On-Soil Home Garden Manual

Ecosystem approach for drought resistant home gardening in Central Dy Zone, Myanmar

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ALiSEA
Agro-ecology Learning alliance in South East Asia

GRET
Professionals for Fair Development

AFD

Summary

HOME GARDEN Manual

How to construct, manage and produce vegetable all year round in the Myanmar Dry Zone, with agroecological conservative practices.

INTRODUCTION

Climate and soil type in the Dry Zone makes vegetable cultivation and availability extremely difficult, during the dry season and not only. From December to April most farmers of the area can only wait until the rainy season to begin cultivation of main crops, such as Pigeon Pea, Mung Bean, Sesame and Groundnut. However, the nutritional input given by fresh and green vegetable is often insufficient. The situation is worsened by climate change and the tendency of farmers to rely on extensive agriculture based on chemical input. While this approach might give initial benefits on productivity, it is highly unsustainable and deepens the environmental problems of the area (soil erosion, loss and desertification). However, thanks to the right techniques and conservative practices is possible to: cultivate all year round without relying on excessive chemical inputs; improve nutritional intake and decrease expenses on food. This has been the aim of ALiSEA project Ecosystem approach for drought resistant home gardening in Central Dry Zone implemented by TDH Italy: improving the livelihood of the beneficiaries through sustainable home garden vegetable production.

The purpose of the following handbook is to provide the necessary information for the construction and management of a home garden using agroecological practices.

1 HOME GARDEN DESIGN and CONSTRUCTION

1.1 Preface.

In this manual, measurements are expressed in the most commonly used units in Myanmar which are Viss for weight, feet and inches for distances, and gallons for liquid volume. Kilogram is also used. To improve the comprehension along the text, here in the table are listed the conversion to apply if needed.

Conversions	
1 Viss	1,6 Kg
1 Feet	30,48 cm
1 Inch	2,54 cm
1 gallon	3,78 L

1.2 Location selection and levelling.

The first step is to select where the home garden will be located. Taking into consideration the average sizes of TDH standard home garden, 15 ft. x 25 ft. The things to take into account when planning the location of the system are:

- ground level
- natural shading
- water source

The home garden should be located in an easily accessible location, close to the water source, not in a shaded area (such as under a tree or tall shrub) and positioned on a flat surface.

1.3 Home garden perimeter

Using wood sticks and nylon string, we can “draw” the perimeter of our garden on the ground, which have to measure 25 ft. x 15 ft. To do so, we will position the 4 sticks on the 4 angles of a rectangle, measuring the distance between each other. An efficient way to draw on the ground a perfect right angle is to mark a triangle with the short side of 3ft, the medium side of 4m (or 4 feet) and the hypotenuse (longest side) 5ft, as graphically explained in Figure 1. When we have to work with big surfaces we can use multiples of those measures (i.e. 6 and 8 for the sides and 10 for the hypotenuse). When the perimeter is set we can also mark with wood sticks the places where to dig the holes to position the wood columns of the roof. To ensure stability the holes should be at least 20 inches deep.

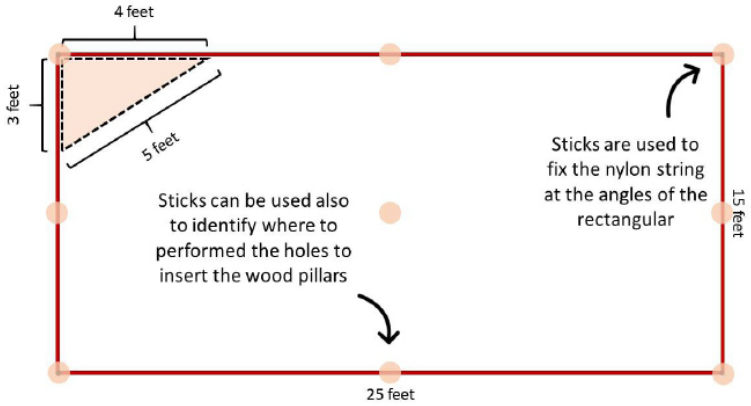


FIGURE 1: PERIMETER PREPARATION USING NYLON STRING AND STICKS. USE THE STICKS TO SET THE PERIMETER AND THE HOLES FOR THE WOOD PILLAR. TO ENSURE THE RIGHT ANGLES, USE THE TRIANGLE TECHNIQUE.

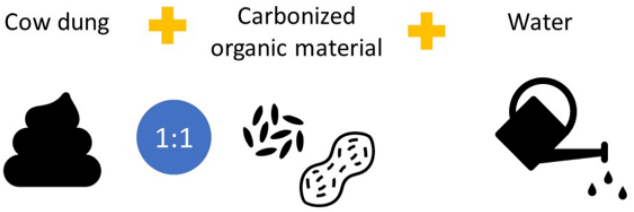
1.4 Soil Preparation

1. Levelling. First of all, level the ground if it is not flat. This can be done moving the soil from the higher level of the plot to the lower making the ground flat, or moving soil from another location. If the surface is really steep, more than 4%, it is recommended to create a terrace, in order to avoid excessive leaching, run-off and soil degradation during the rainy season.

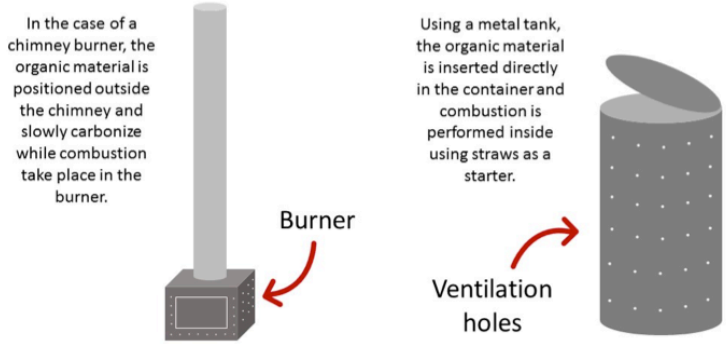
2. Increase soil fertility. When levelling is complete it is time to increase soil fertility. Most of the soil in the dry zone is a poor Luvisol soil, characterized by high sand content, low nutrient content and low organic matter. To increase soil fertility, we amend the soil with a mixture of carbonized organic matter (Biochar) and animal manure. The detail for Biochar production are listed below.

1.5 Biochar preparation

To amend the soil we use a 1:1 mixture of manure and carbonized organic matter, also referred to as Biochar. The carbonized organic product can have different origin, and should be an easily accessible local by-product. In the Dry Zone, rice husk and groundnut pods are the most common options, while the most available animal manure is cow dung.



In our home garden system, characterized by 3 beds of 20 ft. x 3 ft. each, the amount of amendment needed is 50 Kg. Within these 50 Kg, 20 Kg are cow dung and 20 Kg biochar, while at least 10 L of water will be added during mixing and preparation. Water quantity might vary depending on the cow dung stage. It is recommended to use fresh manure, but often, at least in the Dry Zone, it is not available: in that case a higher amount of water is needed. To produce biochar we have to perform a slow combustion process. The most common processes include:
- the use of a chimney burner (especially efficient for rice husk)
- the use of a perforated metal tank (where a slow combustion is occurring directly).



Chimney burner

1. Choose a safe place where to start a fire.
2. Start a fire and wait until it is burning well.
3. Cover the fire with the metal chimney.
4. Check the combustion is still going on, checking that smoke is outgoing and temperature is high.
5. Cover the chimney with 5-6 bags of Rice Husk forming a pyramid (each bag is generally around 5 Kg).
6. Let the rice husk carbonize for more or less 3 hours. Move the rice husk from the distance sides closer to the chimney to ensure uniform carbonization.
7. When carbonization is complete, spread the rice husk, remove the chimney and water the biochar with abundant water using a water tank, this will stop the burning process.

Hollow tank

1. Choose a safe place to position the tank.
2. Fill the tank with dry groundnut shells up to ¾ of the tank capacity.
3. Start a fire on top of the groundnut shells using wood sticks and straw.
4. When the fire is on, cover the tank with a lid, leaving a little space for aeration.
5. Let the groundnut shell to carbonize for more or less 3 hours.
6. Stir the groundnut with a bottom up movement, starting after 2 hours of carbonization.
7. When the result is uniform, empty the tank turning it over and removing all the carbonized pods.
8. Use abundant water to stop combustion

When the carbonized material has been produced it can be mixed with fresh cow dung at a proportion of 1 to 1, applying water to facilitate the mixing. The resulting mixture should be black in colour and uniform, wet but should not release water when pressed within your hand. When the amendment is ready, place it in a large container and cover it for at least one week before proceeding with soil amendment.

When the ground has been levelled and the mixture of cow dung and manure has been produced it is time to form the beds. The beds allow less compact, extra fertile soil for our plants and promote a better root growth, water and nutrient uptake. In TDH standard design are included 3 raised beds 3 ft. wide and 20 ft. long. To ensure the correct size and bed angles, it is recommended to use nylon string and sticks as previously explained or the garden perimeter. When the perimeter has been set, the beds are formed by mixing the local soil with the biochar and, if needed, limestone powder or dolomite rock by adjusting the pH and calcium carbonate to avoid calcium deficiency. For a single home garden is generally applied half Viss (0,7 Kg) of limestone. Beds height should be between 6 and 8 inches.

1.6 External structure

A structure is needed to cover the home garden from excessive sun exposure and to protect it from bird damage. This structure includes the skeleton, constructed with local wood; a side net to avoid damages caused by chickens other animals; and a shading net on top. The main structure is formed by 9 wooden pillars, and bamboo to construct the roof with green or black shading net on top (50% sunlight reduction).

1. Select straight wood pillar of similar diameter and similarly select the bamboo.
2. Clean the wood pillars from lateral branches.
3. Dig 20” holes to position the wooden pillars.
4. Position the wooden pillars in the holes, use the water pipe to mark water level on all of them.
5. From the water level sign, which should be just above ground (5-10”), measure 7 feet and mark it.
6. Cut the wood pillars where marked and fix the bamboos using nails and hammer forming the roof structure.

Instead of bamboo it is possible to use wood boards or other straight wood branches. In this scenario, cut the top part of the raw wood used for pillars in a “L” shape, to improve adherence. The lateral fence can be constructed locally with bamboo, todi palm, or using protective plastic blue nets. An investigation showed that well-built bamboo fences can last over 2 years, and similarly blue nets can last 3 years. The cost is relatively similar, but bamboo fence might ensure a better protection to rodents and an easier access when a door is built.

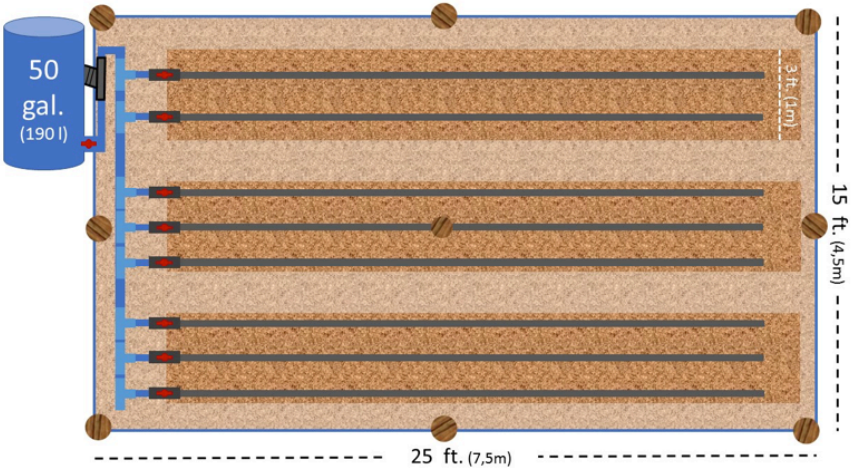


FIGURE 2: SKY VIEW OF THE HOME GARDEN WITH THE DRIPPING SYSTEM ALREADY SET UP AND THE RAISED BED PREPARED.

1.7 Dripping Irrigation System (DIS)

Considered the water scarcity affecting the area, a Dripping Irrigation System has been developed to ensure a more constant soil moisture and to reduce water need. This system consists of 50 gallons (190 L) tank connected to a main conducting tube and 8 lateral pressure compensating driplines. Each dripline has several holes without external emitters which release the water at a constant rate of 1,5L per hour. Each dripline is fitted with an opening valve which can be used to regulate the water flow.

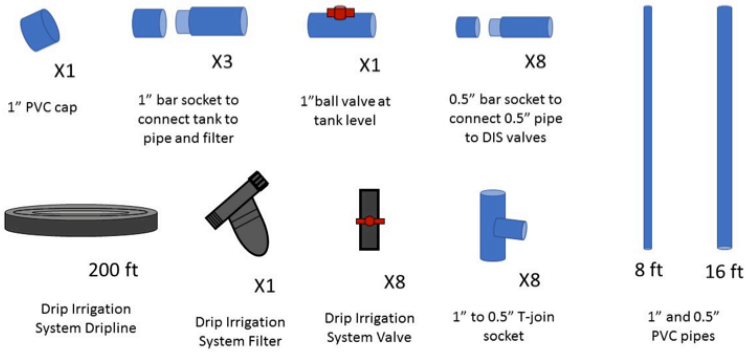


FIGURE 3: MATERIAL NEEDED TO CONSTRUCT THE DRIPPING IRRIGATION SYSTEM, TANK EXCLUDED.

The material needed is shown in Figure 3. The construction procedure is explained here, following the intuitive approach from tank to drippers. However, construction can be performed following other criteria.

1. Perforate the water tank using a 1" hot metal cylinder previously heated in a fire place, or a drill.
2. Position a 1" PVC socket to connect the tank to the 1" PVC tube.
3. The 1" PVC tube is now attached to a valve to ensure opening and closing of the system.
4. Connect the filter to the 1" tube through two 1" sockets.
5. Position the 1" PVC pipe perpendicularly to the garden risen beds.
6. Cut the PVC pipe where you are planning to set the dripline.
7. Attach the T sockets which reduce the diameter from 1" to 0.5".
8. Connect an 8-10" 0.5" PVC pipe previously cut, to the small end of the T socket.
9. Connect a DIS valve to the 0.5" PVC pipe using a 0.5" socket.
10. Attach the dripline to the DIS valve, and extend it for 20 feet until the end of the risen bed.
11. Stop the exceeding dripline folding it and using either a string or an elastic.

12. Repeat steps 6 to 11 8 times, for each dripline. Remember the driplines are 8 for 3 beds. Therefore, one bed is going to have only 2 driplines instead of 3.
13. Position the PVC cap at the far end of the main 1”PVC pipe.

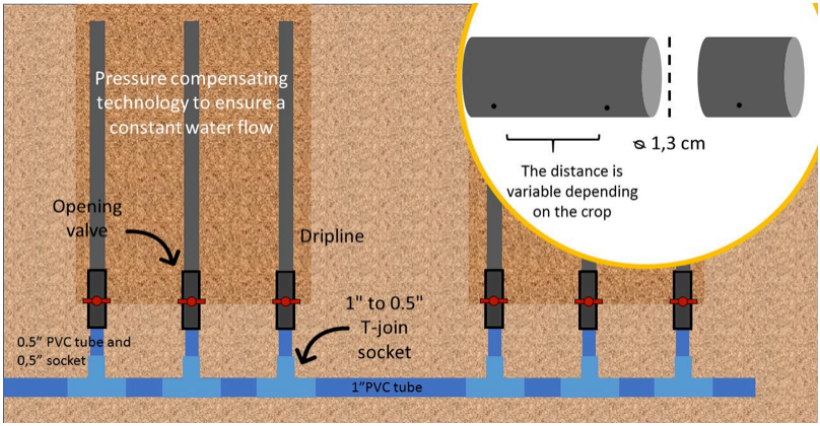


FIGURE 4: SPECIFIC DRAWING OF THE DRIPPING IRRIGATION SYSTEM, SHOWING PIPES AND DRIPLINE SET UP.

Maintenance is an extremely important to ensure a functioning system and its long life. For this reason, a filter is set up between the tank and the PVC pipe before reaching the driplines. The filter should be checked and cleaned every week or two, depending also by water status and conditions.

2 CONSERVATIVE PRACTICES

2.1 Mulching

Mulching is an easy conservative technique to perform, which ensures water retention in the soil and at the same time reduce weeding time. It simply consists in covering the beds, with either natural or synthetic material. In our systems we recommend the use of natural mulches, which are highly available locally. In the dry zone, the two most commonly accessible mulching materials are peanut pods and rice husk, but also dry leaves, shredded palm leaves and straws can be used. Similarly, green mulch (such as green leaves resulting from pruning) is a valid substitute, and it is also a source of nitrogen for the plants. However, we recommend groundnut shells as best natural mulch, due to it long life (rice husk is decomposed more quickly) and sterility (green mulch can also be a pest vector). All of the previously mentioned materials can be easily found within the village perimeter or nearby town and it is generally cheap or free.

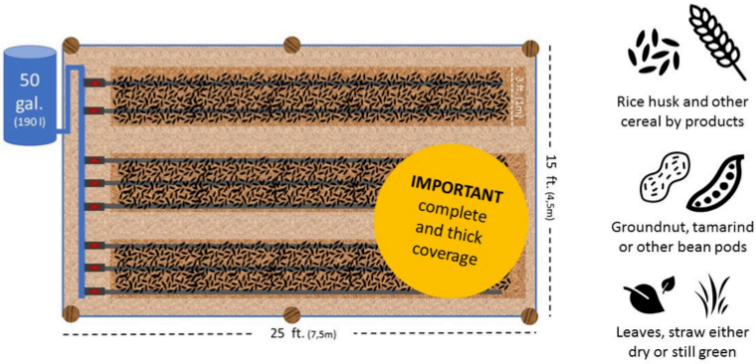


FIGURE 5: THE IMPLEMENTATION OF NATURAL MULCHING ON THE PLOTS AND POSSIBLE AVAILABLE PRODUCTS TO USE AS MULCH.

2.2 Earthworm colony

Earthworms can positively affect soil fertility biologically, physically and chemically. One of the main Earthworm's role is to aerate the soil, avoiding anoxic conditions and permitting water and nutrient to better reach deeper layers of the soil. Moreover, they have an important role in reducing large pieces of organic matter in humus, relocating it and mixing it with the mineral soil.

Earthworms are living organisms, and for this reason they require some extra care to be maintained in the home garden. Few things which should be taken into consideration are temperature, pH and food availability. Earthworms are mainly active at night and during the cooler time of the day, while they suffer elevated temperatures. For this reason, an adequate mulching can provide a better environment for the colony, and extra source of food. Neutral pH is preferred, while acidic condition can be harmful. Inorganic nitrogenous fertilizers reduce pH and for this reason should not be used. Similarly, chemical compounds used for pest control might have negative effects on earthworms.

Food for the earthworms is provided through pierced hollow PVC tubes. The tube, of 4" diameter, is poked either using a drill or with a hot metal tool with a cylinder end. The tubes are then positioned at more or less 10" depth.

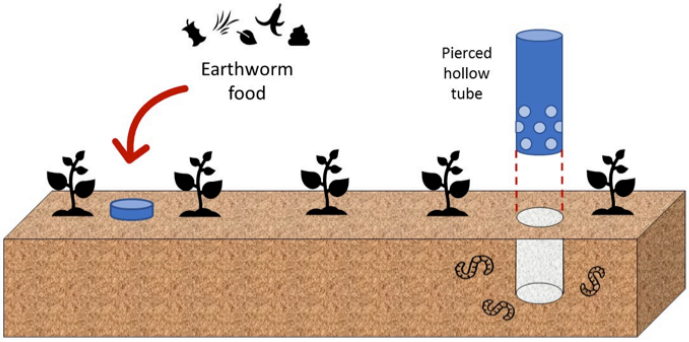


FIGURE 6: EARTHWORM TOWERS. ON THE RIGHT, THE TOWER IS LIFTED UP TO SHOW THE HOLES.

Earthworms feed mainly on organic debris, and for this reason we need to constantly provide some to maintain the colony. Food residues such as fruit peel, leaves and (in small amount) manure are good source of nutrient for the earthworms and they should be provided twice a week. It is also important to cover the food tube with some dry material such as dry leaves or straw, to reduce moisture losses.

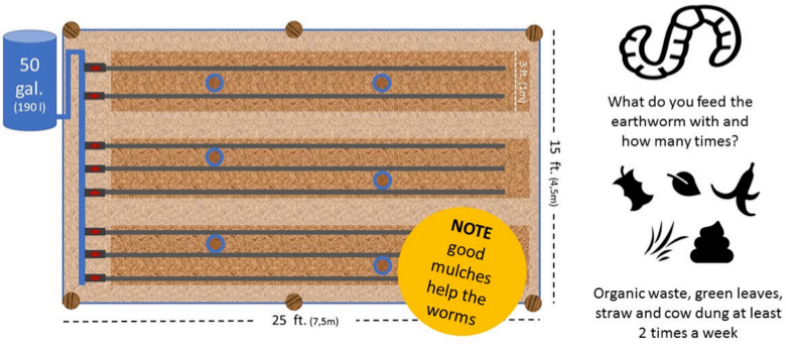


FIGURE 7: EARTHWORM TOWERS AND HOW TO FEED THEM. EARTHWORM TOWERS ARE GENERALLY 3 PER PLOT.

3 CROP PLAN

A crop plan can be extremely useful to increase productivity, ensure quality production and guarantee diet diversification. This plan includes the right choice of plant in the right time and the careful preparation of the seedlings. This choice is also based on useful nutrients, necessary to cover beneficiaries' nutritional requirements. In the following table are listed the most common cultivated crops in the home garden, including growing stages and nutrient content. The preferred period are distinguished based on summer period, characterized by hot and dry weather, from March to June; rainy season, from July to November, with daily rains; and winter period, from November to February, characterized by minor rains and moderate temperatures.

TABLE 1: THE MOST COMMON GROWN VEGETABLE IN OUR HOME GARDENS, WITH THE RELATIVE CULTIVATION TIME AND PREFERRED PERIOD. THE LAST COLUMN ALSO REMINDS THE NUTRITIONAL CHARACTERISTIC OF THE CROP.

Crop name	Cultivation timing (days)			Preferred period	Nutritional characteristic
	Sowing to germination	Germination to transplanting	Transplanting to Harvest		
Lettuce	5	15-18	25-30	Rainy, Winter	Vitamin C, K, E, fiber, folic acid.
Tomato	6	18-20	75	Rainy, Winter	Rich in vitamin A, C and Calcium. Also Biotin is present, and so is less common nutrient such as Molybdenum.
Cucumber	5	15-18	40	Rainy, Winter	Rich in water and vitamin C. Also contain major nutrient such as K, Ca, and P.
Eggplant	10	20-25	75	Rainy, Winter	Copper and Magnesium reach fruit, provide also Vitamin B.

Chive	10	30-35	55		
Pepper	12	30-35	80	Rainy, Winter	Excellent source of vitamin E, and rich in Vitamin A and B. Also good source of Iron and Copper.
Okra	3	15	35	Winter, Summer	Rich in nutrients such as Copper, Calcium and Magnesium. Source of Vitamin A.
Coriander	7	20-25	40		Excellent source of Vitamin K.
Pumpkin	5	15-18	75	Winter, Summer	Excellent source of Vitamin A due to high carotenoid content. High content of Vitamin C, B and nutrient such as Manganese and Copper
Morning Glory	5	15	35	Summer	Vitamin A and C rich,antioxidants and minerals. Very low in calories.
Kale	7	15	40	Rainy, Winter	Extraordinary source of Vitamins. Especially Vitamin K, A and C, but also B and E. Good source of fibres and protein and many nutrients (Cu, Ca, K, Fe, P, Mg)

Bitter Gourd	5	15	100	Rainy, Winter	Rich in vitamin C. Naturally rich in fiber, but also contains many minerals such as Ca, Fe, K and Mg.
Onion	5	15	65	Winter	Excellent source of biotin. Contain good amount of Vitamin C, Manganese, Cupper and Potassium but not very high content.
Mustard	5	15-18	20-25	Winter, Summer	Similarly to Kale it is an excellent source of Vitamin A, C and K and many nutrients.
Roselle	7	15-18	45 (for herbal use), 80 (for flower use)	Rainy, Winter	Roselle calyces are high in calcium, niacin, riboflavin and iron

3.1 Nursery, transplanting and planting

Setting up a nursery increases plants success growth and improves growth rate. The set-up is easy and cheap. The material needed includes:

- a plastic cells tray;
- carbonized rice husk (the same one used for biochar production);
- cow dung powder (obtained through sieving reasonably dry smashed cow dung).

The manure is firstly smashed with a branch, then mixed with hands and finally sieved. The preferable substrate for plantlets is prepared by mixing cow dung powder and carbonized rice husk at a 1:3 proportion. Seeds (up to 3) should be planted in a single hole in each cell at a depth of 3 or 4 times their size. Watering can be performed 3 times a day: early morning, afternoon and evening. As soon as germination occurs, it is important to maintain a single seedling to avoid competition. Transplanting has to be performed when the plant developed at least 4 true leaves. When transplanting, the soil should be pressed firmly to give stability to the plant and to make the roots stick to the ground.

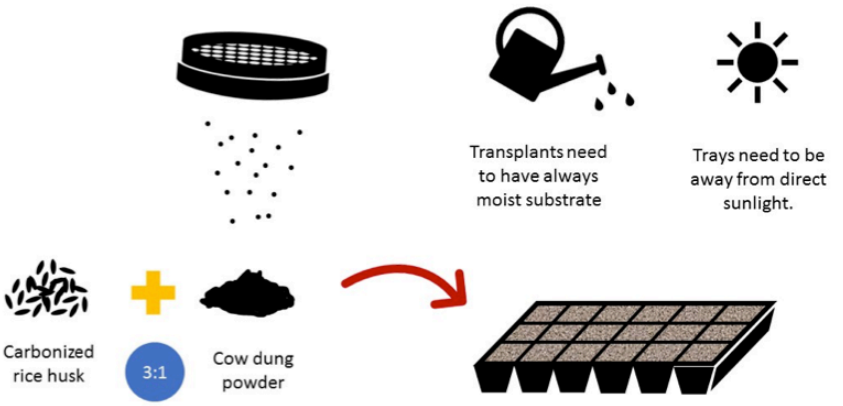


FIGURE 8: PROCEDURE TO PREPARE THE SUBSTRATE FOR SEEDLINGS. IT IS IMPORTANT TO REMEMBER THAT THE SUBSTRATE NEED TO BE REASONABLY COMPACT TO ENSURE SUCCESSFUL PLANT GROWTH.

4 GARDEN MANAGEMENT

4.1 General good practices

This home garden based on conservative techniques does not require excessive maintenance, but good care will ensure successful vegetable production. A few actions need to be taken into account:

- System cleaning is fundamental. The filter of the dripping system should be often checked, and so are the holes, to ensure that they are not clogged. A good tank cleaning once in a while reduces the chances of clogging the valve, the pipes and the filter.
- Watering depends on the water need of the plants, for this reason valves are also positioned for every dripline and adjusted accordingly. Generally watering the plots one time per day with a half filled tank (more or less 100 litres) is enough and ensures water savings and plant growth.
- Mulch requires to be substituted or added timely to ensure a sufficient coverage. This is particularly true for small size material like rice husk or dry leaves. Groundnut seems to be the best alternative in the dry zone, both for its availability, and for its coverage.
- Biochar needs to be done every year, because carbonized rice husk is reasonably fast to degrade due to its small size.
- It is also important to maintain the plots fertility high to ensure plant growth.

4.2 Pest Management

Pest management requires knowledge and experience. However, there are few easy practices which, if performed properly, can drastically reduce the issue related to pest in our home garden. Pest is any harmful organism which can create problem to our vegetable production, and here are listed some tips to prevent, control, and reduce them.

1. The first rule is OBSERVATION and CARE. The home garden is small and can be easily managed, but we need to spend some time inside the fences to check how the plant growth is proceeding. This allow us to control pest in time, before they compromise productivity. Check leaves colour, the presence of insects and weeds. Check for damaged part of the plant, and always look at both sides of the leaf surface.
2. PREVENTION. Prevention is a key concept. This can be done performing a sound crop plan. For example, we should never plant the same crop or strictly related crops, in the same place where we had it before. During rainy season we should carefully plan a drainage system to avoid flooding, and ensure aeration to reduce fungal infection. A fence is also an appropriate technique to prevent chicken damage.
3. ACT IN TIME. If we notice something wrong it is necessary to act fast. If for example our crop is attacked by aphids, or by butterfly larvae (which are generally very voracious) we should act before the pest multiply and population increase out of control. There are many natural solutions against insect pest, such as Neem Oil or Chilli extract against aphids, and Bacillus thuringiensis against Lepidoptera larvae. But they are effective only if used at initial stages.
4. REMOVAL. Sometime there is nothing we can do to save our diseased plants. This often happens if the crop is attacked by a bacterial or virus disease. But there is something extremely important to avoid the spread of the disease, which is the removal of the plant. When plant growth is compromised by a disease is better to remove it and move it far away from the garden. Remember also to change the crop planted in that location.
5. SHARING. Sometime the solution to our problem is just behind the corner. Often the pest issues you are experiencing are the same that your neighboured is experiencing. Share control strategies between other beneficiaries, farmers, technicians, maybe they already found an efficient solution and can help you.