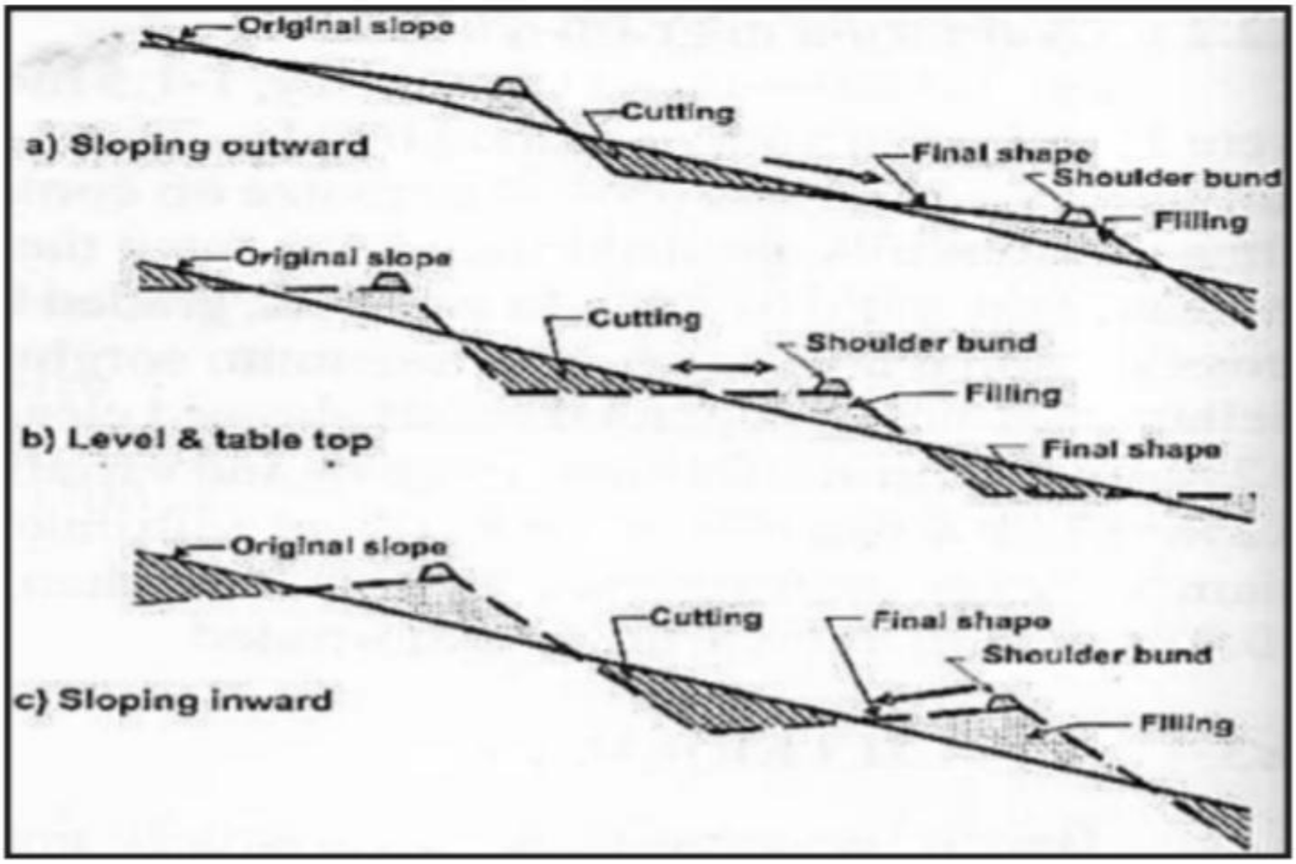
c) Outward sloping.

The suitability of these types is governed by the factors like crops to be grown, rainfall, soil properties and management practices etc.

a) Table top bench terraces are suitable for areas receiving medium rainfall and having highly permeable and deep soils and it is the best practice for paddy cultivation.

b) Inward sloping bench terraces are more effective in high rainfall areas and for the crops like potato (which is susceptible to water logging). It helps in quick but safe disposal of runoff through a drain which is provided on inner side of the terrace these are widely used in different hilly regions of the country.

c) Outward sloping bench terraces are effective only in low rainfall areas with permeable soils of medium to shallow depth and generally from an intermediate step towards construction of table top or inward sloping terraces. In the middle Himalayan region bench terraces are constructed on steep slopes beyond the recommended limit of 33% to the growing food requirements. A survey revealed that about 70% of the bench terraces were constructed between land slope of 50-70% with average outward and longitudinal slope of 10% and 8% respectively. This resulted in high soil and nutrient losses which need to be minimized by providing suitable earthen/ stone-cum-earthen shoulder bunds.



Method of Execution:

With reference to the contour lines the alignment of terraces as per designed vertical interval and width is staked out. The alignment may be done in such a way that minimum convenient width of terraces is always available for cultivation. All sharp and pointed curves should be conveniently smoothened out by deviating, if necessary, from the contour.

Construction of terrace should normally start from the first terrace on the top of the field however, for preserving the top soil the terraces may be built from down slope up or top soil collected at one place before cutting the terrace and spread afterwards.

Spacing of terrace:

$$VI = \frac{S \times Wb}{100 - (S \times U)}$$

VI : vertical interval, in m

S : slope in percentage (%)

Wb : Width of bench (flat strip), in m

U : Slope of riser (using value 1 for machine-built terraces, 0.75 for hand-made earth risers and 0.5 for rock risers).

Example: Calculate the VI of 4 m wide, hand~made benches on a 30% slope with earth risers.

$$VI = \frac{30 \times 4}{100 - (30 \times 0.75)}$$

$$= 1.55 \text{ m}$$

2. CONTOUR TRENCH:

a) Continuous contour trench:

Objectives:

- Slowing down the velocity of runoff
- Checking soil erosion
- Improving local soil moisture profile

Location:

- If the slope is more than 25% do not make contour trenches. The best form of treatment is plantation or protection of grasses, shrubs and trees, appropriate and native to the area.
- If the slope is less than 10% do not make contour trenches - If the slopes are less than 10%, even then contour trenches are not the best measure. This is because in such a situation, in comparison to contour trenches, contour bunds are a more effective means of checking runoff and soil erosion.
- If the slope is between 10% to 25% make contour trenches- Given the above considerations, contour trenches are most appropriate where the slope of the ridge area lies between 10-25%.

Distance between Successive Rows of Trenches:

- "The vertical interval between contour trenches is fixed at 1 meter". Thus, with a constant vertical interval of 1m, the contour trenches would be spaced at a horizontal interval of 20m on a 5% slope and 10m on a 10% slope.

- On high slopes, the trenches should be close to each other but never closer than 10 m.
- On low slopes, the trenches should be far from each other but never farther than 30m.

Design of Contour Trenches:

- Contour trenches are always dug half a metre deep and half a metre wide.
- Depth:50 cm
- Width: 50 cm
- Berm: The mud excavated is spread out 20cm away, downstream of the trench. This gap between the trench and mud is called the berm.

Layout of Contour Trenches:

- Measure the slope in different parts of the ridge area
- Mark out areas with slope between 10-25% for the lay-out of contour trenches
- Begin with the longest section within this area.

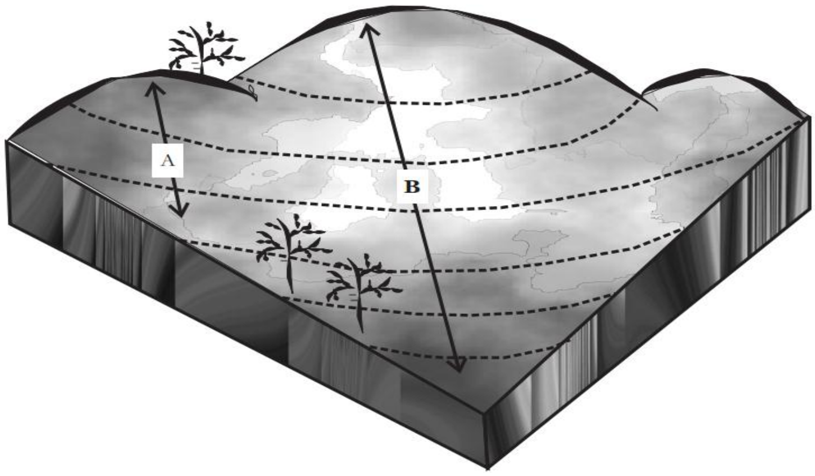


Fig 11 Layout should be made beginning with the longest section

In Figure 11, Section A is 30m long. If we begin laying out contour trenches of 15m successive intervals from this section, we will only be able to dig 2 rows of trenches in the entire area. On the other hand, if we begin laying out contour trenches from Section B (which is 90m long) we will be able to dig 6 rows of trenches. Thus, only when you start from the longest section will you be adequately cover the ridge area with contour trenches. Of course, we must also bear in mind that the interval between rows of trenches will narrow at the steeper slopes. Make sure that this interval does not become less than the minimum you have stipulated for your area.

b) Staggered Contour Trench:

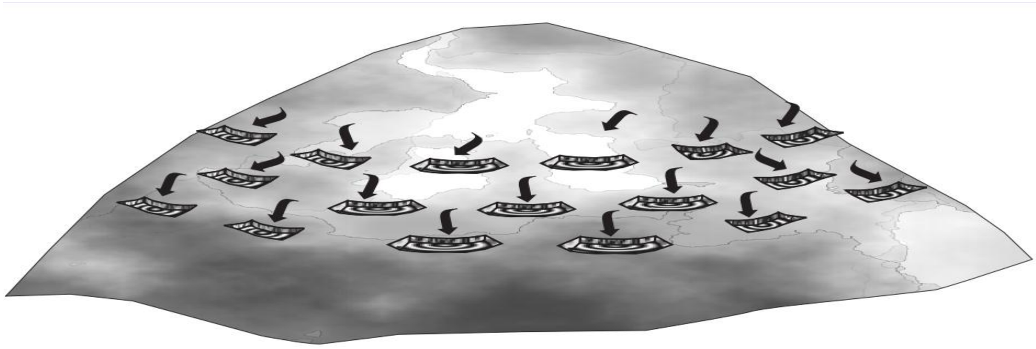


Fig.12.Staggered trenches minimise the risk of going off the contour and are therefore safer

Dig a trench 4m long on a contour line. Give a gap of 4m. Dig another4m trench
along the contour. And so on, along this particular contour. Then, come to the next contour line. Begin digging in a stretch which covers the gap left in the higher contour
line. The gaps in this contour line should fall below the trenches in the higher contour line. In this way, we maximize the runoff harvested by the trenches.

3. EARTHEN CONTOUR BUNDS:

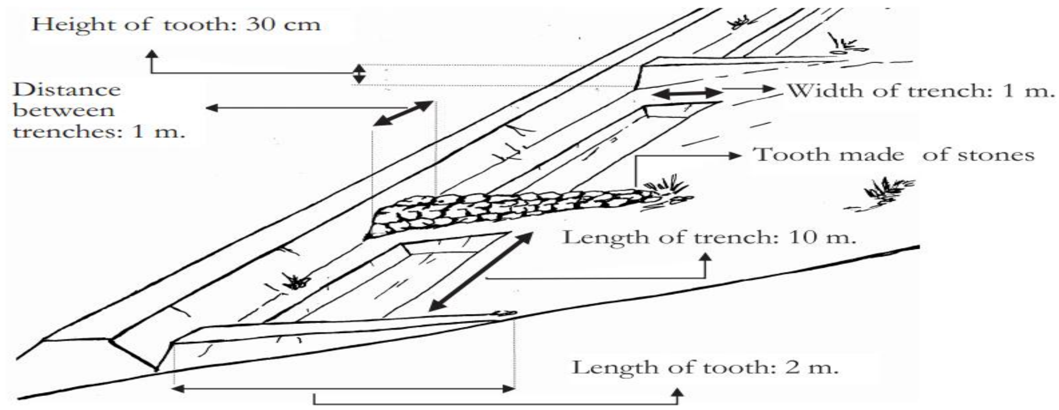


Fig.13.Excavation for construction of contour bunds should not be continuous. Teeth should be made at regular intervals perpendicular from the bund

Objectives:

- Slowing down the velocity of runoff
- Checking soil erosion
- Improving local soil moisture profile

Location:

- **If the slope is more than 10% do not make contour bunds**. This is because on such steep slopes, the velocity of run-off will break these bunds.
- **If the slope is less than 10% make contour bunds.** In a contour bund, waternot only stops in the excavated portion but also against the bund. Therefore, here contour bunds must be constructed in place of contour trenches.

The Distance between Contour Bunds:

- With a constant vertical interval of 1m, the contour bunds would be spaced at a horizontal interval of10m on a 10% slope and 100m on a 1% slope.
- On high slopes, the bunds should be close to each other but never closer than 30 m.
- On low slopes, the bunds should be far from each other but never farther than 60 m.

Design: In Relatively Permeable Soils

- Height: 60 cm
- Settlement Allowance: 20-25%
- Thus, height of bund at time of construction: 60 x 1.25 = 75 cm. In gravelly soils, the settlement allowance can be lowered to 10%
- Top Width: 20-30 cm
- Upstream Slope: 1:1
- Downstream Slope: 1:1.5. In gravelly soils, both upstream and downstream slopes can be kept at 0.75:1
- **Exit:** the exit should be placed slightly above ground level. The water will stop at the bund for a short time and then flow out of the exit. In such cases, however, it is extremely important to strengthen those sections of the bund which are adjacent to the exit.
- **Soil Excavation:** Soil should never be excavated continuously because this will cause the formation of channels, which will erode soil and carry out water. Instead, several discontinuous trenches should be made in which soil and water can collect. The width of this trench should be 1 m. Where excavation is discontinued, a small tooth should be constructed at 90 degrees or perpendicular from the bund. This tooth should be about 2 m. long and should have a maximum height of 30 cm. If stones are available, this tooth should bemade entirely of stones.
- **Berm:** There should be a distance of at least 30cm.

- **Bund Protection with Plantation:** Wherever possible, contour bunds must be protected against erosion by planting grass on the bunds.

EARTHEN CONTOUR BUNDS

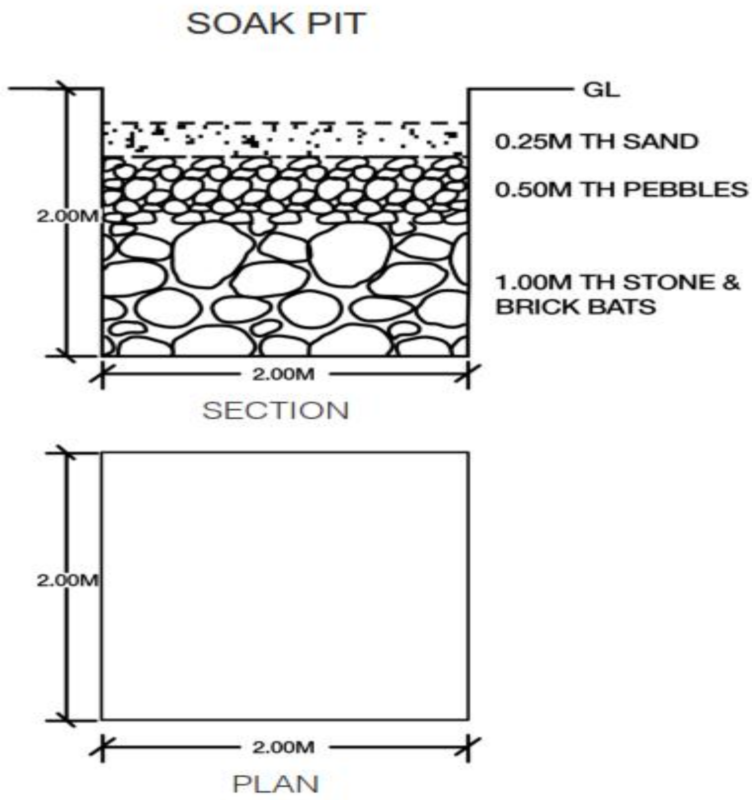
4. SOAK PIT:

Soak pit is an underground structure that allows water to soak into the ground. This helps in improving sustainability of the source of water. Further it also helps in reducing the propagation of harmful insects which develop more in water stagnated areas.

Site selection: Site should be selected close to well, hand pump, or bore well where most of the water could be collected and drained into the channel.

Drawing and budget estimate: Dimension of pit should be 2m X 2m X 2m. It should be filled with stones and bricks up to 1m from the base. After it is filled with stone and bricks, pebbles should be filled up to 0.5 m. The last layer should be filled with sand till 0.25m. Remaining 0.25 m should be left open to collect water. As a result the water gets percolated down to the surface.

Estimated Cost: The unit cost of soak pit is estimated to be Rs 2,200. The unskilled labour : material ratio is approximately 40:60.



All dimensions are in metre.

5. **RECHARGE PIT:**

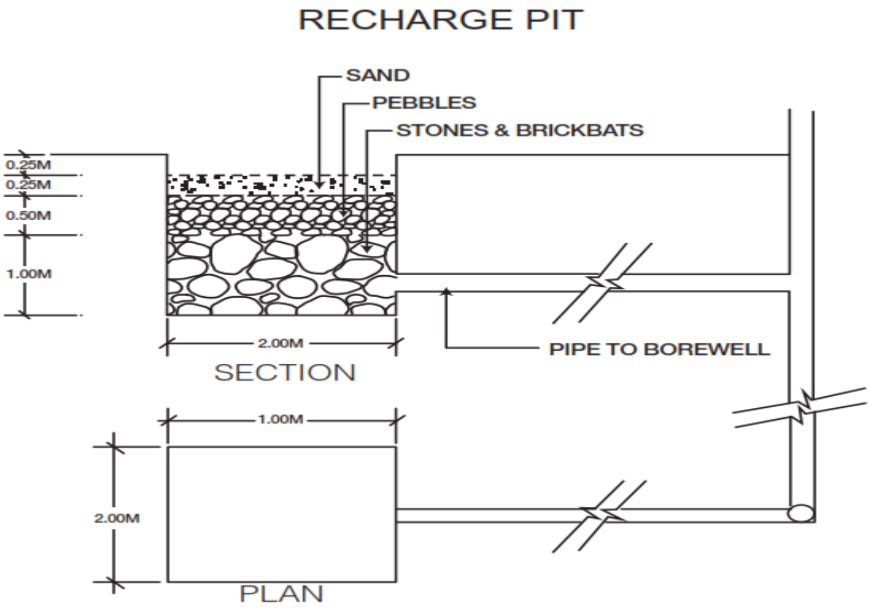
A recharge pit allows rainwater to replenish groundwater. It can be built to recharge a bore well or dug well, just to help the water infiltration in an area. This helps in improving sustainability of the source of water.

Site Selection:

- The site should be close to well or bore well so that water can move toward well or bore well without traveling a long distance.
- The site of pit should be at a low elevation point where rain water can accumulate.

Drawing and budget estimate: Dimension of pit should be 2m X 2m X 2m. It should be filled with stones and bricks up to one meter from the base. After it is filled with stone and bricks, pebbles should be filled up to 0.5 m. The last layer should be filled with sand till 0.25m. Remaining 0.25 m should be left open to collect water. As a result the water percolates down to the surface and move into tube well casing or open dug well through pipe.

Estimated Cost: The unit cost of recharge pit is estimated to be around Rs 5,000. The unskilled
labour to material ratio is approximately 15: 85.



SPECIFICATIONS

SAND: The sand should be free from clay particles
PEBBLES: Before filling in the pit pebbles should be cleaned properly and the over aged pebbles should not be used.
STONE AND BRICKBATS: The hard stone, properly cleaned shoule be used and the brickbats should be of properly burnt bricks.

NOTE: It should be ensured that the filling material is cleaned properly and hygenic.

1. **PUBLIC GARBAGE PIT:**

Community level composting may be resorted to when management of solid waste at household level is not possible. For community level composting, Panchayat should select a suitable site as Compost Yard for the village. Site should be selected taking into consideration wind flow direction, so that the inhabited areas don't get any foul odour. The site should be easily accessible for transportation of waste and manure. It should not be a low lying area to avoid water logging.

Size of the pit:

Depth of the pit should not be more than 1 meter and width should not exceed 1.5 meter. Length of the pit may go up to 3 meter. In the pit, waste takes about 4-6 months to compost. Hence, adequate number of pits will be required. Distance between two pits should be more than 1.5 meter. While digging pits, care should be taken to ensure that there is adequate facility to transport the garbage and store the manure.

Action

The construction of composting pit or heap is very simple and user friendly. Gram Panchayat (GP) can easily construct compost pit with little technical support from outside.

Underground unlined manure pit or garbage pit.

Applicability:

- Rural areas with low rainfall
- Villages where there is lack of space at household level for composting.

Description:

- Dig adequate number of pits of not more than 1m (depth) x 1.5m (width) x 3m (length) dimension depending upon quantum of garbage generated
- Make a ridge with the help of soil at the periphery of the pit & compact it by light ramming. Use and maintenance of the pits
- Go on adding collected garbage in the pits (only biodegradable type)
- Wherever possible, it is advisable to add cow dung slurry to the garbage to enhance the composting process
- Spread a very thin layer of soil over it (once a week) to avoid odour & fly nuisance • Continue to add garbage everyday
- Follow the above procedure & repeat the layers till the pit is full. It is recommended to fill the pit up to about 300mm above ground level
- After 3-4 days the garbage above ground settles down
- Plaster it with soil
- Leave the pit as it is for 3-6 months for maturation and start other pits sequentially
- After 3-6 months take out the compost & use it in the fields. Cost: Manual labour (3 man days) to dig one pit. Limitations: Not suitable for heavy rainfall areas and rocky.

COMPONENT – 7 – 8

1. ANIMAL SHELTER.

a) PIG STY:

Principles of Design

The ideal pigsty allows easy dung and urine collection and separates the different age groups of the animals. The pigsty should be at the backside of the house in order to avoid disturbance by bad odour. The pigsty is divided into the following compartments:

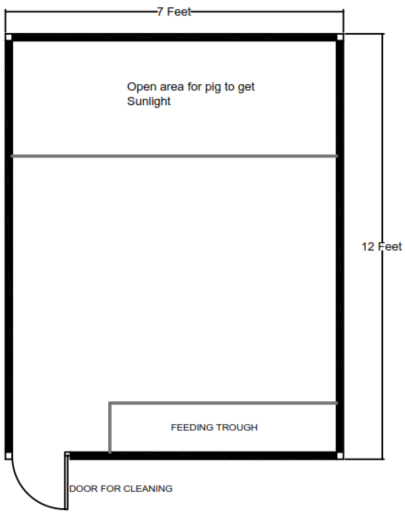
-The boar box, which is big enough to accommodate both the boar and the sow for mating.
-The farrowing box, with protection rails for piglets to hide when the sow lays down.
-The gestating box for sow and weaning piglets
-The finishing box (boxes) for growing piglets no longer weaning.
-The finishing box (boxes) for pigs to grow to market size.

Each of the compartments consists of a clean resting and feeding area and a dirty area where pigs defecate. The dirty areas of several boxes are Inter-connected and form a corridor in order to allow easy cleaning and washing of the floor. Pigs need a draft-free and rather uniform environment (minimum 15^0 C for adults, 22^0 C for piglets). Therefore, the wall of the boxes should be built to a height of 1.50m completely closed and a roof of only 1.80-2.00 m above the floor.

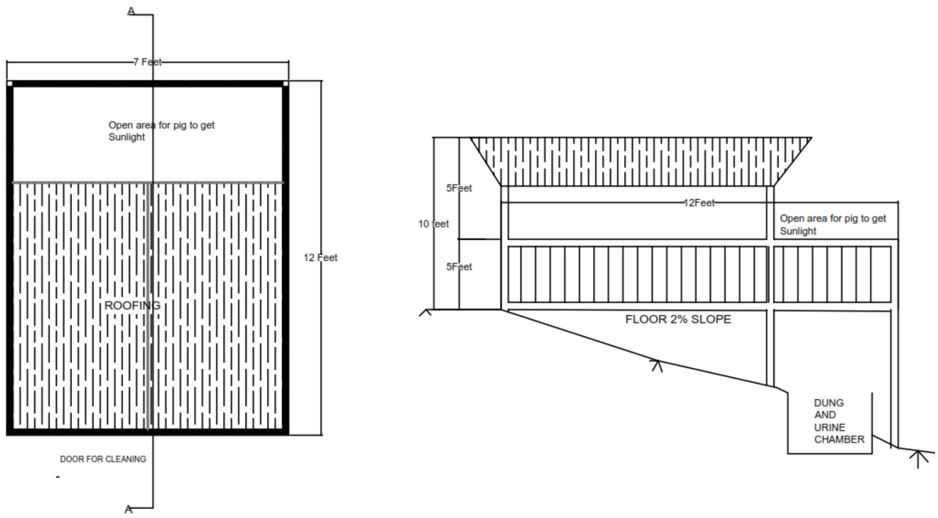
Construction Details

The slope of the floor of the boxes to the corridor and that of the corridor to the dung and urine chamber is 2%. The doors of the boxes close the individual compartments when opening the corridor and vice versa.

Beneficiaries were motivated and encouraged to construct a larger pig sty (about 40 square feet per pig) to improve the comfort of the pigs. They were encouraged to construct the sty in their backyard, especially in a dry area having plenty of sunlight and a proper drainage system with two manure pits for collecting the dung, which is used as fertilizer for food–feed crop cultivation. The materials used for constructing the pig sties were generally locally available materials (preferably wooden plank and thatch). The fodder trough is covered or protected by bars to prevent the pigs from laying in the fodder. There is a pipe for draining and easy cleaning at the bottom of the trough.



PLAN



SECTION

Fig: Typical Pig Sty Design for tow pigs with floor area of 84 sqft.

b) POULTRY SHELTER

Site Selection:

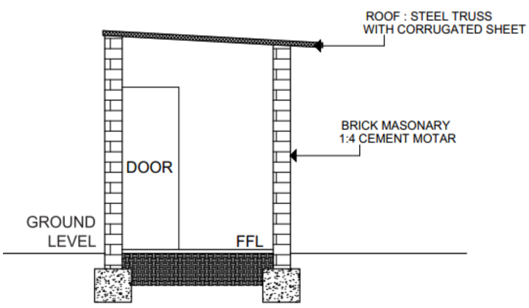
Site should be located close to the house to ensure regular monitoring. The selected site should preferably be on the upland to avoid water logging conditions. The size of the selected area should be sufficient to accommodate the existing stock. The area of the plot is important, but the choice should be left to the beneficiary.

Instructions for the Beneficiaries:

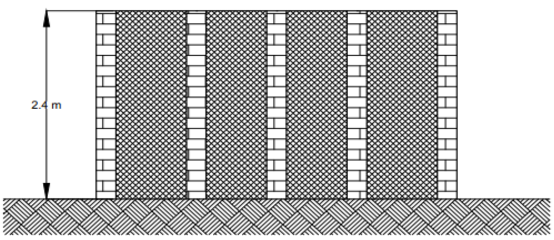
A shelter of 7.50 sq m. (length 3.75 m and width 2 m) would be suitable for 100 birds. On the longer sides, the shelter will have a 30 cm high and 20 cm thick brick masonry wall upto plinth level. From the plinth to the top of the shelter there is a wire mesh supported by brick masonry pillars of size 30 cmx30 cm. The shorter side will have a 20 cm thick brick masonry wall with an average height of 2.20 metres. The roof will be supported by a steel truss. The roof will have galvanised iron corrugated sheets. The base of the floor will be constructed by hard moorum filling. The floor will be built by using 2nd grade bricks with packing in 1:6 ratio of cement mortar.

Estimated Cost:
The total cost of such a poultry shelter is around Rs. 40,000. The poultry shelter will have an unskilled labour: material cost ratio of 20:80.

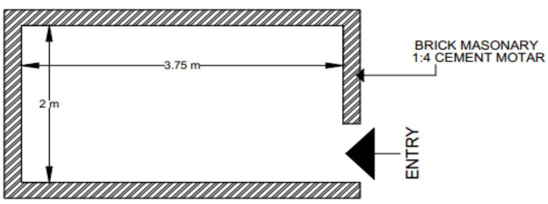
POULTRY SHED



CROSS SECTION



LONG WALL 3.75 m



PLAN

All dimension are in metre

c) CATTLE SHED:

Site Selection:

If a new site is proposed then it should be close to the house to ensure regular monitoring. The place should be located slightly on upland or higher elevation so that it does not get flooded during rainy season.

Drawing and budget estimate:

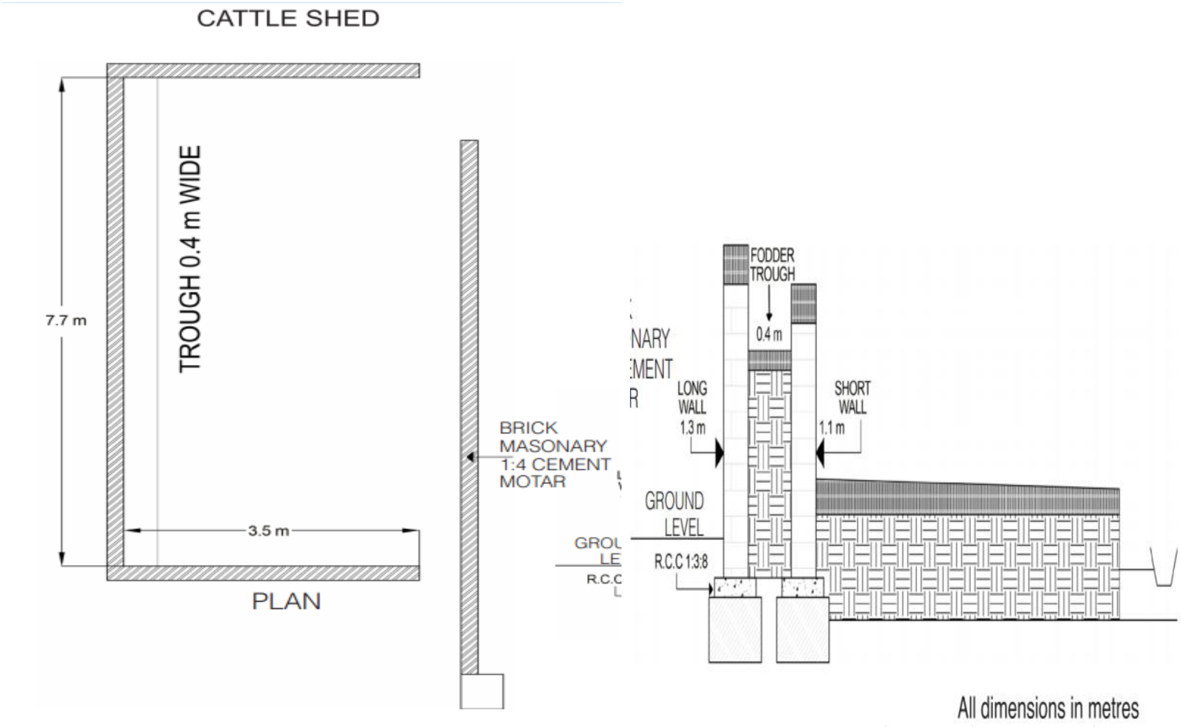
The area of the cattle shed floor for 6 heads of cattle is 26.95 Sq.m. [redacted] cum fodder trough (7.7mx 0.4m x0.65m) and a cattle urine collection tank of 250 litres has [redacted]

Estimated cost:

Unit cost of construction of concrete floor, urine tank and fodder trough for cattle shed will be around Rs 35,000 for which the unskilled labour to material ratio is approximately

Instructions for the Beneficiaries:

- [redacted] should be constructed in a manner such that it has an inclined slope.
- A wet, slippery floor may cause serious injuries to the animal such as fracture, tearing, over stretching of ligaments and even abortion. So the floor should be nonporous and non-slippery.
- Application of lime would prevent infestation of pathogens.



d) Goat Shelter

Poor rural households depend on small ruminants like goats and sheep for additional source of income. It is a well-known fact that for tribal families of Central India, goat rearing and poultry are often as important means of livelihood as agriculture. However, they lack the resources to construct and provide an adequate living space for their animals, leading to their poor health and frequent illnesses. Poor shelter infrastructure also leads to low and inefficient collection of dung and urine, which could be a source of valuable and locally available organic input to farming. Thus, provision of better shelter facilities for these small ruminants offers a win win situation by which animal health and soil health can be improved simultaneously, with very low initial investment.

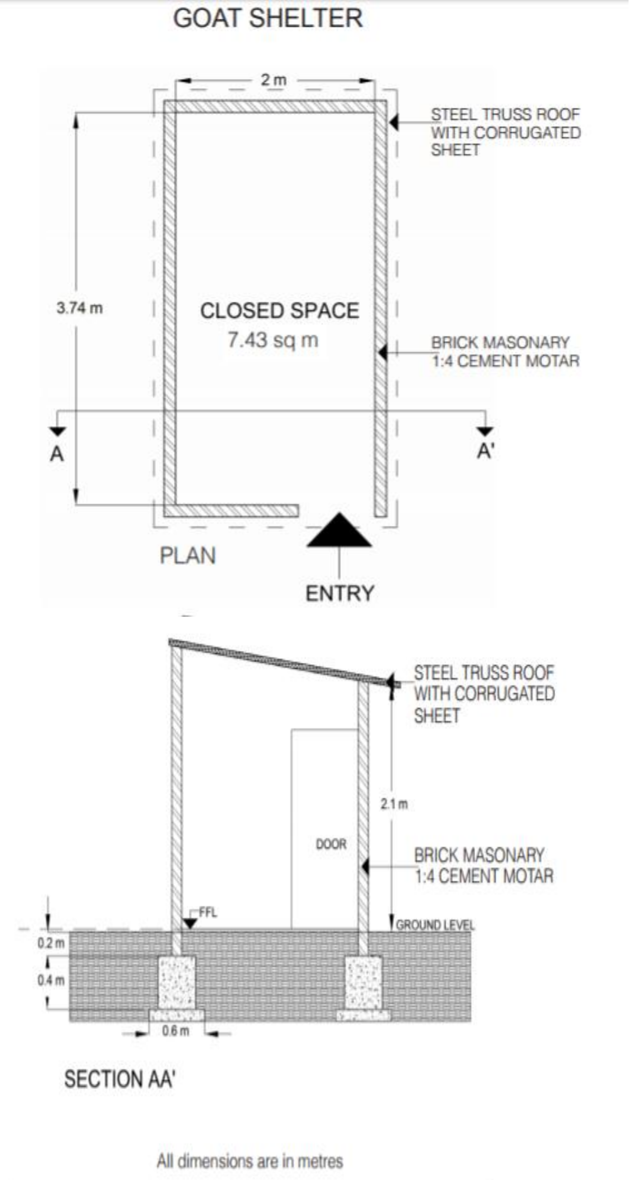
Site Selection: Important measures for site selection are the same as mentioned under the site selection of poultry shelter.

Design and Estimate of Goat Shelter: A 7.5 sq m. shelter (length 3.75 m and width 2 m) would be suitable for 10 goats. The 4 walls will be raised to an average height of 2.20 metres. The walls will be of brick masonry using 1:4 cement mortars. The roof will be supported by a steel truss. The roof will have galvanised iron corrugated sheets. The floor will be of hard moorum.

Estimated Cost: The cost of such a goat shelter will be around Rs. 36,000. The goat shelter will
have an unskilled labour to material ratio of 25:75.

Instructions for the Beneficiaries:

- An uneven hard floor is uncomfortable and unhealthy for animals. The floor should be constructed in a manner such that it has an inclined slope.
- A wet, slippery floor may cause serious injuries to the animal such as fracture, tearing, over stretching of ligaments and even abortion. So the floor should be nonporous and non-slippery.
- Application of lime would prevent infestation of pathogens.



2. **FODDER PRODUCTION.**

Introduction of Green Fodder Production:- Green fodder plays major role in feed of milch animals, thereby providing required nutrients for milk production and health of the dairy animals. Green fodder production provides the better option of feed buying alternative for farmers who are planning to go for sheep farming, goat farming or dairy farming. Some farmers even depend on the cultivation of green fodder just like any other crop and sell it in the market. Some types of green grasses can be chopped into pieces using local chop cutting machine and make silage which can be stored for years and used as fodder in dry or drought seasons. Green fodder can be cultivated in open fields choosing right hybrid perennial variety. Green fodder even can be grown using hydroponics system.

Objectives of Green Fodder Production in Agriculture:- The following are the primary functions of Green Fodder.

- Green fodder provides natural way of nutrients for animals and plays major role in livestock growth and health.
- Green fodder cultivation cut the cost of feed.
- Produced green fodder can be made into silage and used for future.
- Green fodder production time is short and as most of the varieties are perennial, one can get fodder for years.
- Cultivation cost and maintenance of green fodder is low.

Types of Green Fodder:- The following are the types of Green Fodder. These are different types of fodders to achieve a common result based on different types of plants.

- Legume Fodder.
- Cereal Fodder.
- Grass Fodder.
- Tree Fodder.

Green Fodder Production from Legume Crops:-

1) **Cowpea:**

- Cowpea is an annual crop and this can be grown in grown in tropics, sub-tropics and warm temperature regions.
- Cowpea is useful for feeding in green form, for hay making or for ensiling in mixtures with sorghum or maize.
- This crop can be cultivated during Kharif, Rabi and summer seasons.
- Cowpea can be cultivated throughout the year.
- Generally, it takes about 40 to 45 kg/ha seed rate.

- Cowpea can be harvested after 45 to 50 days after sowing (40 to 50% flowering stage).
- This variety yields the green fodder of 20 tonnes/ha.
- Plant height is about 95 cm (cm) and posses 2 to 3 branches and 10 to 12 leaves.

2) **Stylo:**

- Generally, stylo reaches height of 2 meters.
- Stylo is drought resistant and a good pasture legume crop and it requires low rain fall.
- Stylo can be grown in tropical climate. This crop is tolerant to low fertility soils acidic soils and soils with poor drainage.
- The crude protein content of stylo ranges from 16% to 18%.
- The best season for stylo is June – July to Sept – Oct months.
- When it comes to seed rate, for line sowing @ 30 x 15 cm, the required seed rate is 6 to 7 kg/ha and for broadcasting 10 to 11 kg/ha.
- Stylo will be ready for harvesting 70 to 75 days after sowing at flowering stage and subsequent harvests depending upon the growth.
- During the first year (establishment phase) of crop, low yield can be expected and subsequent yield would be high and yield of 25 to 40 tons/ha/year can be obtained from 3rd year.

3) **Desmanthus:**

- This crop is a perennial one and can grow all around the year. This crop can be grown under rainfed and irrigated conditions.
- This crop requires 18 to 20 kg of seeds per hectare and seeds should be sown in solid stand on the side of the ridges dug over the lines where manures and fertilizers are applied @ 2 cm depth.
- Make sure the seeds are covered with top soil.
- Irrigation should be carried immediately after sowing the seeds. Life irrigation should be given on 3rd day and subsequent watering should be provided once in 6 to 7 days. It does not require any irrigation in rainy season.
- This crop will be ready for first harvest in 3 months after sowing when it is 45 to 50 cm height.
- Subsequent harvesting should be done @ 35 to 40 days interval depending on the growth.
- Green fodder yield of 80-90 tons/ha/year can be obtained.

4) **Lucerne:**

- Lucerne is popularly known as queen of forages and this legume crop is deep rooted perennial forage grown on wide range of climatic conditions ranging from tropical to alpine.
- Lucerne very palatable and nutritious green fodder and contains about 15% to 20% crude protein on dry matter basis.

- Apart from all these benefits, Lucerne adds nitrogen to soil and improves soil fertility.
- This crop is usually grown for green fodder, hay, silage. However it does not tolerate close grazing.
- Seeds rate of 18 to 20 kg/ha are required.
- Co1 cultivar is suitable to grown in July-Dec months and not preferred to grow in extreme hot and extreme cold climates.
- The first cutting will be ready 70 – 80 days after sowing and subsequent harvests can be made @ 21 to 30 days.

Green Fodder Production from Cereal Crops:-

1) **Maize (Corn) Fodder:-**

- This crop requires a seed rate of 40 to 45 kg/ha and dibble one seed to a spacing of 15cm between the seeds in the row which are 30 cm apart.
- The average green fodder yield of 45-50 tons/ha and the dry matter yield is 10-15 tones/ha can be obtained.
- Staggered sowing is recommended for supply of green fodder for a long period.
  Usually it comes to harvesting stage in 2 months when the cob is in the milky stage.

2) **Sorghum Fodder – Jowar:**

Sorghum Crop

- This crop is cultivated for both grain and fodder.
- Sorghum is a drought resistant annual crop and grows well in tropical areas with a temperature range of 25-36 C.
- This crop requires an annual rainfall of 300- 400 mm. It can be cultivated on wide range of soils, however too much sandy soils should be avoided.
- This crop requires seed rate is 40 to 45 kg/ha and 12 to 13 kg/ha for Co.F.S. 29 varieties.
- This crop can be harvested after flowering stage for green fodder.
- If it is a single cut, it should be harvested at 60-65 days (50% flowering) after sowing and if it is a multicut, the first cut is 2 months after sowing and subsequently once in 45 days.

Green Fodder Production from Grass Crops

1) **Hybrid Napier Fodder:**

- Basically, this is a perennial grass fodder and possesses more tillers and leaves than Napier grass and ismore vigorous and yielding and quality is higher.
- This crop contains crude protein from 8 to 10%.
- Usually 40,000 to 45,000 slips should be required to plant in one hectare land.

- First cutting should be done on 70to 80 days after planting and subsequent cuttings at intervals of 40 to 45 days.
- Hybrid Napier grass can be intercropped with Desmanthus at 3:1 ratio and can be harvested together and fed to livestock.

2) **Guinea Grass:**

- This grass reaches about 5 meter tall and tufted and fast growing highly palatable perennial grass.
- It has short creeping rhizome and establishes readily with seed or plantation of rooted slips.
- This grass contains crude protein of 4-15%.
- This grass can be grown in all types of soil with well-drainage. However, it does not grow well on heavy clay soil or flooded or stagnation conditions.
- This crop requires seed rate of 2 to 2.5 kg/ha and slips of 65,000 nos./ha which accommodates spacing of 50 cm x 30 cm.
- Usually, the first harvest will be ready in 70- 80 days after germination or 40 to 45 days after planting of slips. Subsequent cuts should be carried out at intervals of 40 to 45 days.
- Green fodder yield of 17- 180 tonnes /ha per year in 8 cuts can be obtained.

3) **Para Grass:**

- This grass forage is a perennial and ideal for growing in humid climatic conditions.
- This can be cultivated in seasonally flooded valleys and lowlands. This grass can withstand water stagnation and long term flooding as well.
- Avoid dry lands in arid or semi arid regions as it does not thrive in these type of soils.
- This grass is sensitive to cold and the growth is adversely affect in sub-tropical regions.
- It prefers water logged soils for high yielding of green fodder. It can also thrives in sandy soils.
- The disadvantage of this grass cultivation is, seed setting is very poor and is propagated exclusively by stem cuttings.
- This can planted anytime during the year provided there is sufficient irrigation is available.
- In this grass, there are no hybrid cultivars available.
- Thin shoots should be used as planting material and stems with 2-3 nodes should be planted in 45 to 60 cm rows at 20 cm distance. The stems should be pressed into wet soil leaving the two ends sticking up.
- 900-1000 kg of stem cuttings should be required for planting in one hectare field.
- The first harvest will be ready in 70-80 days after planting and the subsequent cuts should be given at 40 to 45 days interval. There would be totally 6 to 9 cuts can be taken in a year with an average green fodder yield of 90-100 tons/ha.

4) Blue-Buffel Grass:

- This type of grass suitable for pasture land and it is a perennial.
- Well drained soil with high calcium content is suitable for this grass cultivation.
- This crop requires seed rate of 5 to 7 kg/ha.
- Generally, first cut can be made 70 to 75 days after sowing and subsequently 4 to 5 cuts depending on growth.
- This grass crop can yield up to 35 tons/ha/year in 4 to 5 cuts.

Green Fodder Production from Tree Crops:

1) **Subabul Fodder:**

- This is one of the fastest growing fodder trees and produces maximum seeds.
- The best time for sowing these plants is in the month of June-July.
- These plants will be ready for first cutting in as early as 6 months after planting the seeds. However, the initial cutting should not be done until the trunk has attained at least 3 cm in diameter or the plant has completed one seed production cycle.
- Subsequent cuttings can be carried once in 45 – 80 days depending upon growth and season.

- In case of drought regions, allow the trees to grow for 2 years to ensure deep root penetration.
- The trees should be at 95 to 100 cm height from ground level.
- Under irrigated conditions, a green fodder of 90 to 100 tons/ha can be obtained.
- Under rainfed conditions 40 tons/ha of green fodder can be achieved.

2) Sesbania Fodder – Agathi:

- The leaves of Agathi trees are highly palatable and mostly liked by goats.
- This tree leaves contain protein content of 20 to 25%.
- These trees can be grown all around the year provided there is a sufficient irrigation available.
- These trees thrive best in soils with good drainage and organic matter.
- This crop requires seed rate of 7 to 8 kg /ha, seeds should be sown at a distance of 100 cm x 100 cm (100 cm between ridges and 100 cm between plants within the ridge).
- The first harvest will be ready after 7 to 8 months and subsequent harvests can be done at an interval of 70-80 days depending on the growth.
- These trees can produce green fodder of 90 to 100 tonnes per/ha/year.

3) Gliricidia Fodder:

- This tree is a small and semi-deciduous tree with pale bark.
- Glyricidia sepium and Gliricidia maculata are the two species available and Gliricidia maculata is more useful as green leaf manure. It also fixes atmospheric nitrogen in the soil.
- Glyricidia sepium tolerates a wide range of climatic conditions. Growth of this tree is fast in areas where annual rainfall exceeds 850 mm, but it can grow well where rainfall is as low as 400 mm.
- The tree prefers soils ranging from heavy clays to sands and on rocky eroded sites; however, it is sensitive to water stagnation so drainage is very important.
- The plant is used for fuel wood, animal feed, green manure, shade, poles, and living fences and as support plants.
- These plants are generally propagated through seed or cuttings.
- This produces fresh growth after every cutting of the leaves. it will supply enough green leaf manure for 2 to 2.5 tonnes/ hectares of land.

Fodder plantation can be done on both public land and private land as decide by Gram panchayat or gram sabha.

1. SOLID WASTE MANAGEMENT

The Steps in Solid Waste Management

In this chapter we present the steps an aspiring GP can follow in order to take up solid waste management (SWM). It follows a step-by-step approach. It starts with *preparatory arrangements* required, and goes up to *monitoring the progress* a given GP is making in SWM.

Step – I: Preparation

1) **Panchayat functionaries meeting:** The Panchayat President, Vice-president, secretary, and other ward members should express their willingness and support, and resolve to take up the cause of clean GP within certain time period (one year).

2) **Gram Sabha Meeting:** Gram Sabha should discuss about (and pass a resolution) what it means to be a clean village; in what way each household may have to cooperate etc. This can include resolutions such as: (i) cloth bags to be used, and avoid use of carry bags; (ii) tea stalls to use only stainless steel glasses and no use and-throw cups; (iii) a by-law in this regard can be prepared and passed as well

3) **Community Education:** Various segments of the community need to be educated. It must include the households, SHGs, shopkeepers, tea stalls, local restaurants, school children, marriage and community halls etc. It is good to meet each group separately. Community education must essentially include: what are bio-degradable wastes; and what are non bio-degradable wastes? Which ones are recyclables; what hazardous wastes are; what is meant by *primary segregation* that the households are supposed to do?

4) **Identify infamous spots**: Generally street corners and empty land in between houses are vulnerable spots to become 'undeclared dump yards'. Every household silently assume that spot for dumping household wastes. There are three things that need to be done about such places. (a) First of all, identify such infamous places / spots; (b) the garbage heap in such places must be moved to some existing landfills; and (c) fencing can be done to prevent future misuse, or if it is a common land, put some plants or tree saplings to grow. If funds are available put up a swing for children to play there. Keep that place occupied, it should not be seen being empty.

5) **Community Preparation:** Each household must be provided with three buckets – Green, Blue and a Red one. (a) The Green bucket is for disposing of kitchen refuse, leftover food and other **wet waste**; (b) The Blue bucket is meant for keeping **dry wastes**; and (c) the Red bucket is for keeping

hazardous wastes like batteries; fused bulbs etc. For an illustrative list of wet waste / dry waste / hazardous waste see Box – 2 (Waste Category). The wet waste in the Green buckets shall be collected daily morning (or morning and evening) as decided by the Gram Panchayat. Collecting two times a day (morning and evening) renders handling easy. That is when the waste is still fresh and has not started emitting smell, effective segregation becomes easier, than handling wastes that are stale and decayed. The dry waste shall be collected separately, and the hazardous waste shall be collected from households once a month, for instance, on the 5th day of every month. If found more, it can be made once a fortnight. The chance of hazardous waste being more is very remote.

Step – II : Planning

1) **Area Survey:** Estimation of the nature, type and quantum of wastes generated by different category of people viz. households, tea stalls, restaurants, marriage halls, vegetable market, fish market, bus stand, temples, and schools etc. is necessary to be able to plan for collection, transport, and manpower requirements. For households, average waste generated can be estimated. But, with regard to other stakeholders such as restaurants and markets a site-visit might be required to assess the waste they generate daily. The existing arrangement for waste disposal should also be studied.

2) **Material Planning:** Tri-cycles or (solar) battery operated vehicles for waste collection (one vehicle with two waste collectors for every 150 households, for instance), uniform and gears (jacket, gloves, cap, water bottle, first aid kit) for the workers, segregation shed, compost yard for wet waste, storeroom to lay in dry waste, tools and equipments.

3) **Manpower Planning:** SWM is a labour intensive work. We need two workers per 150 households. That means with each garbage collection vehicle two workers can be deployed, who can help each other. They can together cover 150 households every day. They may cover 150 HH in the morning (7.00 – 10.00 am) and 150 HH in the evening (4.00 – 7.00 pm). Two hours can be spent in secondary segregation at the shed - one hour in the morning and one hour in the evening. The experience in some places is that poor and destitute women are trained in this work. Those already involved in rag picking are also recruited and trained. Selection and training are important because wrong selection shall require frequent recruitment.

4) **Technical Planning:** This is about processing and treatment of wastes collected. This guide does not suggest elaborate treatment methods. It suggests to go for simple windrow composting with wet waste, and if possible to go for vermi-composting. The dry waste can be segregated and what can be sold as recyclables may be sold to merchants who deal in scrap sales

/waste recyclable items periodically. The rest may be sent to a sanitary landfill.

5) **Financial Planning:** This involves two types of costs. (a) Capital cost for setting up the facility, and (b) Operational cost for meeting out the recurring expenses month after month. Capital cost pertains to point No.2 above; and Operational cost pertains to points No.3 & 4 above. The financial planning necessarily must involve a budgeting exercise too.

Step – III: Organising

1) **Manpower:** Recruit the manpower as required by the plan. One experience is that very few local persons volunteer to work in dealing with garbage. It is good to recruit destitute women and those who are willing to take up such tasks. In some of the successful SWM projects, wherever the authors of this handbook paid visit, we could notice destitute women from the neighbourhood villages, and men outside the State working. Often they are recruited from faraway places. In such cases, they stay in a place given by the GP. There are places where actual rag pickers have been recruited and trained. They get orientation and trained so that they are ready to take up the task. While doing a training need assessment it is advisable to go by 'task-based session plans'. Regarding compensation, each worker has to be paid at least Rs.150 per day or the minimum wages as prescribed in MGNREGS.

2) **Materials & Facilities:** The physical facilities required for setting up an SWM are as follows. We need to organise these things so as to commence work.

- Land to construct the segregation shed plus composting yard or the vermi-beds
- Setting up a compost shed / segregation yard Baskets / Containers for households – 3 per household Green / Blue / Blue Baskets (one for wet waste; other for dry waste and a third one for hazardous)
- Tri-cycles for every 300 households – 1
- Sanitation Workers (Janitors), 2 workers for every 300 households (to cover 150 HH in the morning and 150 HH in the evening)
- Uniforms (cap, gloves, whistle)
- Tools and equipment (broom sticks, bins, tin, sheets etc.)

3) **Technology:**

This can include three things in the context of SWM. **First,** what vehicles are to be used in waste collection – are they simple tri-wheelers, or battery operated vehicles etc.? **Secondly,** the technology to be used in treating the wet waste / biodegradable waste – are they going to be converted into simple compost or vermicompost? **Thirdly,** how the landfill is to be located and where it is going to be set up? Depending upon what technologies we choose, we need to organize materials And funds to procure such materials.

4) **Funds:** The State Governments through centrally sponsored schemes like Swachh Bharat Mission (Gramin) makes grants available for construction of facilities required for solid waste management. However, in the event of this fund being insufficient, GPs have approached CSS. There are also instances where the District administration and DRDA have found other sources of funds to assist setting up solid waste management facilities. This is about initial investment. The real challenge is about covering the operational expenses (running cost) of the unit month after month, paying workers salary, maintaining collection vehicles etc.

5) **Coordination:** Running an SWM unit is a time-consuming and long-drawn out task. Once started, it must go on and on. If left unattended for four-days, things will fall back as bad as how it was earlier. Therefore, the GP must constantly keep in touch with the community; the sanitation workers; and watch out the supportive income sources that help compensate the loss incurred in SWM etc. Poor coordination may result in ineffectuality, eventually resulting in unsustainability.

Step – IV: Implementation

1) **Segregation at Source:** The households must have sufficient knowledge of segregating bio-degradable from non-bio-degradable wastes. Since we have covered about *preparing the community* at Step – 1 itself, at this stage we assume that the community members know how they should participate and contribute. First of all, primary segregation takes place at the source, namely at the household itself. If this is done properly, it will considerably reduce the work in secondary segregation. Otherwise, it is an unpleasant task to lay hand in wet waste that is more than 8 to 12 hours old, which has already started decomposing / decaying. The households keep kitchen refuses in a Green Bin.

2) **Collection:** The sanitation workers indicate their arrival by blowing a whistle. The Green Bin is emptied into the cabin meant for it in the tri-cycle. Wet wastes are collected every day morning from 7 – 11 am; or in the evening from 4.30 – 6.30 pm. During the collection, the sanitation workers progressively perfect the community on what should be kept in the Green Bin, and what should go into the Blue bin, and what are hazardous items, and how they should be disposed safely.

3) **Secondary Segregation:** The tri-cycle reaches the segregation shed where the garbage undergoes a secondary segregation. In secondary segregation the sanitation workers sift (pick and choose) the 'recyclables' from the lot

received. The discarded ones in the process are non-recyclables, which along with hazardous waste reaches the 'sanitary landfill'.

4) **Facility for Treatment & Treatment of Waste:** Construct two composting yards of 3 x 5 metres of one metre height in single brick masonry. It can be above the ground level. It does not require any plastering. There needs to be a roof (tin sheet) over them considering the rainy days. That means both the composting yards are under one roof. One composting yard can be used for 60 – 75 days. When it is nearly full in two months time, cover it with sand, and start using the second one. By the time the second one gets filled, the garbage dumped in the first yard has become compost and is ready to go to field. These two pits can be used alternately like in a twin pit toilet. We do not impose vermi-composting considering the work and additional workers required to maintain it. GPs may opt for vermi-compost, if they can manage time, and additional worker(s). All that it might require are: (i) turning around the garbage once in ten days or so; (ii) ways to control insects and flies from breeding; and (iii) how to control odour. Windrow composting is the easiest. To get to know about various methods of composting 'Government of India (2015), *Technological Options for Solid and Liquid Waste Management in Rural Areas*, published by MDWS, Swachh Bharat Mission (Gramin)' is a good reference material.

5) **Service charge Collection:** Service charge collection from every household is very essential to cover the operational expenses. The Sanitation Supervisor (or Panchayat Secretary) should take responsibility to sit in a designated Cash Counter at the GP Office, at least four hours daily to collect service charge from households (for household drinking water connections, for solid waste management, house tax etc.). People get habituated to visiting the office and paying, once the system is established, and when the community members are sure that the GP Office is definitely open from 12.00 noon to 2.00 pm; and again from 5.00 pm to 7.00 pm. If this is irregular, people tend to think poorly of the system, and do not adhere to paying, citing 'closed GP office' as a reason.

Step – V: Monitoring and Correctives

1) **Household adherence:** The households must adhere to segregating waste at source. They must be sufficiently educated. There might be initial hiccups. The sanitation workers must be sufficiently trained in order to educate the community members patiently and stop being intolerant on them. If primary segregation is properly done, a considerable work for the sanitation workers shall reduce. Ensure households adhere to proper segregation and cooperate.

2) **Feedback from Households:** The households must have the GP Sanitation Supervisor's / GP President's mobile number to offer suggestions on the system, or make complaints in the event of sanitation workers being irregular or behave irresponsibly.

3) **Feedback from Waste Collectors:** The GP President, GP Secretary, and the GP Sanitation Supervisor should talk to the sanitation workers / waste collectors on the response of, and the cooperation extended by the households. If their intervention is necessary to solve some of the problematic households, or habitual delinquents, they must be attended to and dealt with appropriately.

4) **Physical Verification:** The GP Sanitation supervisor should make visits when sanitation workers are on duty, collecting waste from households. It helps solve some of the problems. Similarly, the GP President should make visits whenever he has time. Initially the GP President may have to visit the wards, often enough, so as to build confidence in the households. It communicates to the households how earnest the GP President is about the solid waste management system.

5) **Corrective Measures:** The GP functionaries should hold a discussion with the Sanitation workers, and representatives from households on corrective measures required to make the system more effective. The system can keep improving as months pass by, as the GP gains experience in managing solid waste.

2. ALOE VERA

INTRODUCTION:

The medicinal importance of *Aloe vera* (*Aloe barbadensis* Mill.) had been discussed in an Egyptian documents *Papyus eber,* written about 1550 BC. This documents states twelve formulas for mixing Aloe with other agents to treat both internal and external human disorder. Though Aloe vera has originated in the warm, dry climates of Africa, due to its medicinal and cosmetic importance, it is now grown in different agro-climatic regions.

SOIL AND CLIMATE:

Aloe vera is grown in almost all climatic condition, from tropical regions to Arid and semi-arid regions. Since its water requirement is very low, it can be grown in constant drought conditions. It is grown in all kind of soils but well drained soil with high organic matter, is most suitable. It grows well in bright sun light. Shady conditions results in disease infestation. It is highly sensitive to water stagnation. Therefore, well drained high land should be selected for its cultivation. Naturally occurs in driest and poorest soils and can be grown in variety of soils. But the most ideal soil is sandy loam that is slightly alkaline with a pH up to 8.5. The soil should not be disturbed too deep as the root system of aloe does not penetrate below 20-30 cm.

PROPAGATION:

Aloe is normally propagated trough root suckers (pups) or sometimes by cutting of the new growth. About 15-18 cm long root-suckers or rhizome cuttings are planted by keeping two third portions under the ground. Both plant-to-plant and row-to-row, 60 cm x 60 cm spacing is to be maintained. After planting of suckers, the soil around the root zone must be firmly pressed and drainage must be made proper to avoid water stagnation.

PLANTING TIME:

Suckers should be planted in July-August during monsoon season to get better filed survival and subsequent growth of the plants. However, under irrigated condition, planting can be done all round the year except in winter months (November - February).

INTERCROPPING:

During the first year of planting, more than 40% of the land remain unutilised, thus an attempt must be made to utilise the field in efficient manner. For this purpose, suitable leguminous or less competitive intercrops like cluster bean, groundnut, sesame, coriander, cumin etc. could be grown to provide subsidiary income.

INSECT PEST AND DISEASES:

Not much problems of insect pests and diseases have been observed in this crop. However, mealy bug, anthracnose and leaf spot have been reported. Sometimes, termite problem has also been observed which can be easily managed by giving a light irrigation.

HARVESTING:

Leaving the fresh and young leaves from the top, older outer leaves are generally

harvested. The plants can be removed manually or with the help of a tractor-drawn disc harrow or cultivator. Crop is ready to harvest after 18 months of sowing. Economic yields are obtained in 5 years after that it needs replanting. In India, the average yield for organically grown Aloe is about 12 tonnes/ ha (on fresh weight basis).

3. PASSION FRUIT

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.

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 200 to 30 0C and temperatures below 15 0C 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.

PROPAGATION:

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

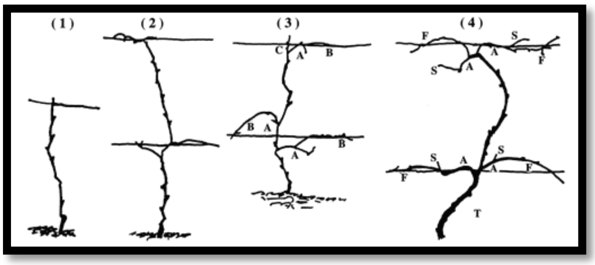
SPACING AND PLANTING:

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. 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.

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.

HARVESTING AND YIELD:

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. 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.

COMPONENT - 9 – 10

1. AFFORESTATION

Convergence between NREGA and National Afforestation Program(NAP) is mutually beneficial. Ministry of Environment and Forests has the task of achieving one third of the land area under forest and tree plantation as envisaged in the National Forest Policy, 1988. This cannot be accomplished by the MoEF alone due to enormity of the task. Convergence with NREGAS will provide additional resources. Operational guidelines of NAPalso Suggest co-ordination with rural development programmes so that the forest fringe areas and community/privately owned forests can be developed on watershed approach in a holistic manner. The integrated area development approach with ecological concerns will benefit NREGA leading to better quality planning and selection of works capable of generating sustainable employment.

NATIONALAFFORESTATION PROGRAMME (NAP)

NAP is being operated as a 100% Central Sector Scheme. The overall objective of the scheme is to develop the forest resources with people's participation, with focus on improvement in livelihoods of the forest –fringe communities, especially the poor. NAP scheme aims to support and accelerate the ongoing process of devolving Joint Forest Management Committee (JFMC) at the village level and Forest Development Agency (FDA) at the forest division level. Financial support under NAP Scheme is meant for afforestation. For its success, ancillary activities are supported as well. The financial support is available for:

(a) AfŸforestation – following models: Ÿ
- Aided Natural Regeneration Ÿ
- Artificial Regeneration Ÿ
- Bamboo Plantation Ÿ
- Cane Plantation Ÿ
- Mixed Plantation of tree having MFP and medicinal value.
- Regeneration of perennial herbs and shrubs of medicine value. Ÿ
- Pasture Development/Silvipasture

(b) Mobilization of village JFMC and Micro-planning in project villages.
(c) Soil and Moisture Conservation
(d) Entry Point Activity (for village development; average assistance Rs.4000 per ha of afforestation)
(e) Fencing, Monitoring and Evaluation, Training, Awareness raising

NAP is implemented through a 2-tier structure of Forest Development Agency (FDA) at the forest division level and Joint Forest Management Committee (JFMC) at the village level.

The decentralized, participatory management and the nature of works of NAP are both complementary to NREGA. NREGA is implemented by the PRIs with about 50% to be executed by Gram Panchayats. Line departments like the forest departments are also included among the implementing agencies and the norms are followed as of forest department. The project area under NAP are forest area and adjoining land areas including village common lands, community lands, revenue waste lands, Jhum lands and private lands, which are also covered under NREGA.

PARAMETERS OF CONVERGENCE

Works identified under NREGA for convergence will be planned and executed with the parameters of NREGA i.e.

a) The cost of material component of projects including the wages of the skilled and semiskilled workers taken up under the scheme shall not exceed forty per cent of the total project costs.

b) As far as practicable, a task funded under the scheme shall be performed by using manual labour and not machines.

c) No Contractors

MODALITIES FOR CONVERGENCE BETWEEN NREGAWITH NAP

In operational terms, convergence of activities under NREGAand NAP will require coordination between these two programmes at the levels of

(i) Management
(ii) Planning
(iii) Works

Management

The DPC NREGA (Collector/CEO) will constitute a District Resource Group (DRG) at the district level with representative from the Forest Department (FDACEO) and the department of Rural Development (NREGA and SGSY) and Panchayati Raj and a similar resource group at the Block level (BRG).

The group will facilitate

(a) **Knowledge sharing** : Familiarization of all the members of the group on guidelines of NAP and NREGA. This will clarify the programme parameters for what can be converged and what cannot.

(b) **Planning** : Since under both programmes, there are ongoing activities as well as that have to be planned afresh the group will have to determine the nature of interventions in the ongoing works and lay down a planning process that have to be planned a new.

(c) **Communication** : Since both programmes aim at participatory processes effective IEC with the local community, user groups, workers, forest dwellers, will have to be planned and implemented.

(d) **Training** : Training of personnel/agencies responsible for NREGS and NAP implementation must be planned and implemented.

(e) **Technical Support** : Techno-feasible norms for works selection, technical designs and appropriate technologies for afforestation and plantation projects will have to be formulated by technical expertise available for NAP. NAP should provide technical support for the supervision and evaluation of NREGA works so that they conform to appropriate designs and technologies.

(f) **Resource Pooling**:

(i) **Human**: Under NREGA dedicated personnel is to be deployed. In intensive afforestation/plantation works districts, some of the personnel could come on deputation from the forest department or some personnel with suitable qualifications for afforestation/plantation could be taken on contract.

(ii) **Financial**: Sharing of information on financial resources available and expected to be made available in the ensuing years. This will determine the quantum of works/activities that can be taken up and indicate where activity convergence will enable gap-filling or augmentation in scale/value and which activity is to be funded under which programme.

(iii) **Informational**: Data management could be converged through the use of NREGA MIS which provides work wise/beneficiary wise details. Any additional feature required by the NAP may be incorporated in the NREGA MIS after discussion with the Ministry of RD.

(g) **Monitoring and Evaluation** : Joint monitoring and supervision of activities should be planned. Baseline assessment, concurrent appraisal and documentation and evaluation of impact of NAP and NREGA on a set of indicators for eco-restoration as well as for local community needs could be initiated. Quantification of benefits of works undertaken could also be taken up.

PROCESSES FOR CONVERGENCE IN PLANNING AND THROUGH WORKS

Planning

Convergence of NAP will have to be both for preparing perspective plans and annual plans. Guidelines of NREGS stipulate the formulation of perspective plan to facilitate advance planning and to provide a development perspective for the district. The aim is to identify the types of NREGA works that should be encouraged in the district and the potential linkages between these works and long term employment generation and sustained development. The NREGA perspective plans identify the needs and gaps in the district in all sectors, not just related to works permissible under NREGA. Thus, afforestation/planning needs are to be factored in the NREGA perspective plan. Multi year planning of afforestation would be dovetailed in the NREGAperspective plan.

The Annual Work Plan (AWP) of NREGAlists the shelf of projects recommended by the Gram Sabha and finalized by the Gram Panchayat/IP/ZP. If the perspective plan has been made than the AWP will be broadly based on the perspective plan but must be endorsed by the Gram Sabha/PRLs as per the Act. The NREGA plan will be based on the permissible works under schedule one NREGA.

Micro plans would be prepared by the JFMC/EDCs as per NAP guidelines for NAP assistance and consolidated/vetted through FDAs for NAPfounding. 6.5.1.4 Alist of project activities to be planned for under NAPincludes inter alia

i) In situ soil and moisture conservation measures,
ii) Soil and moisture conservation by constructing small scale engineering structures.
iii) iii) Planting and sowing of multi-purpose trees, shrubs, grasses and legumes, as well as non-timber species.
iv) iv) Fuel wood and fodder plantation including pasture development for meeting biomass needs of the rural communities.
v) v) Conservation in situ of medicinal plant species and augmenting their plant population by undertaking plantation in the watershed.
vi) vi) Raising of Bamboo, cane plantation and medicinal plants.
vii) vii) Raising of coastal shelterbelts in the problem areas.
viii) viii) Cultural operations.
ix) ix) Promotion of agro-forestry and sericulture etc. as appropriate.
x) x) Wood substitution and fuel wood conservation measures such as distribution of fuel efficient stoves.
xi) xi) Measures needed to disseminate new technology.

All the activities / works listed above at serial number (i) to (ix) are also allowed/covered under NREGA. Therefore, a project covering forest area and adjoining land areas including village common lands, community lands, revenue waste lands, Jhum lands and private lands with watershed approach, will be prepared. Work required and covered under NREGA will be selected under NREGS. Works not allowed under NREGAbut permissible under NAP will be selected under NAP.

IMPLEMENTATION AGENCIES

Beside the Forest Department and the Gram Panchayat, Joint Forest Management Committees may also be the implementation agencies.

NON –NEGOTIABLE IN WORK EXECUTION

(a) Only Job Card holders to be employed for NREGAcomponent. (b) Muster rolls to be maintained on work site with copies in the Gram Panchayat and to be electronically maintained on nrega.nic.in (c) Social audits to be done through Gram Sabhas. (d) Wage payment will be through no frills account in banks/post office. (e) Financial assistance under NAP for ancillary activity can be provided only when afforestation under NAPis carried out.

PILOTS FOR CONVERGENCE OF PROGRAMMES In selected districts representing Bio-Geographic zones, lot of projects on convergence may be taken up. These will be operationalised in accordance with the process suggested above. The pilots will be like action research and will be concurrently evaluated for identifying further possibilities and up scaling.

FUNDING WILL BE THROUGH NREGAAND NAP.

THESE GUIDELINES WOULD BE SUBJECTED TO EXISTING FORESTRY LEGISLATIONS /REGULATIONS.

1. **ROAD SIDE PLANTATION**:

Introduction:

One of the core objectives of the MGNREGS is, "Providing not less than one hundred days of unskilled manual work as a guaranteed employment in a financial year to every household in rural areas as per demand, resulting in creation of productive assets of prescribed quality and durability" and Strengthening the livelihood resource base of the poor".

The works related to drought proofing including afforestation and tree planting are permissible works as per Schedule-I-para-4(I),I.(v)"Afforestation, tree plantation and horticulture in common and forest lands, road margins, canal bunds, tank foreshores and coastal belts duly providing right to usufruct to the households covered in paragraph 5". Tree is the only asset which grows producing sustainable income to the household every year. Hence the importance to the tree planting in MGNREGA.

Plantation on Road Margins:

There are a number of roads i.e., national, state highways, PMGSY and other rural roads, where road side plantation is being done, but because of limitation of funds for plantation and maintenance of plantation under the respective schemes, most of the roads cannot be covered under plantation.

Road side plantation will not only create productive assets but will also check the deterioration of roads and will contribute to strengthen ecological balance and reducing global warming.

To start with, it is proposed to go for road side plantations on PMGSY and National Highway roads under MGNREGA in a systematic and planned way.

Objectives :

i. To provide sustainable, productive and green assets for livelihood of the rural poor.
ii. To promote ecological balance by promoting soil/water conservation works alongwith tree plantations.

Identification of PMGSY Roads:

PMGSY roads for taking up the plantation work are to be identified by PMGSY field officers in consultation with the Gram Panchayat/Zilla Panchayat and MGNREGA officers (through routes and link routes with adequate land beyond the road shoulder, to be identified).

Transect walk (for deciding the location, area of plantation and preparing a tentative sketch indicating plantation area and no plantation area) to be undertaken involving Pradhan /Sarpanch/ Members of Gram Panchayat as well as Gram RozgarSevak. During Transect Walk, all the details will be recorded.

Avenue plantation can be done along the road (beyond the road shoulder) and block plantation can be done wherever Government land is available adjacent to the road and without any prejudice to safety aspect of the road.

Identification of National Highways

The National Highways will be identified by the NHAI. The roadside plantation under this plan on National Highways shall be implemented in convergence with NHAI, where the material component of the estimate would be contributed by NHAI by depositing the same with the State Employment Guarantee Fund under MGNREGA.

Identification of Beneficiaries:

The Gram Panchayat, in consultation with the revenue authorities would decide the stretches of roads/canals for undertaking the plantation work under this programme.

Before execution of plantation work, the beneficiaries shall be identified and prioritised from the households belonging to categories as in Para 5 of Schedule-I of the MGNREGA in the villages falling on the side of roads. Among these beneficiaries, the first priority will be given to those whose land is falling by the side of the road.

The identified beneficiaries along with the proposed lands shall be placed in the Gram Sabha as per MGNREGS guidelines for approval.

On approval of Gram Sabha, Gram Panchayat shall file, an application on behalf of the identified beneficiaries (Proformain **Format I**-enclosed) before the designated authority responsible for protection of such Government land seeking permission to plant under the scheme duly specifying: the areas for plantation, name of the beneficiary, species proposed to be planted.

Permission:

i. The designated authority, on receipt of application in Format I, shall consider the same and decide whether to give permission or not.
ii. Permission for plantation shall be refused if such plantation (a) could threaten the public safety or (b) land is unavailable or under dispute or (c) land is required for departmental use in the near future.
iii. All cases of rejection for plantation can be appealed to an higher authority, who shall have the power to over-rule the rejection made and could grant permission.

iv. Permission granted shall be in Format II (enclosed) which shall contain granting of usufruct rights on the trees planted which shall be heritable but not alienable.

v. Each beneficiary shall be allotted land strips for planting not more than 200 trees.

vi. Permission granted can be revoked by a higher authority based on the report of the Programme Officer of MGNREGS and the designated authority for protection of the land if the beneficiary has: (a) not performed his obligations as per the scheme (b) damaged or has attempted to damage the land (c) encroached lands of nearby farmers or (d) has done or attempted to do any illegal act on the land.

Usufructsor the Tree Pattas:

The identified beneficiaries of the scheme will have heritable but inalienable right over the usufructs of the trees allotted to them, but they will have no right on the land covered by the trees. This right is subject to the beneficiary performing

a. All operations for raising, protecting, watering the trees as per the estimate/schedule with the members of his household.
b. Shall reap the usufructs of the trees after they are mature without damaging the trees or the public assets; and if removal of the plant is essential, shall do replantation at his cost with proper consultation.
c. Shall not encroach on other lands, not allotted to him.
d. Shall not do or attempt to do any activity that would damage the land allotted.
e. Shall not use the land for doing any act prohibited under law.

Identification of Plant Species:

The selection of tree species to be done in by the community in consultation with the local Gram Panchayat and Forest and Horticulture Departments, considering the suitability and availability of plants for arid and dry region, moist areas, marshy areas, saline areas etc. as recommended in IRC SP 21: 2009.

For conducting Plantation activities, plant material can be procured by Gram Panchayat from Government Nurseries or Forest department in the first year. In the subsequent years self-help groups may raise nurseries and provide the plants.

The following shall be kept in view while establishing the nursery:

a) The location of the nursery may be in the Government land or in the house premises of an SHG, where water facilities are available and should be close to the major plantation site.
b) The materials to be used for the construction of the nursery must be ecofriendly, like nursery sheds with thatch and bamboo.
c) Live fencing should be preferred or fencing with locally available material.
d) If available leaf bags or similar instead of poly bags should be promoted.

e) Farm Yard Manure which is easily available should be used as manure.
f) In the nursery as per the activity, Physically handicapped, and other weak, old age, Job card holders should be given priority to work, where there maximum potential can be utilised.
g) Persondaysfor maintenance activities needs to be judiciously planned so as to keep the plants always in healthy condition.
h) The number of seedlings raised in the nursery should be in sufficient number say upto 150 % as per the demand.
i) The seeds needed for sowing in the nursery should be obtained after consultation with the Forest Department.
j) All nursery operations like, Pre-treatment of seeds, timely sowing of seed as per its viability, etc should be under the guidance of the Forest department.
k) The SHGs or committees involved in the nursery preparation, must be trained by the Forest/Horticulture Department from time to time.
l) The ratio of 60:40 needs to be maintained at the Gram Panchayat level.

2. ARECANUT

INTRODUCTION:

Arecanut or betel nut (*Areca catechu*) is chewed both s raw nut and after processing. Owing to the medicinal properties, it is used in treating leucoderma, cough, fits, worms, anaemia and obesity. The leaf sheath is a good material for making throw-away cups and plates, plyboard, decorative veneer panels and picture mounds.

CLIMATE AND SOIL:

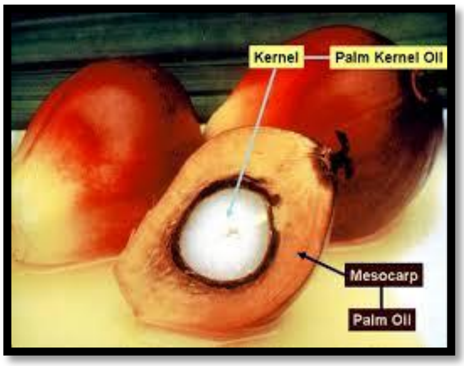
Though arecanut grows up to 1,000m above MSL, its quality is affected adversly at higher altitudes. The crop flourishes well at a temperature range of 14˚-36 ˚C. Extremes of temperature and wide diurnal variations are not conducive for desireable performance. Laterite soil and red clay soil is ideal for cultivation of arecanut.

PLANTING:

About 12-18 months old seedlings are used for planting. The spacing of 2.7m x 2.7m (8.8ft x 8.8ft) is adequate. Square, rectangular, triangular and quincunx system of planting are used. Planting in proper alignment helps prevent sun scorching of the stem. May-June or the onset of monsoon is best time for planting. In clayey soils having waterlogging, it is taken up in August-September. Pits of 90cm x 90cm x 90cm size are dug and filled with mixture of top soil, FYM and sand to a height of 50-60cm from bottom. The seedlings are planted in the centre of the pit, covered with soil to the collar level and firmly pressed.

INTERCROPPING:

The intercrops should be tolerant to shade, should not compete with arecanut for various resources and should have marketing feasibility. Banana, pineapple, tapioca, sweet potato etc. are ideal crop for intercropping depending on the region where cultivated.

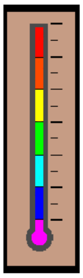


3. OIL PALM

INTRODUCTION:

Oil palm (*Elaeis guineensis*) is the highest oil-yielding plant among perennial oil-yielding crops. It produces palm oil and palm-kernel oil. These are used for culinary as well as industrial purposes.

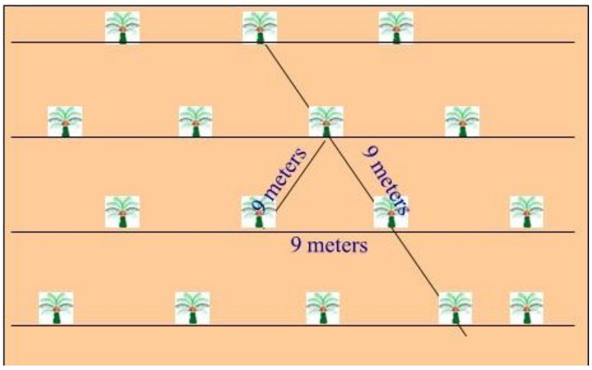
CLIMATE AND SOIL:



Oil palm is a humid tropical palm which thrives well where annual temperature range is 29˚ - 33 ˚ C (Max) and 22˚-24 ˚C (Min) with an evenly distributed rainfall of 2,500 – 4,000mm, relative hunidity more than 80% and not less tha 5hr sunshine/day. It can be grown upto 900m above MSL. It can be grown on a variety of soils. But moist, deep, loamy and alluvial soils rich in organic matter with good water permeability are best suited for its cultivation. The soil pH should be 5.5 – 8.

PLANTING:

Planting can be done in any season, preferably during monsoon period. About 10-14 months old seedlings 1-1.3m height from base and 13 functional leaves with good girth at collar are used for planting. The seedlings are planted in the main filed in triangular system at a spacing of 9m (30ft), accommodating 143 palms/ha. Pits of 60cm x 60cm x 60cm are dug.



INTERCROPPING:

Oil palm is a wide spaced perennial crop with long juvenile period of 3 years. Hence, there is a good scope for utilising horizontal and vertical space for growing intercrops. Vegetables, pulses, banana, flowers, tobacco, chilli, pineapple etc. are suitable.

IRRIGATION:

Oil palm requires sufficient irrigation, as it is a fast-growing crop with high productivity and biomass production. Insufficient irrigation reduces the rate of leaf production, affects the sex ratio and results in inflorescence abortion and yield reduction. For grown-up yielding palms of 3 years age and above, a minimum of 150 litres water/day is a must. However, in order lantations during hot summer, this amount may be increased up to 200 litres. When drip irrigation is given, care should be taken to avoid clogging and for uniform discharge of water. Four drippers are sufficient to discharge 150-200 litres water within 5-6 hr.

ABLATION:

Ablation is the removal of male and female inflorescences produced in early stage which enables the palm to gain adequate stem girth, vigour and develop strong root system. Start ablation immediately after appearance of inflorescences on palms. They can be removed easily by hand pulling or by IIOPR ablation tool. Ablation can be extended up to 2.5 to 3 years depending upon the growth and vigour of the plant.

HARVESTING:

Harvesting of bunches can be started from 4th year onwards. It takes 5 to 6 months depending on the climatic conditions for ripening a bunch. Nature of harvesting affects both quality and quantity. At least 20 % of Oil accumulates in the bunch during last 7 to 10 days of bunch ripening. Bunch is ready for harvest when few fruits are dropped. Over ripening results in too much fruit drop and results in poor quality and quantity and high labour costs. Harvesting of unripe bunches results in lower recovery oil. Hence, harvesting at right stage is important

YIELD:

Factors like Variety, age of the garden, agro-climate and management practices affecting the yield. 15 – 20 t FFB/ha yield can be expected.

1. **BANANA**

INTRODUCTION:

Bananas are one of the most widely consumed fruits in the world for good reason. Eating them could help lower blood pressure and reduce the risks of cancer and asthma. Today, bananas are grown in at least 107 countries and are ranked fourth among the world's food crops in monetary value. Americans consume more bananas than apples and oranges combined.

CLIMATE AND SOIL:

Banana can be grown in all kinds of soils having good drainage. Banana grows faster in sandy loam soil as compare to clay loam or vertisol. Though soil pH of 6.5 to 7.5 is optimum, it can be grown in soils having a pH up to 8.5 with suitable amendments. The optimum mean temperature for growth of banana is 20˚ – 30˚ C with a rainfall of 500 – 2,000 mm/year. Water stagnation in poorly drained soil leads to slow growth.

SYSTEM OF PLANTING:

Depending on the variety and system of planting, the planting distance varies. In High density planting system, which is the very economical planting system, the planting distance is 1.2m x 1.2m x 2 m, which means plant to plant distance is 1.2m and row to row distance is also 1.2m. Then after every two rows, a space of 2 m should be made available. This 2 m spacing is very important especially in a slope because it provide easy accesses for inter-culture operation and harvesting. Pit of 60 cm^3 should be dug (2ftx2ftx2ft).

PLANTING SEASON:

The ideal time for planting is from 15 June to 15 July. However, tissue cultured bananas can be planted throughout the year. If early planting, bunch will emerge during sever winter, which will reduce the yield. High temperature in the month of September – October and severe cold winter reduce the growth of bunch.

INTERCROPPING:

Intercropping is a common practice in banana orchards to check weed growth, improve soil health and to augment the additional income. In initial years, Soyabean, cowpea, beans and yam are grown. The crops which can attract nematodes or soil-borne diseases should be avoided. Brinjal or cucurbits should not be grown. However, intercropping is only possible during early stage of the plantation.

SPECIAL OPERATIONS:

The following practices would directly affect the productivity and quality of the Banana plants.

i) Desuckering / Pruning: Keeping too many sucking plants will reduce yields. It is advisable to remove all suckers once the desired followers have been selected. An age interval of 2 months between the mother plant and subsequently each of the followers is most desirable as these followers will become your main stem after the mother plant fruits. The most effective method to permanently remove unwanted suckers is to cut the stem off the ground and then cut into the centre of the plant. This should kill the sucker.

ii) Propagation: The alternative of pruning is propagation of bananas. Instead of destroying the suckers, suckers can be removed from the clump and replanting it in a newly cultivated land. Large suckers called the "sword sucker" are the preferred planting material. When removing the suckers, it must be cut into the mother plant enough to unearth some roots. These suckers must be re-planted within a day or two and should not be exposed to the sun. Otherwise the roots may dry up.

iii) Deflowering: Remove the "Bell" (the purple flower petals at the end of the bunch – also known as "banana blossom" or "banana heart"). This is generally practiced because this way, Banana plant will conserve its energy into growing bigger bunch and not longer stalk.

iv) Earthing up: Soil level should be raised after 3 months of planting to keep soil loose. This will also help prevent Banana plants from falling due to severe wind.

v) Removal of female hands: Remove the last one (1) to two (2) hands of the bunch. Banana growers often remove the bottom female hands so that the remaining hands grow bigger as it facilitates fruit development and increases bunch weigh.

vi) Bunch Covering: Bunch covering increases the weigh and enhances quality of fruit. Traditionally, Banana growers protect the bunch from sunburn by placing dry leaves on the top hand of the bunch but this is not practical during rainy season and can be time consuming. Commercial growers however, use blue plastic sleeves. This practice is to protect Bananas from insects, sunburn, diseases, spray residue, dust and birds. Covering the Banana bunch increases the temperature within which helps in early maturity.

vii) Propping: Support Banana plants with bamboos. Banana plants often go off balance due to the heavy weight of the bunch. Therefore, two (2) bamboos should be propped by placing one (1) against the top of the bunch and the other against the stem on the leaning side.

Propping using only one (1) bamboo is not advisable as the Banana plant may plunge to the other direction during strong wind.

2. **TEA**

INTRODUCTION:

Tea plantation in India has been contributing significantly towards the socio economic development of the people of the tea growing regions of the country. Tea industry contributes substantially towards the national and state economy by way of enriching the foreign exchange reservoir and State exchequer besides employment. Today the major tea growing states are Assam, West Bengal, Tripura, Tamil Nadu, Kerala and Karnataka. Himachal Pradesh and Uttaranchal are also traditional tea growing states, albeit to a less significant extent. Besides, tea plantation has come up recently in states like Arunachal Pradesh, Manipur, Sikkim, Nagaland, Meghalaya, Bihar, Orissa, etc. Mizoram also has the potential for development of commercial tea plantation.

CLIMATE AND SOIL:

Well distributed rainfall ranging around 2000 mm to 5000 mm is considered suitable for successful tea plantation. The monthly average maximum temperature ranging between 28˚C and 32˚C during April to September, with occasional rise up to 36˚C-37˚C is good for the plantation. Generally, sandy loam to silty loam type of soil with pH range of 4.5 - 5.5 is ideal for growing tea. Soil should possess a minimum 1% of organic carbon, 1-2% of organic matter, 35ppm of P_2O_5 and 80 ppm of K_2O for successful establishment of tea. Tea plantation being a long term investment it is advisable that before going for new plantations, soils may be tested in soil testing laboratory of the State Agriculture Department or KVK's.

PLANTING:

The sources of planting material must be very reliable. The quality of the planting material will primarily decide the health of the plants and to a great extent the style of bush formation. Planting of tea is done either in spring (June-July) after the first few showers of rain or in autumn (October-November) while the soil is still moist and the area has irrigation facilities.

In north-east India, the planting density varies from 14,000 to 17,000 bushes/ha. The minimum space required between plants is 60cm and between rows 105 cm. The dimension of planting pits is 45cm x 45 or 60 cm. The bringing up of young tea is an important aspect and is aspect and is achieved through a series of operations such as decentering, thumb pruning, debudding and frame forming pruning.

PRUNING:

Tea bush are pruned at periodic intervals to revitalise their vegetative vigour, regulate their height and for good yield of crop. It is also aimed at developing good frames. There is also a direct relationship between pruning and drought stress. Generally, a 4-year pruning cycle is followed in the mid-elevation areas and 5-year cycle at high elevation.

Pruning is carried out during the pre-monsoon or post-monsoon periods since adequate soil moisture is a pre-requisite for pruning. A pruning height of 30-40cm is termed as hard prune while medium style of pruning refers to pruning between 45 and 55cm. When bushes are pruned at a height between 60 and 70cm, it is referred to as light pruning. If the bushes are pruned about 75cm, it is referred to as **skiffing** which is the lightest form of pruning. The criterion for determining the height of pruning should be the thickness of branches.

The recovery of bushes after pruning depends on the height of pruning, type of wood, time of pruning, health of bushes, carbohydrates reserves and elevation of the garden. Height of tipping decrease with increasing height of pruning. The objectives of tipping is to established a level plucking surface, to provide adequate maintenance foliage and for the quick production of secondary branches.

SHADING:

Conventionally, tea is grown under shade trees. The beneficial effects of shade tree in tea field have been well realised. These trees help to regulate temperature and humidity at bush level. They minimised the loss of water through evaporation and transpiration. They help to reduce the injury caused to tea leaves by UV radiation. They also help in minimising soil erosion and increase soil fertility by adding 8-10 tonnes of OM/ha/Year. However, shade tree can caused reduction in response to applied nutrients and compete with tea plant for moisture and nutrients.

HARVESTING:

Harvesting is a labour intensive yet most important cultural operation which influences yield and quality. Plucking is the main economic and labour intensive activity of the tea garden. New growth, mainly top 2-3 leaves and the bud is plucked at regular interval and this is called the plucking operation. The shoots thus plucked are taken to the tea factory for manufacturing tea. The new growth

taking place after pruning & skiffing operations is plucked at a certain height initially to form the table of foliage – this operation is called Tipping. The foliage left on the tea bush after tipping operation is the maintenance foliage which does the photosynthesis for production of crop. Harvesting should be carried out when shoots attain maximum weight, without compromising on quality. Targeting for about 85% leaves and a bud and pegging down the immature shoot component to less than 5% is considered optimal to get maximum benefits.

3. MANDARIN ORANGE

INTRODUCTION:

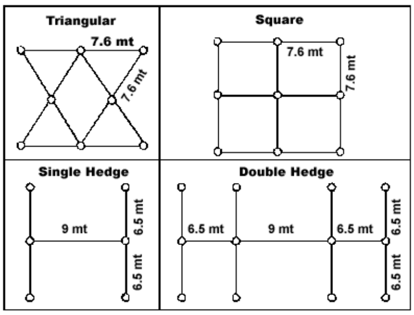
Mandarin orange/M. Orange (*Citrus reticulata*) is most common among citrus fruits grown in India. It occupies nearly 50% of the total citrus area in India.

CLMATE AND SOIL:

M. Orange grows successfully in all frost-free tropical and subtropical regions. They are adapted well to sub-mountainous tract 370-1,500m above MSL and temperature 10˚-35 ˚C. Hot wind and excessive heat during flowering and fruit set are highly detrimental for fruit bearing and cause fruit drop and sunburn of the fruit. Low humidity favours colour development, whereas plants not having adequate sunlight produce low yields of poor quality fruits. M. Orange may be grown in a wide variety of soils but medium or light loamy soils with slightly heavy sub-soil, well-drained with pH of 6-8 are ideal.

PLANTING:

Generally, planting is done during monsoon in all mandarin-growing areas. Usually M. Orange are planted in pits of 50cm x 50cm x 50cm size in a square system with a spacing of 4.5m – 6m, accommodating 350-450 plants/ha. In North-eastern parts of India, Khasi Mandarin are very closely (4.5m x 4.5m) spaced, accommodating more than 500 plants/ ha.



TRAINING AND PRUNING:

An ideal M. Orange tree should be low headed with a dome like crown. Trees are trained to single stem with 4-6 well-spaced branched for making the basic framework. Further, the lowermost branches should be allowed not to grow below the height of 50cm from the soil surface. Removal of water sprouts and suckers of rootstock is also highly essential. Pruning of non-bearing trees can be done any time of the year, but for bearing trees the best time is after harvesting, during late winter or early spring when these are in somewhat dormant stage.

HARVESTING:

Picking of fruits at proper stage of maturity is of paramount importance. Harvesting at right time not only maximizes profits but also helps build up the demand for quality fruits. Unlike climacteric fruits, M. Orange does not improve in taste after harvesting. Therefore, fruits should be harvested when they attain full size, develop attractive colour with optimum sugar: acid blend. Method of harvesting is very important as it affects the shelf-life of fruits considerably. Further, faulty harvesting and rough handling adversely affect the marketability of fruits.

The common commercial practice of harvesting is to pull the fruits from the branch, which may rupture the skin near the stem-end leading to fungal infection and subsequent rotting. This practice should be avoided. Therefore, fruits should nether be plucked nor torn off, but should be cut off preferably with clipper, shears or secateurs. Generally, M. Orange start bearing from the fourth year having 15-20 fruits/plant. However, its plan attains the level of full bearing at the age of 10-12 years.

Storage life of M. Orange is influenced by many pre- and post-harvest factors. Green or fully ripe M. Oranges can be stored successfully at 8-10˚C with 85-90% relative humidity without impairing fruit quality.