Near the House

Part One

The Farmers' Handbook

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The Farmers' Handbook is about techniques for sustainable farming, and this is the second of 5 volumes. There are 12 techniques presented here. In five volumes there area total of 44 techniques and approaches

CONTENTS

Subject ▽ **Chapter No:** ▽

Chapters are separated by a yellow page

The Farmers' Handbook - this Volume's Introduction

This is the second volume of a five volume production of the Farmers' Handbook. In all there are forty four techniques and approaches shown, of whch twelve are in this second volume. In this volume we introduce you to some of the methods used near the house (part one). The titles of these are given on the previous "Contents" page.

This Farmers' Handbook provides information about sustainable farming methods, and can also be used as a resource for runnning literacy programmes. Information about these, and how the Handbook can be used, is provided in volume five. A list of new or difficult words and their explanation is also provided in volume five.

Aims

The main aim of this handbook is to help farmers make their own farms more successful. This is done by providing information about using simple methods which strengthen, rather than damage the environment, and help to create sustainable livelihoods for future generations.

Background

The techniques described in the handbook are the results of research made by the farmers of Surkhet and Jajarkot districts of Mid-Western Nepal. We believe these methods will also work well for farmers of other countries. However, around the world there are diverse climates and soils, and so we expect that small changes will need to be made in the techniques according to this diversity. Similarly, it may be necessary to change plant species according to climatic region, but their function will remain the same. For example, the chapter on the **Living Fence** describes the use of thorny plants as a barrier. In the low altitude, hot Tarai of southern Nepal, "Babool" (*Acacia nilotica)* is suitable for this. But this does not grow in the higher elevations. Here, species such as wild pear, wild blackberry and Sea Buckthorn make a good living fence.

Evaluation & Feedback

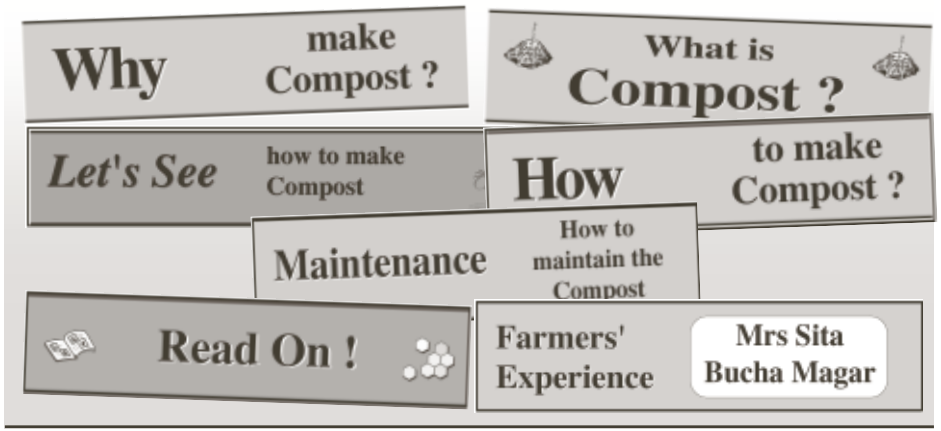
Comments and/or questions about the techniques and approaches described in this handbook will be most welcome. Suggestions for improvement will be used for future editions of this handbook and other similar publications.

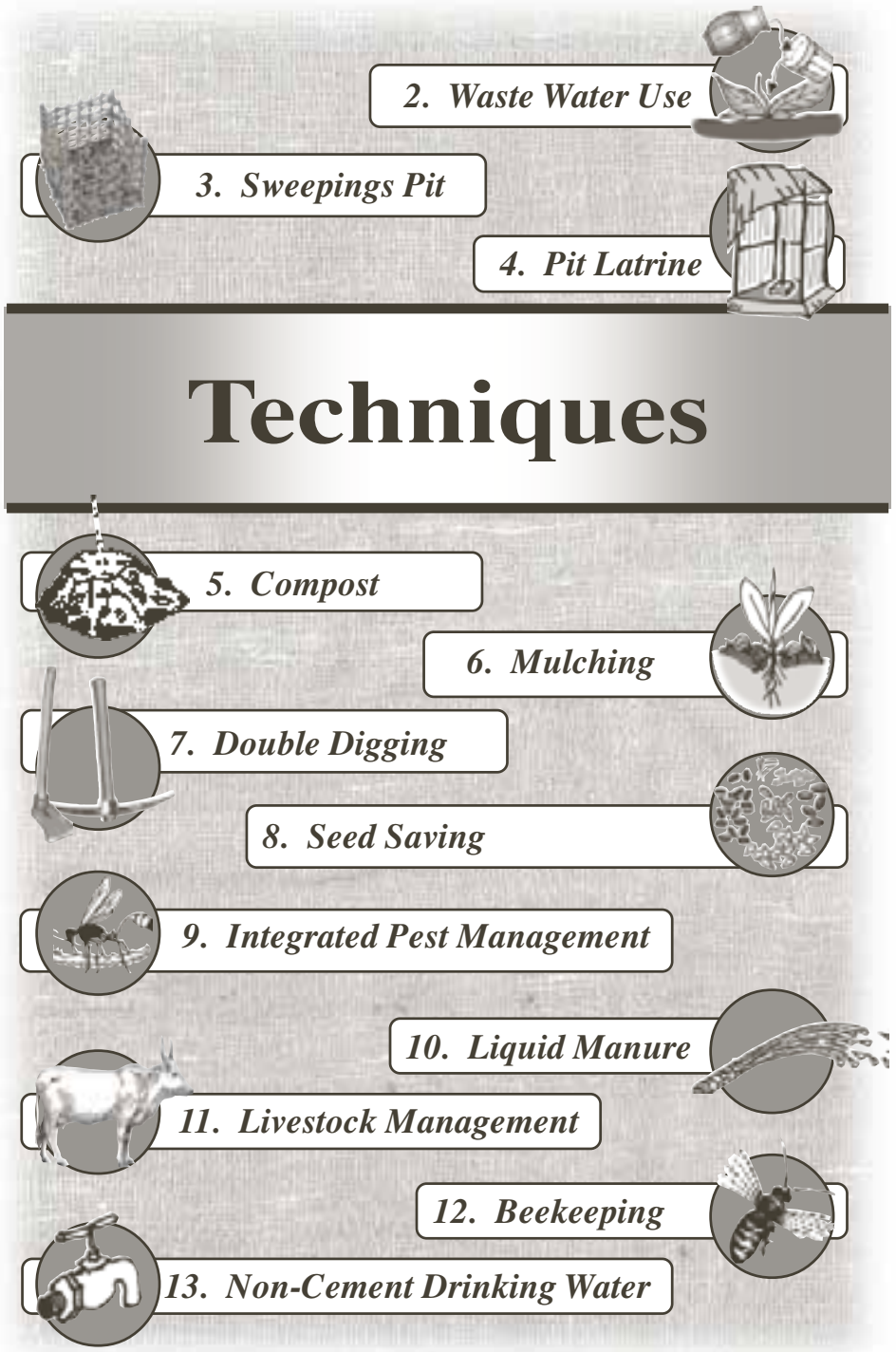
Structure of the Handbook

Inside the handbook each method is descibed in a separate chapter, or chapter. All methods are descibed in the same way:-

- "What is?" - the method is defined and described.
- "Why?" - the benefits of using this method are then described.
- The main part is then "How to?" make or do the method;
- In the "How To" section the centre pages show colour pictures about the method.
- After describing how to create the method, how to maintain, care for, manage and/or operate it is described.
- After this, there is an interview with an experienced farmer who has built and used the method.
- Finally, information is given about other chapters in the Handbook which are directly connected to this method.

There are minor changes to this structure as necessary.





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What is Waste Water Use ?

In Surkhet, Nepal, waste water is collected from the taps to water vegetables

There are many problems of water shortage in our homes and villages. Apart from needing water to irrigate nurseries and kitchen gardens, in many places it can be difficult to get water even for the essentials of daily life. It's not possible to carry water from far away to put on the garden. In places where it isn't plentiful, waste water from washing dishes, hands, faces and bathing can be used to irrigate kitchen gardens. This is called **Waste Water Use**. Water that has already been used once is still a valuable resource to use again.

There are many resources around us which can be easily and beneficially used . Problems come only when we don't know the methods to do this.

Why use Waste Water ?

Benefits of Using Waste Water

- Water isn't wasted after washing dishes and bathing
- We can use that water to increase crop production
- Increase resources for the household
- Waste resources are recycled
- Keeps the house and court-yard clean

Because ashes and other materials are used in the waste water, it is very fertile. So it gives nutrients to crops as well as irrigation. Plants grow really well with these extra nutrients. This is a good use of waste resources.

This Chapter's Author:

Mr Laxman Rana
Community Service Group,
Dahachaur 4, Surkhet, Nepal

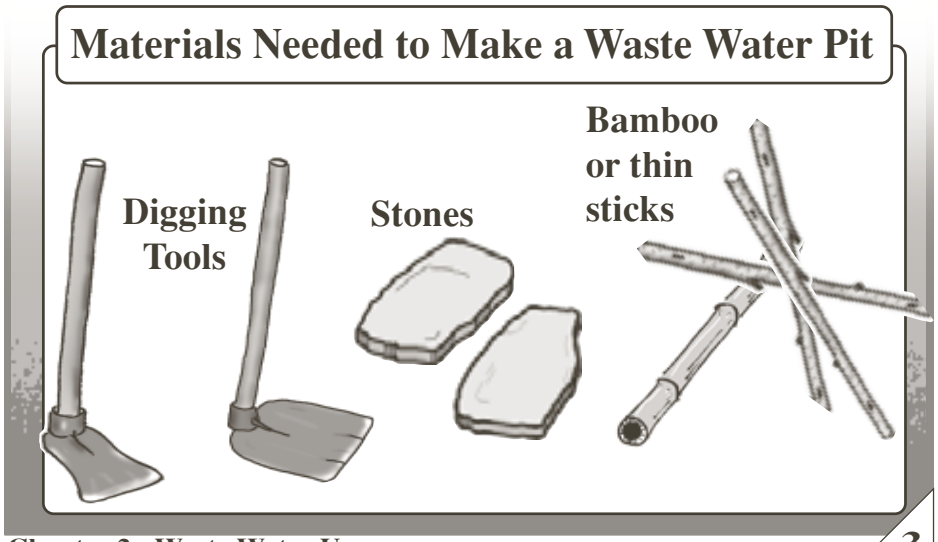
How to use Waste Water ?

Where to Collect the Waste Water ?

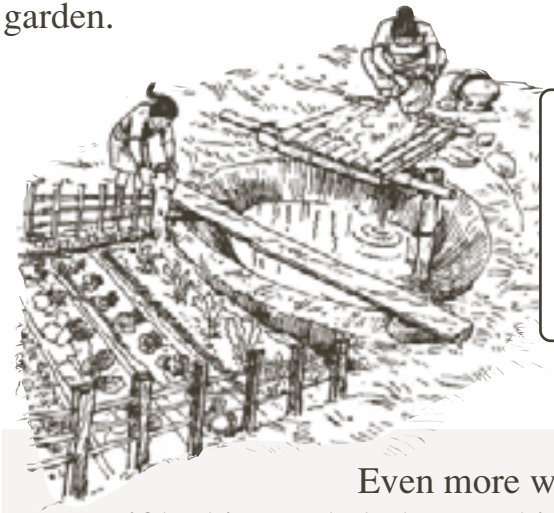
On the edge of the courtyard around the house there should be a fixed place for washing hands, pots, etc. When the pit is made close to this, the waste water can be collected. When making a pit, it should be close to the household's kitchen garden or home nursery, so irrigation is easy.

When to Make it ?

Ways of collecting waste water can be made at any time. Waste water collection helps to keep the area clean all year round. It's especially useful for irrigation in the dry season.



There are different methods of collecting and using waste water. You can use the method which is best for you according to your own needs and resources. For any method, first all water should be collected at one point. Water can be collected into a pit and then a watering can be used to put it on the garden. Or a series of small canals can lead from the washing place directly to the where the water is needed in the garden.

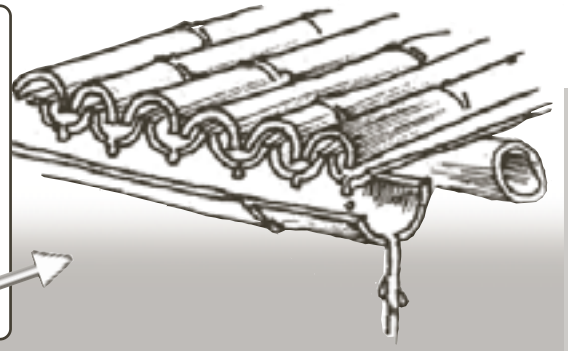


After collecting waste water like this, it can be used in the garden.

Even more water can be used this way if bathing and clothes washing are also done here.

The pit should be kept clean, and the water used as quickly as possible, otherwise mosquito and other pests or diseases can collect.

A draining platform like this can be made to send the waste water straight to the garden

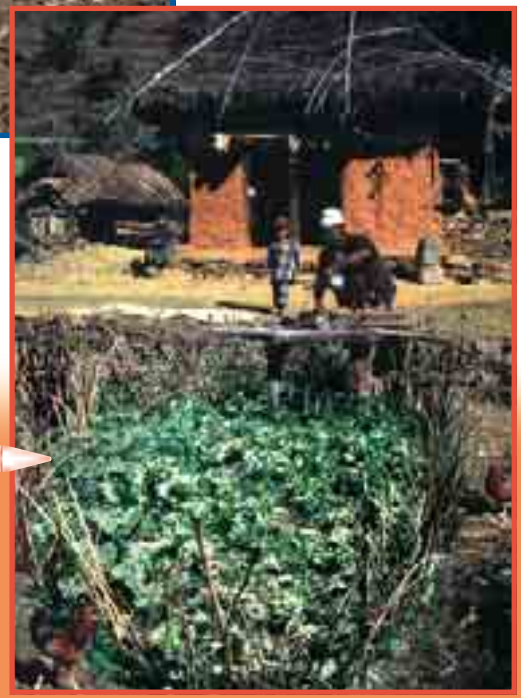


Let's See

How to make a waste water pit

If water used in the house goes to waste it cannot help to grow crops, and also makes the court-yard dirty.

In the very same place with very little input, a good kitchen garden can be made



At the washing up place, on one side the clean pots are dried, and on the other the waste water is made to flow away.

Then the waste waster flows by itself onto the garden.

In this way the washing place, drying place and place to send the water away can be easily arranged.

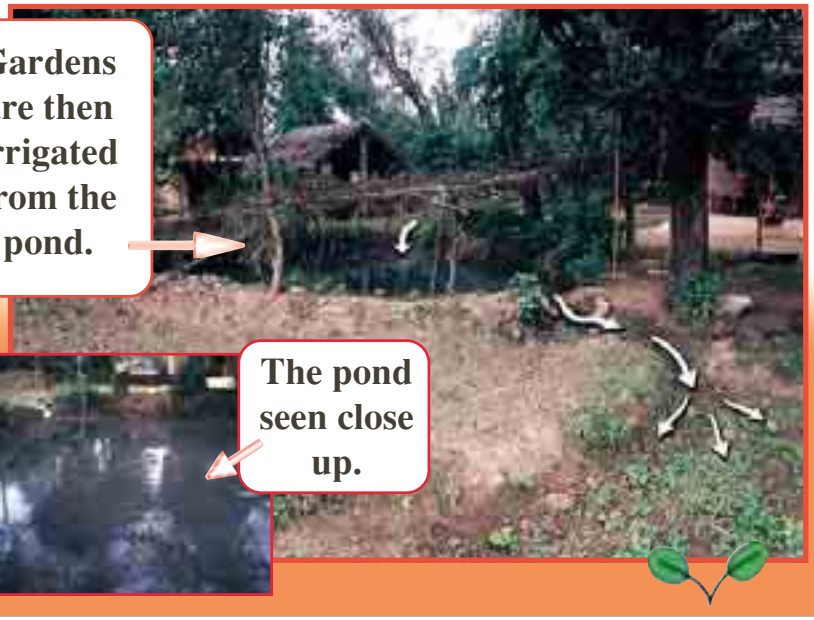
Here is the washing place

Because the waste water is well managed to go to all the right places in the garden, this is enough for watering and fertilizing the vegetables in the beds.

From a community tap or well there is enough water for several kitchen gardens or nurseries.

Here waste water from a community tap is collected in a canal.

Then the canal flows to a pond.



Gardens are then irrigated from the pond.

The pond seen close up.

Maintenance

How to Maintain the Waste Water Pit

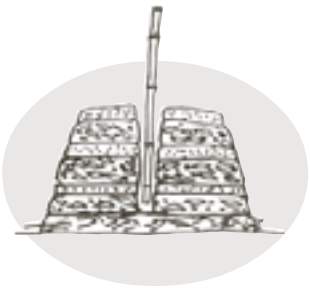
Where to use the Waste Water ?

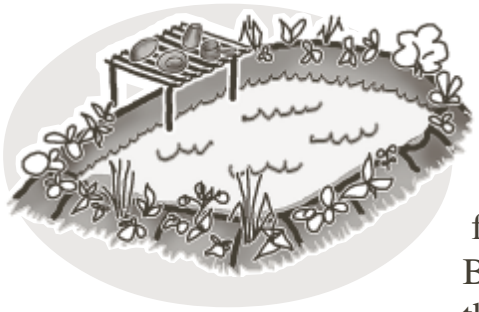
Using waste water collected daily

- to water small kitchen gardens
- to water nurseries of fruit, fodder trees, fodder grass seedlings etc. for your own use or to sell or trade
- to raise vegetable seedlings for the kitchen garden

Because nurseries or kitchen gardens are made near the house, livestock like chickens, goats and pigs mustn't be left to roam the area because they will destroy the plants there. They will also damage the pit or tank.

If waste water is sometimes added to the compost pile, it will help it to rot down quicker.





Around the edges of the waste water pit perennial plants like lemon grass, comfrey, tree tomato and fruit trees can be planted. Because it is always moist, these plants will grow and produce well.

Farmers' Experience

Mrs Tilisara Gharti

From Nepal, Surkhet district, Gumi - 8, Pandit Kanla village, and a member of "Women Improve" women's group, Mrs Tilisara Gharti has made an waste water pit. Now let's hear about her experience.

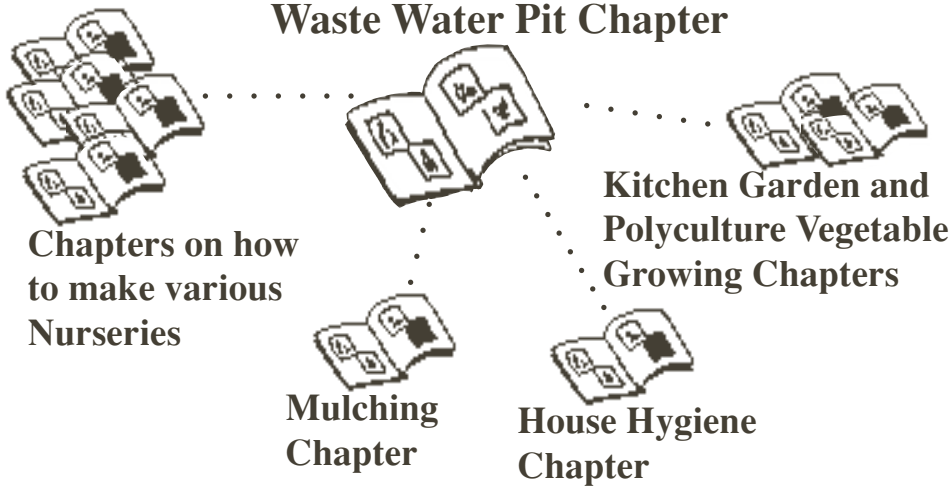
Mrs Tilisara Gharti

" At first I didn't know about this method. All the water from washing up went to waste. Now, after learning about this method, a waste water pit has been made. From here, a small ditch carries water into the nursery and kitchen garden area. Now the washing area is better managed, a bamboo rack has been made, and water is collected into one place. From here it goes to the garden. A small amount of work has solved the water problem. Now waste water from our house is used for vegetables, and a fruit seedling nursery. This method is really easy and efficient. Now others are starting to use the same method in the village. "

Read On !

Subjects Related to Waste Water

Good benefits can be had from the information in this book about collecting and using waste water. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.



Mulching Chapter

If water is to be used it must first be conserved. A mulch covers the soil and prevents water loss, so giving more water for the plants. In this chapter is information on how to do mulching.

Chapters on how to make various Nurseries

Different types of plants need different types of management to grow them. Information on how to build and manage the home nursery, fruit nursery, air nursery, hot bed and leaf pots is given in these chapters.

Kitchen Garden and Polyculture Vegetable Growing Chapters

How to make and manage a home vegetable garden for permanence, ease and simplicity. Information on doing less work for more production while also being able to produce a wide range of fresh vegetables is given in these chapters.

House Hygiene Chapter

Don't think that health improvement comes only from eating a good diet. If the house and kitchen are dirty, even more diseases can spread. Information about easy techniques to keep the house clean are given in this chapter

What is a Sweepings Pit ?

Mrs Maiya Khatri is growing potatoes in her sweepings pit

Dirt is the home of disease. If we don't pay attention to regular home cleaning we can suffer from various illnesses. It can be very expensive to be cured from these illnesses. Now let's think, how dirty are our homes and courtyard ? Yes, they're dirty, but there's an easy way to solve this. The dirt should be collected in one fixed place. Extra money or work isn't needed for this. The place to put the dirt is called a **sweepings pit**.

The Sweepings pit is where dirt, leaves and other organic waste swept up from inside and outside the house is kept, and it is used to make compost as well as keeping the area clean and tidy .

Why make a Sweepings Pit ?

The Benefits of a Sweepings Pit

- dirt is put in a fixed place
- this keeps the home and courtyard clean
- this helps to protect against illness
- the decomposed sweepings can be used as an extra source of compost

This Chapter's Authors:

Ms Balkumari Giri
Mr Bhuvan Khadka

How to make a Sweepings Pit ?

How to make :-

It's really easy to make a sweepings pit. It doesn't take much time and can last for a long while.

Time to make :-

The sweepings pit can be made at any time. It's good to start it after the monsoon, if you have one.

Place to make it :-

The sweepings pit should be made at the edge of the courtyard.

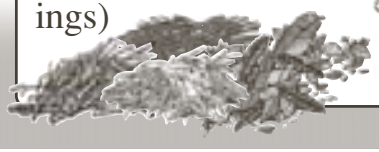
Method of making a Sweepings Pit

There are 2 ways of making it :-
(a) digging a pit; (b) without digging a pit

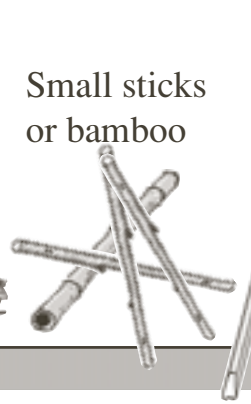
Materials needed to build a Sweepings Pit

Hook (cutting tool)

Leaves, etc. (sweepings)



Small sticks or bamboo



Crow bar

Broom

(a) Digging a pit

You can choose the best place on the edge of your courtyard to dig the pit. The depth and width of the pit is up to you - see how much you sweep up daily, and according to filling the pit once or twice a year, decide how big the pit should be.

After making the pit, the collected sweepings are very good compost for fruit trees. In one farmer's experience, fruit trees given compost from sweepings fruited 2 years before those which didn't have it.

(b) Not digging a pit

Put 4 strong upright corner posts in the ground and in between put in smaller uprights. Weave bamboo or other small sticks to make a basket-type effect. This needs to be good and strong, to last a long time. Fill this with the daily sweepings, making sure they can't spill out.

If sweepings can be kept for a long time this can be used as compost for your own field crops or kitchen garden. So it's good to make a pit or frame to hold as many sweepings as possible, for a long time.

Like this you need to develop the habit of daily putting the sweepings into the pit.

Let's See

How to make a sweepings pit

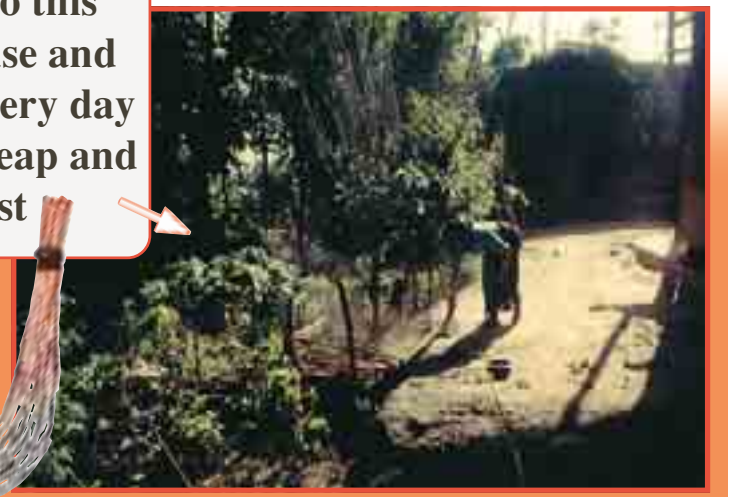
The pit is made in the right place to collect the sweepings, on the edge of the courtyard

Put 3-5 seed potatoes onto fertile soil placed in the bottom

To make the heap, first put 4 upright sticks at the corners

Then put smaller sticks in between

Sweeping into this from the house and courtyard every day will fill the heap and make compost



A stick buried in the middle of the heap (◀) will help the sweepings to rot quicker

If potatoes are planted in the heap, you need to water from time to time

After 4 months the potatoes are ready for harvesting. This is also called "vertical growing"

When the heap is taken apart, both potatoes and compost can be removed

Using bamboo in a pot, here straw-berries are grown in the sweepings

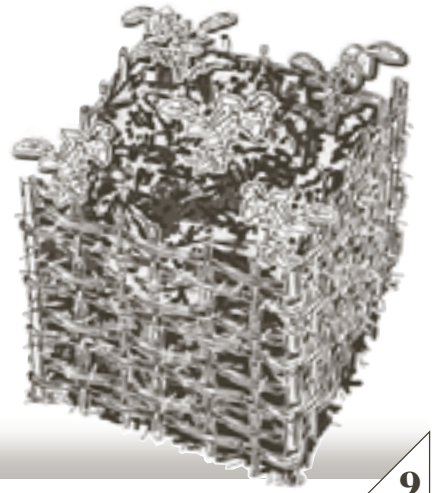
Vertical Potato Growing

There are many methods to give maximum production from a small area with minimum inputs. Of these, to get quick benefits from a small space potatoes can be grown using this method. This way of growing potatoes is done on an area about 1 metre square and one metre high. So from a square metre of land a small family doesn't have to buy potatoes.

Using vertical growing on this much land, 12-15 kg of potatoes can be produced

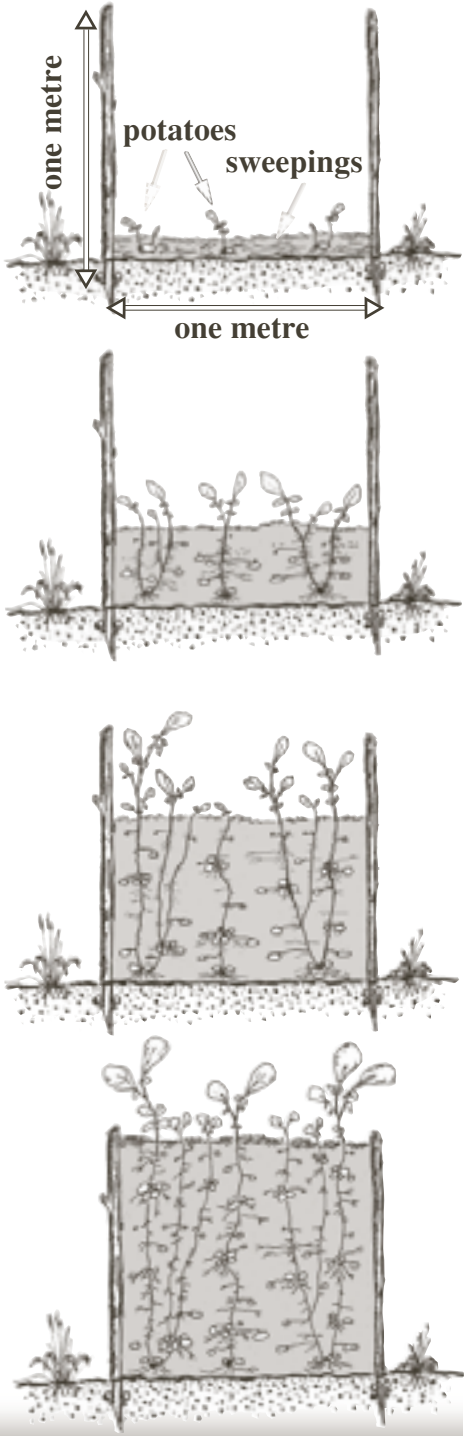
Benefits of Vertical Potato Growing

- produce lots of potatoes on minimum land
- minimum input gives more production
- don't need much seed
- don't need to dig or earth up
- makes use of waste biomass



Vertical Growing Method

Make a frame one metre square from upright sticks, and weave or tie horizontal sticks or bamboo up to a height of 1 metre. Put 2-4 inches of leaf litter and compost on the bottom. On top of this place 4-5 seed potatoes, spaced separately and evenly. Now cover the potatoes with 4 to 6 inches of leaf litter and sweepings. The potatoes will sprout, and after they sprout above the leaf litter, from time to time should be covered with more litter and sweepings, allowing just an inch of the tip sticking out. Keep on adding the sweepings daily. Keep covering like this for up to 3 months, then stop adding for one month until the potatoes start to flower at about 4 months. At this time, the heap can be taken down and potatoes harvested all at once, or as needed.



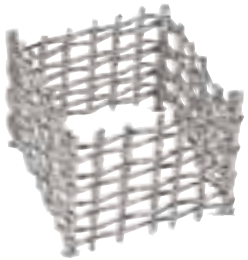
Farmers' Experience

Mrs Rikali Gurung

From Nepal, Surkhet district, Gumi - 3, Ratadada village, and a member of "Hariyali" women's group Mrs Rikali Gurung has made a sweepings pit. Now let's hear about her experience.

Mrs Rikali Gurung

" At first I didn't know this method and sweepings were thrown away anywhere. But compost made from sweepings is really well rotted and fertile. Our corn grew much better using this compost compared to any other compost. Before, all the dirt from the house and yard went to waste. Now, in 5 months we get 15-16 baskets of compost. At first I put it on the corn, and by the time this is harvested another load is ready for the wheat. There's even some left for the kitchen garden. In this way, waste resources are well used and the house and yard are kept clean. This gives many benefits, and I'm going to keep using this method each year. "



Read On !

Subjects Related to Sweepings

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Chapters on how to make various Nurseries

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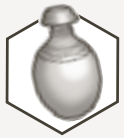
House Hygiene chapter

Don't think that health improvement comes ony from eating good food. If the house and kitchen are dirty, even more diseases can spread. Information about easy techniques to keep the house clean are given in this chapter



Kitchen Garden and Mixed Vegetable Growing

How to make and manage a home vegetable garden for permanence, ease and simplicity ? Information on doing less work for more production while also being able to produce a wide range of fresh vegetables is given in these chapters.

What is a Pit Latrine ?

Vishnu Maya Siris's temporary pit latrine, Surkhet

When eating, people will take in and digest any food nutrients they need, and what is left is pushed out of the body - this is called **excrement**, or **faeces**. The proper place to dispose of this is in a **toilet** or **latrine**. Without toilets, excreting in just any place can lead to many problems of health and pollution.

This chapter gives information on how to solve these problems, and at the same time getting more benefits from the toilet.

Why make a Pit Latrine ?

What if we don't make a latrine ?

- the environment is dirty
- many types of disease can spread
- there's no use for this local resource
- so the resource is wasted
- self esteem and dignity is lost

To avoid these problems, and to turn our waste into benefits for minimum expense, we can build temporary pit latrines.

Temporary Pit Latrine - how to get more benefits from the toilet

A pit latrine made from your own local resources is called a **temporary pit latrine**. When the pit of one latrine is full another pit latrine is dug in another place. By doing this you can plant a useful and valuable fruit tree in the fertile pit. Mixing soil and leaf litter with the excrement and urine as it is made means that it quickly rots down to make good compost. These are free nutrients for the fruit tree.

This Chapter's Author:

Mr Laxman Rana
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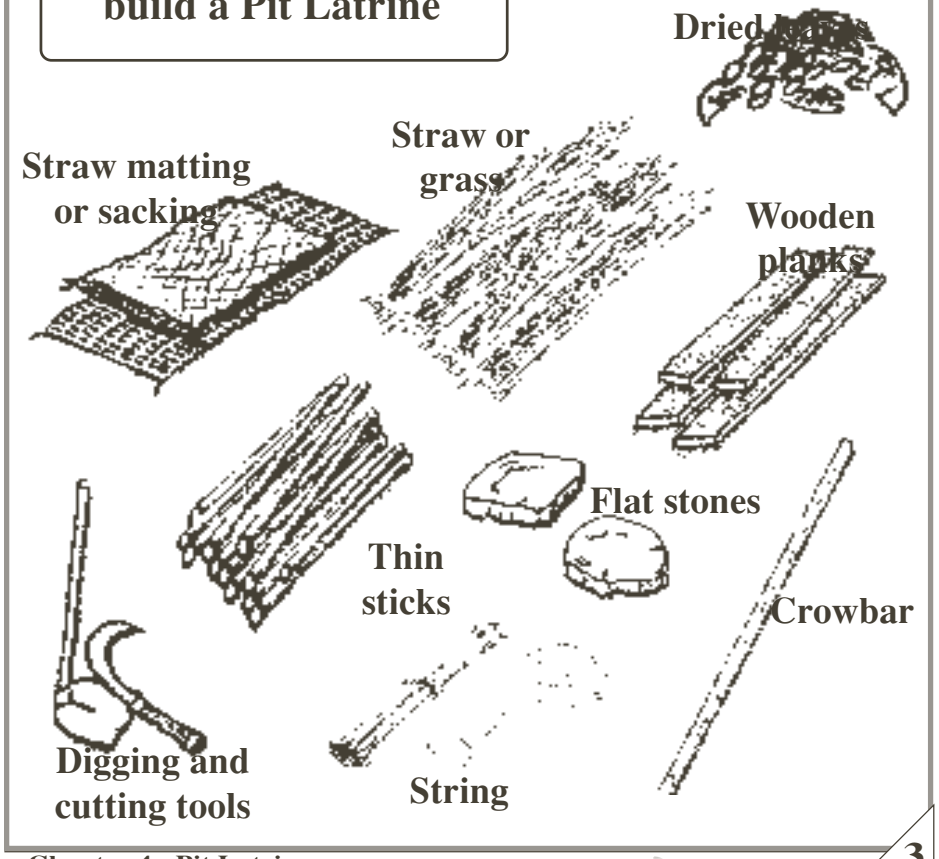
How to make a Pit Latrine ?

Where to make the temporary pit latrine ?

The pit latrine should be made on the edge of a field or terrace. Also, you can select a spot according to wherever you want to plant a fruit tree.

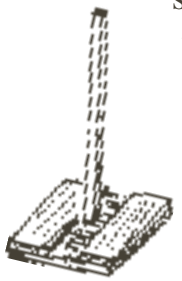
Materials needed to build a Pit Latrine



1. Digging the Pit

Dig a pit 1-1.5 metres deep and a metre wide. Fill the pit half-full with straw or leaf litter. Don't think the work of digging the pit goes to waste, as you can plant a fruit tree in the pit after it is full.

2. The frame and lid



There needs to be strong timber over the pit to support the frame and the weight of a person using the latrine. At right angles to this put smaller sticks, leaving a space for the toilet hole. Fill in all the gaps using sticks and soil. Using planks is best as they join tightly and be kept clean easily. If you can't get planks, then sticks and soil will do. Make a raised footstep either side of the hole. This keeps the feet from getting wet. Finally, make a lid which fits and covers the hole well, keeps flies out, and can be moved easily.

3. Covering around the latrine

To surround the latrine so no one can see inside, use straw matting, sacking, cut sticks such as wormwood or morning glory, or even maize stalks. This should include a doorway to make getting in and out easy.

Now your pit latrine is ready to use

Let's See how to make a pit latrine

First dig a pit 1-1.5m deep and 1 metre wide

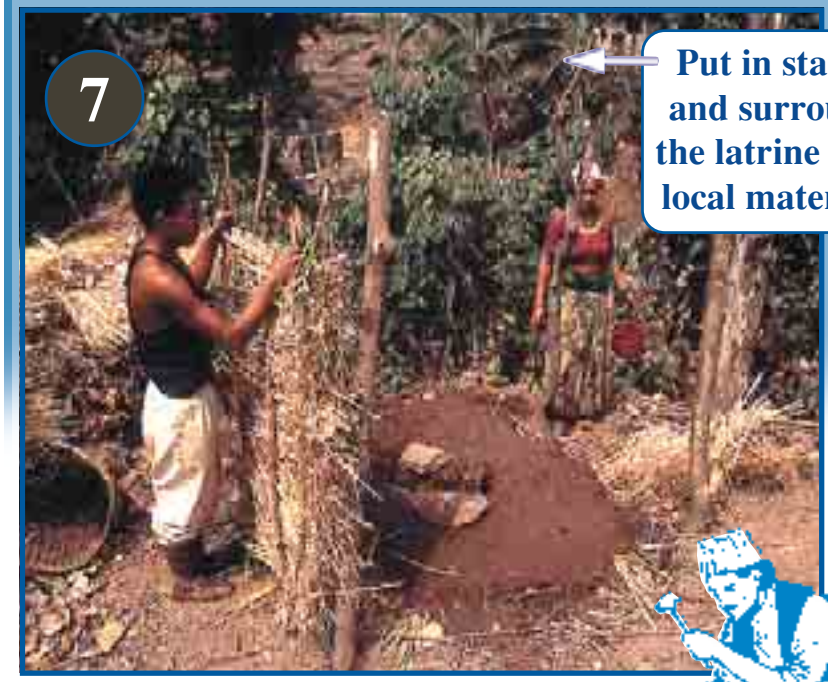
Fill the pit half full with straw or leaf litter

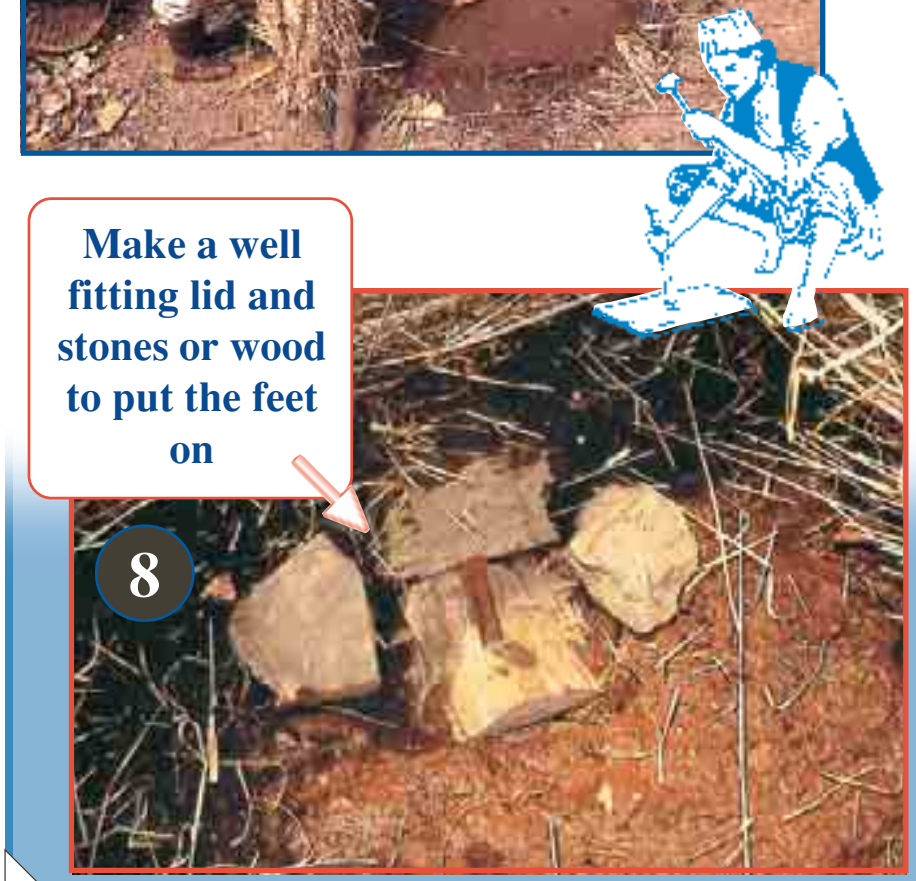
Now put large timber over the top

Leaving a hole in the centre, fill in the gaps with other sticks or planks

Fill in the smallest spaces with straw and mud

Cover the top with a thick layer of soil





Maintenance

How to Maintain the Pit Latrine

Things to consider when using the pit latrine

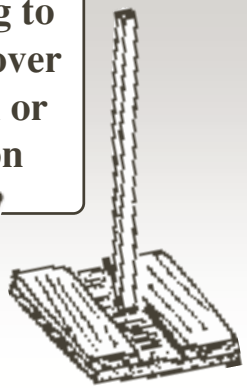
Each time you have used the latrine, cover your deposit with soil and/or leaf litter. From time to time add ash which improves the rotting of the excrement. Always keep the lid on the hole.

Putting soil, leaf litter and ash on the excrement prevents flies settling. This also helps micro-organisms to rot down the excrement quicker. This makes nutrients ready for trees planted in the pit. When the pit is full the contents will settle so add an extra foot or 2 of soil on top. If soil, leaf litter, ash, etc. is well mixed as the pit is filled then a seedling can be planted straight away. If these materials aren't mixed in, it takes the excrement a long time to rot down.

This is how, with good use of a latrine's waste, excrement can be turned into a useful resource.

A permanent toilet can cost $200 to build. Can we afford this? For us farmers the temporary pit latrine is cheaper AND more useful than an expensive toilet !

After going to the toilet cover it with soil or vegetation



Always keep the lid when the latrine is not in use

When you come out from the latrine wash your hands well with soap or ash

Farmers' Experience

Mrs Chavi Gurung

From Nepal, Surkhet district, Gumi - 5, Krishnagar, Mrs Chavi Gurung has made a pit latrine for her own household. Now let's hear about her experience.

Mrs Chavi Gurung

"There are lots of benefits from making a pit latrine. Waste is made useful, and the house and yard is kept clean. Before making the latrine, first I dug a round pit After digging the pit I put planks over the top. I left a hole in the top, and made a lid to fit exactly over the hole. This all stopped the latrine from smelling. After going to the toilet, soil and leaf litter are put in. When this pit is nearly full, we start digging a new pit latrine. On the full pit we add more soil and can plant a mango seedling straight away. I'll be planting another mango in the new one when it's ready. It takes about a year to fill one pit. Now others have seen how easy it is, and are starting to make the same type. "

Read On !

Subjects Related to Pit Latrine

In this book benefits can be had from the information about the pit latrine. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.

Pit Latrine chapter

House Hygiene chapter

Fruit Tree Planting chapter

Building a pit latrine is good for the health. But dangers to health can come from many different places. Information on where dangers come from, and how can we protect ourselves from them is given in this chapter.

After raising good seedlings in the fruit nursery, if they're not planted well, all the work can go to waste. Information on more productive planting is given in this chapter.

What is Compost ?

Mrs Saraswati Adhikari and her improved compost heap, Begnas VDC, Kaski district, Nepal

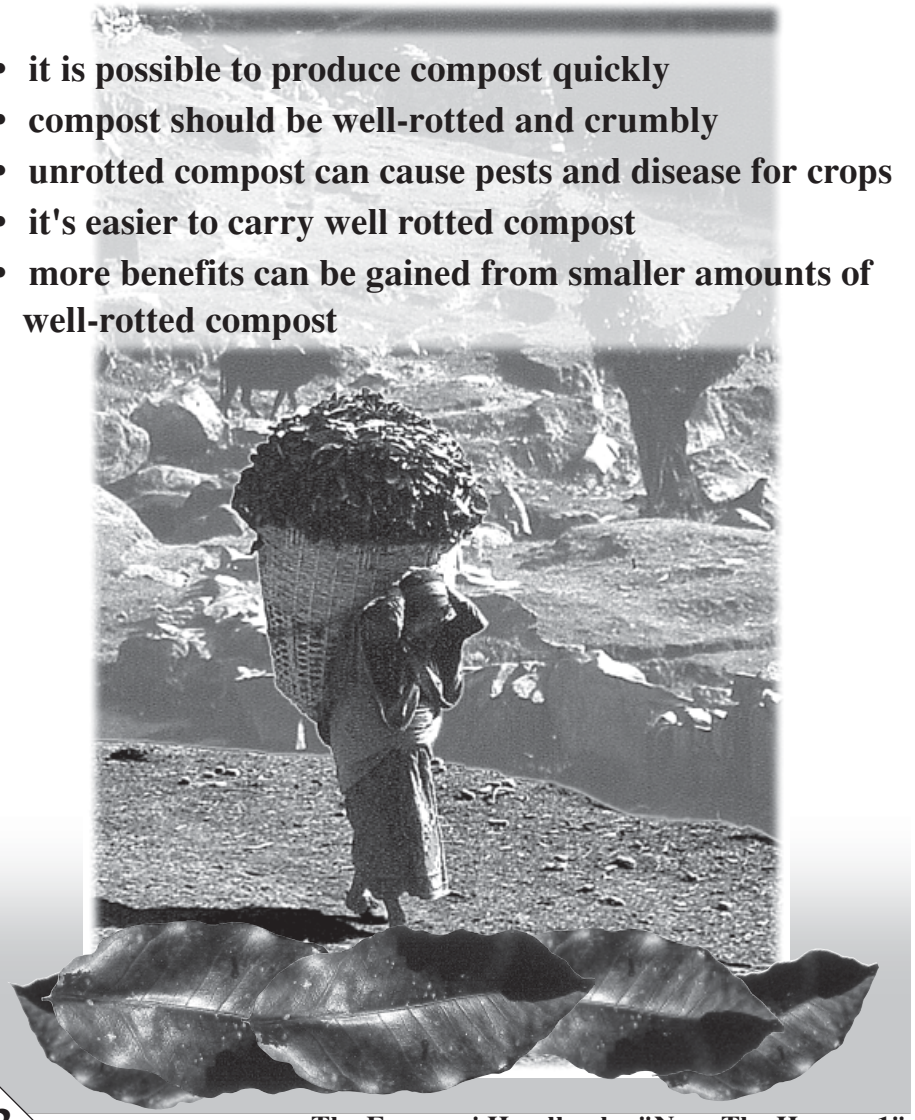
All farmers have experience of making compost. They also know very well how much compost is needed for their plants. But if the compost used on the fields is not well rotted down, it can cause more problems of pests and disease, rather than benefits. Like carrying fodder from the forest and tending livestock, carrying the compost is hard work, but it should also give good production. But if the compost is poor quality all the work can be wasted and result in loss for the farmer.

So this chapter gives information on easy methods to produce good quality compost.

Why make Compost ?

Things to consider when making compost

- **it is possible to produce compost quickly**
- **compost should be well-rotted and crumbly**
- **unrotted compost can cause pests and disease for crops**
- **it's easier to carry well rotted compost**
- **more benefits can be gained from smaller amounts of well-rotted compost**



How to make Compost ?

To improve the method of compost making, first it's necessary to understand how compost is made and what things it needs to make it.

Materials needed to rot animal manure and plant materials (biomass) :-

- **things to decompose** :- leaf litter, grass, animal manure, etc.;
- **decomposing agent** :- micro-organisms break down biomass, manure, etc. These micro-organisms are present in rotted compost and fertile soil;
- **moisture** :- micro-organisms need the correct moisture to work;
- **air** :- micro-organisms also need air to work;
- **right temperature** :- it shouldn't be too hot.

Quick rotting compost needs good management of the micro-organisms

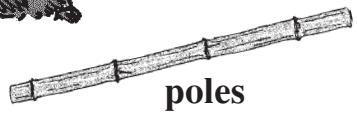
Materials needed to build a Compost Heap

soil or well rotted compost

unrotted manure, leaf litter, straw, etc. from the livestock sheds

small twigs or branches

poles



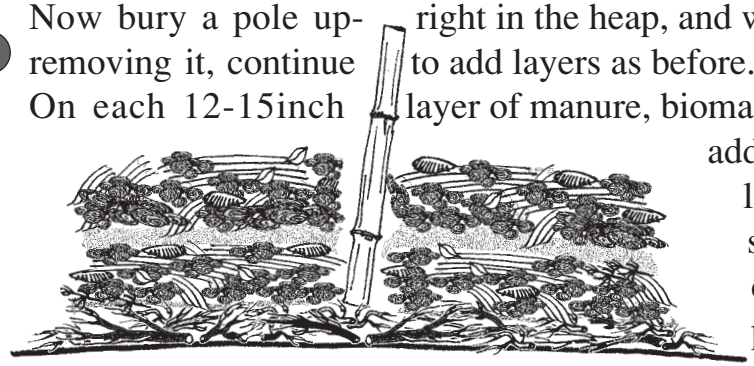
How to make Compost ?

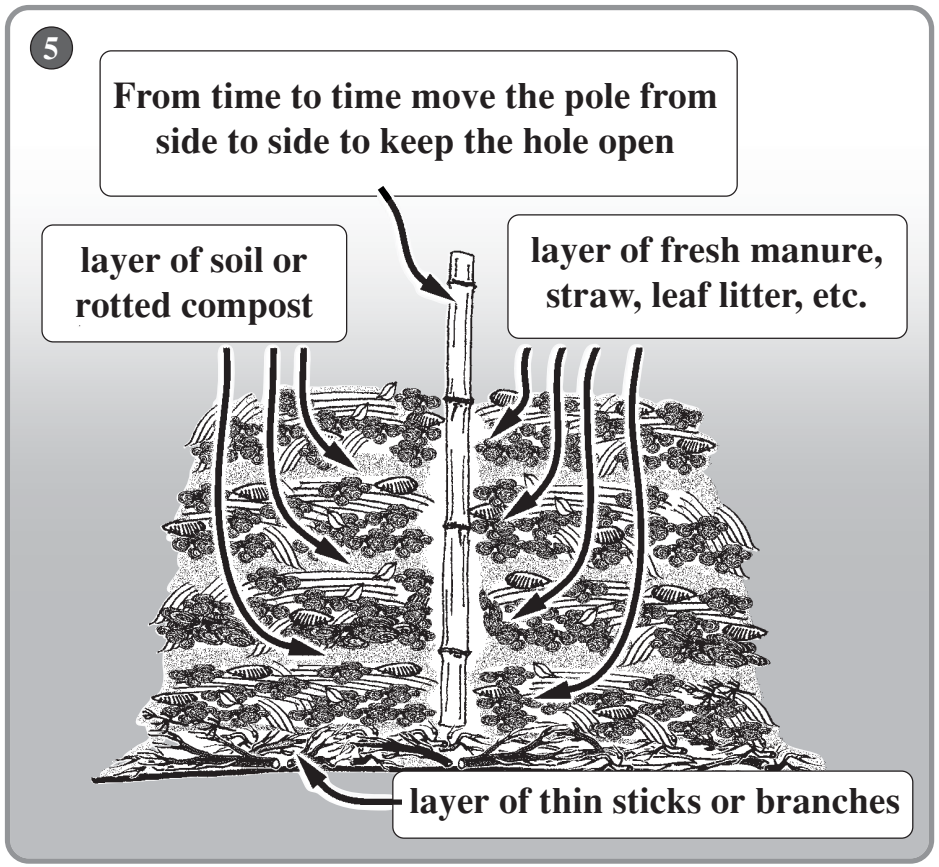
1. When making a compost heap first put a layer of thin sticks and branches on the ground

2. Then put a layer of the material to be rotted - manure and biomass from the livestock pens, leaves, etc.

3. Then put a thin (2 inch) layer of soil or fine, well rotted compost. This layer should completely cover the one beneath so you can't see it.

4. Now bury a pole upright in the heap, and without removing it, continue to add layers as before. On each 12-15inch layer of manure, biomass, etc., add a thin layer of soil or compost.





- If there is a tradition of removing all the manure from the livestock pens at once, just burying the poles without making layers will still improve the compost.

By doing this, the numbers of micro-organisms in the compost will increase. Then, they can decompose the manure and biomass quickly. There are most micro-organisms in the soil and rotted compost, so this does the same work as "seed" to help make more micro-organisms to rot the compost.

The thin branches and the pole allow air into the heap.

Let's See

how to make Compost

Compost made in separate heaps, with poles

Shaking the pole from time to time quickly rots the compost

Remove the pole to test the heap

If there's too little water in the heap a white fungus can be seen

This well rotted compost heap is being removed

Maintenance

How to maintain the Compost

In many villages there is a shortage of water. However, from time to time it's good to put waste washing up water down the holes in the compost heap.

Symptoms of poorly rotting compost

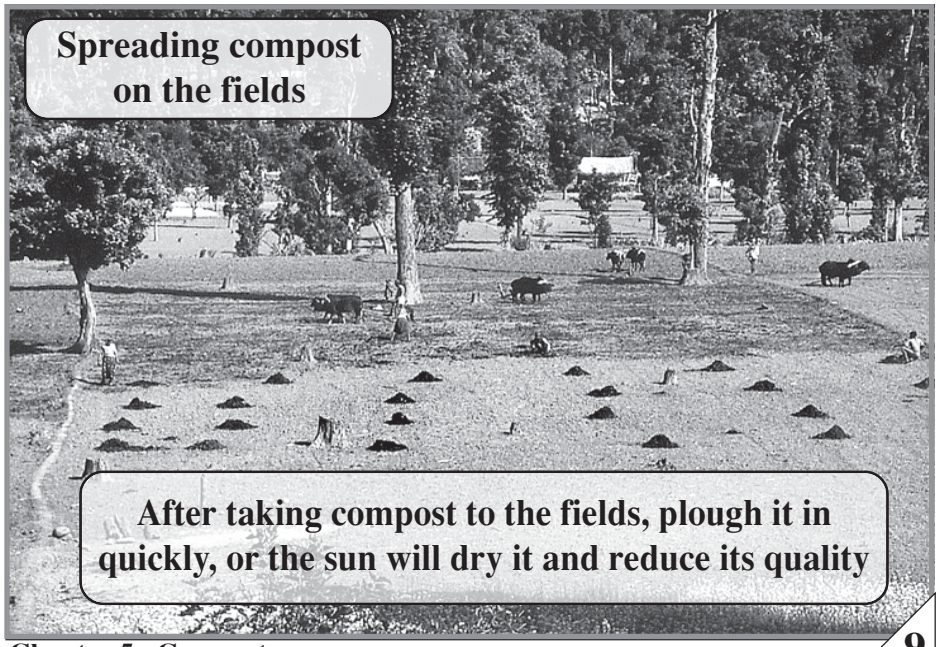
If there is anything lacking in management of the compost heap, it will rot slowly or badly. But how to recognise what is wrong ?

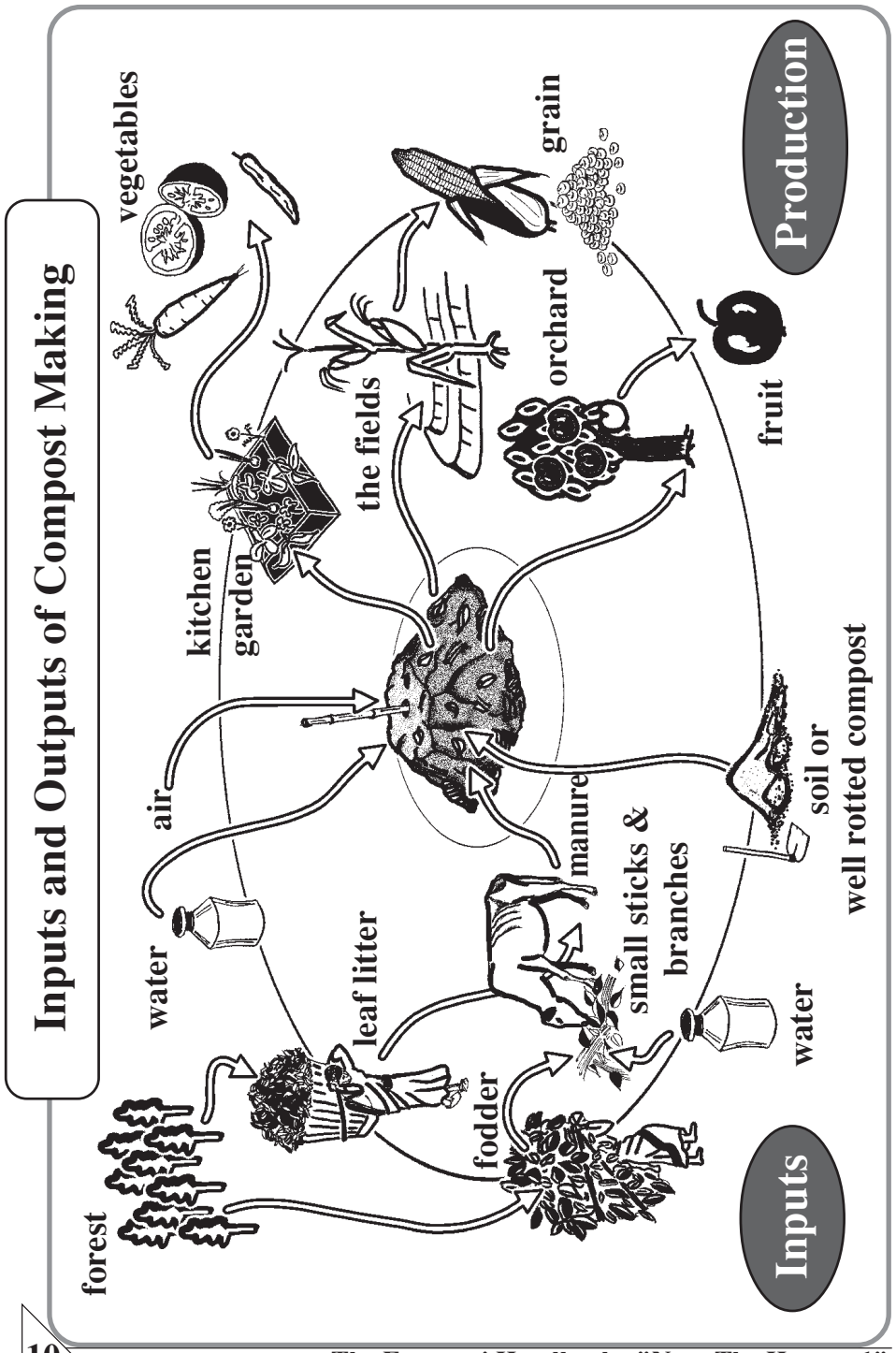
- If there is white fungus on the pole when taken out, perhaps there is not enough water in the heap. Pouring a little water from time to time will solve this problem.
- If your hand is burned when you bury it in the heap, this is a bad sign. Too much heat will also kill the micro-organisms. This will slow the decomposition process. This is probably due to not enough air circulation. Make more holes in the heap to solve this.

- If there is a bad small from the heap, and lots of flies, add more straw or leaf litter. This can also be due to lack of micro-organisms and without them, the manure etc. will not rot down well. For this, add more soil or well rotted compost to increase micro-organisms.

When all these needs are met, compost will rot quickly, and you will have better compost to go onto the fields

If you can't make a heap with layers and it is all stacked in one place, you don't have to do anything else but make holes in the heap with the poles. Move these sticks around from time to time. Just doing this will improve the compost.





Farmers' Experience

Mrs Sita Bucha Magar

From Nepal, Surkhet district, Gumi - 3, Ratadada village, and a member of "Hariyali" women's group, Mrs Sita Bucha Magar has made improved compost. Now let's hear about her experience.

Mrs Sita Bucha Magar

" In 1994 I learned how to improve my compost from the Homestead Programme (JPP). Before this we would put out just partially rotted compost. We had a habit of heaping compost anywhere to rot. Now we make it with a pole for a chimney, and it rots much more quickly. Mixed grass, leaves and manure are stacked in layers with soil or old compost, and the pole buried in. It's an easy method. Before this the compost would be wet and sticky but now it's much better. It's more crumbly, and is also easier to carry, and to spread out on the fields. Now we always make compost like this. Twice a year we carry it to the fields. It's easy to make compost like this, you don't have to work hard. And because it's easy to do, it's easy to learn and to teach others as well. That's why there are many farmers using this method in the village nowadays. "

Read On !

Subjects Related to Compost

Soil Conservation and Improvement Chapter

What is soil? What does good soil need? What damages the soil? What methods are there to protect and improve soil? The answers to all these questions, and more information on soil, are given in this chapter.

Livestock Management Chapter

Livestock can be healthy and give good production from nutritious fodder grown close to the home. Information on this and other simple methods to manage livestock through health, diet, hygiene and breeding are given in this chapter

Agroforestry Chapter

Trees planted on the land produce many products to make compost for the soil, but you can't plant them anywhere. In this chapter, information is given about how to plant trees on farmland without decreasing farm productivity.

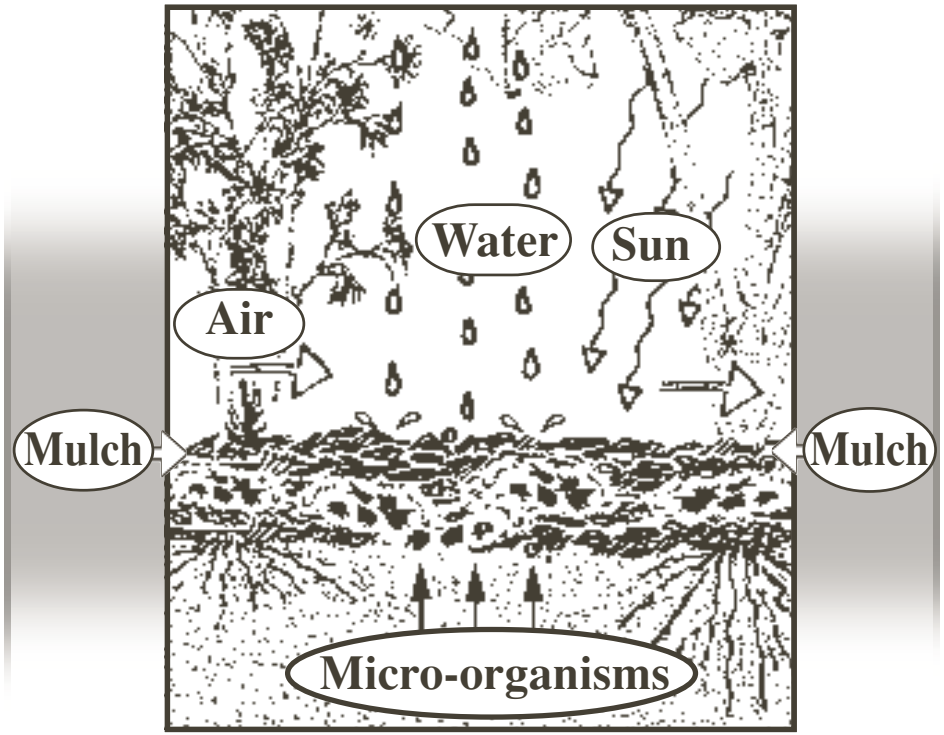
What is Mulching ?

Purna Bahadur Nepali's mulch bed

We farmers have to work hard for food to eat and clothes to wear. But when we can produce enough from this work, then we can live well. For farmers, the foundation of our wealth is the soil. If soil is washed away or becomes poor, how can we grow food to eat ? We farmers, who work and play with the soil, must also learn to love the soil. One method of loving, caring for and respecting the soil is called ***mulching***.

Mulching is a method of using cut leaves, straw, leaf litter etc. to cover the bare soil while still farming and growing crops on it.

Why do Mulching ?



There are various problems if soil is left bare. Rain will wash soil away, and the sun will dry it out. Wind will dry out and blow away the soil. The beneficial organisms living in the top soil will also be lost. All these reasons cause soil loss and damage, and to remake the fertility in the soil then takes extra work. So mulching is an important technique to prevent these problems happening from the start.

How to do Mulching ?

The main objective of mulching is to keep the soil covered while farming it. There are many types of mulch but they all share this objective. Mulch is usually made from biomass (leaves, straw, etc.) but where spare vegetation is uncommon, stones covering the soil have the same benefit.

There are 2 main types of mulching :-

1. Temporary mulch
2. Permanent mulch

Fresh green or dry leaves, any straw, stones, cardboard, etc. are all useful to use as mulch

1. Temporary Mulch

With temporary mulching, the ground is kept covered for some time only. Mulch made of green or dried leaf litter, straw, etc. can be put on the soil during the fallow period, or mixed with compost and ploughed in. After crops have been planted they can also be mulched. Potatoes, garlic, onions and various vegetables benefit from a mulch after planting. The mulch will rot as the crops ripen. Mix the mulch with the soil by ploughing or digging in, after the crop has been harvested.

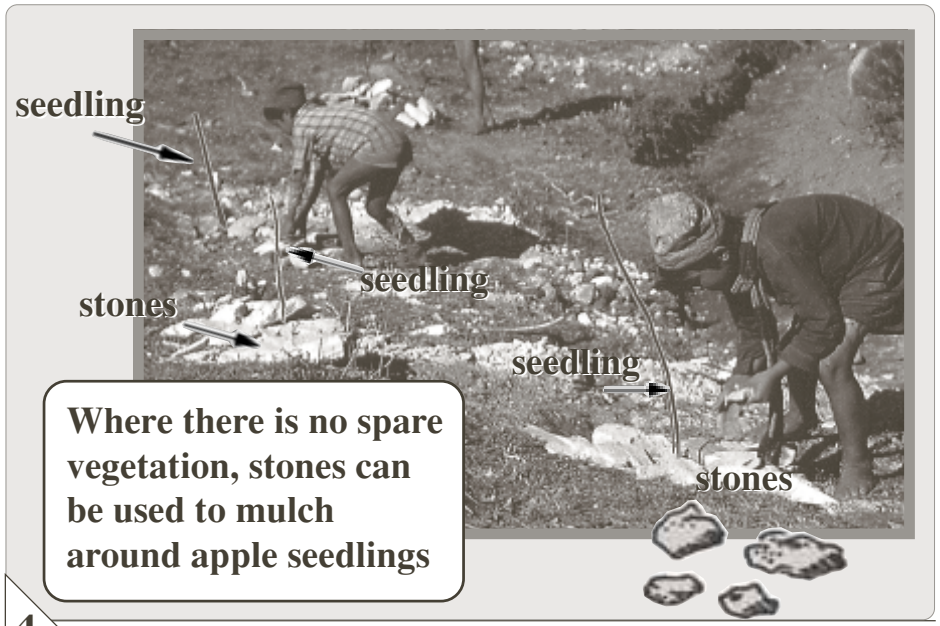
2. Permanent Mulch

For a permanent mulch, layers of well rotted compost, semi decomposed biomass, and a thick layer of fresh biomass are put on the soil, and seed and seedlings planted into this. In this method, after establishment new mulch (green biomass) is added only twice a year, and the soil never needs to be dug.

Making a Permanent Mulch

a. Preparing the mulch

- If necessary, dig or plough the soil one last time. If the soil is soft and fertile, this should not be necessary.
- Cover the soil with a thin layer of well rotted compost.
- On top of this put a 6 inch layer of dried or semi decomposed biomass, such as straw, leaf litter, etc. After putting down each layer soak with water if possible.
-

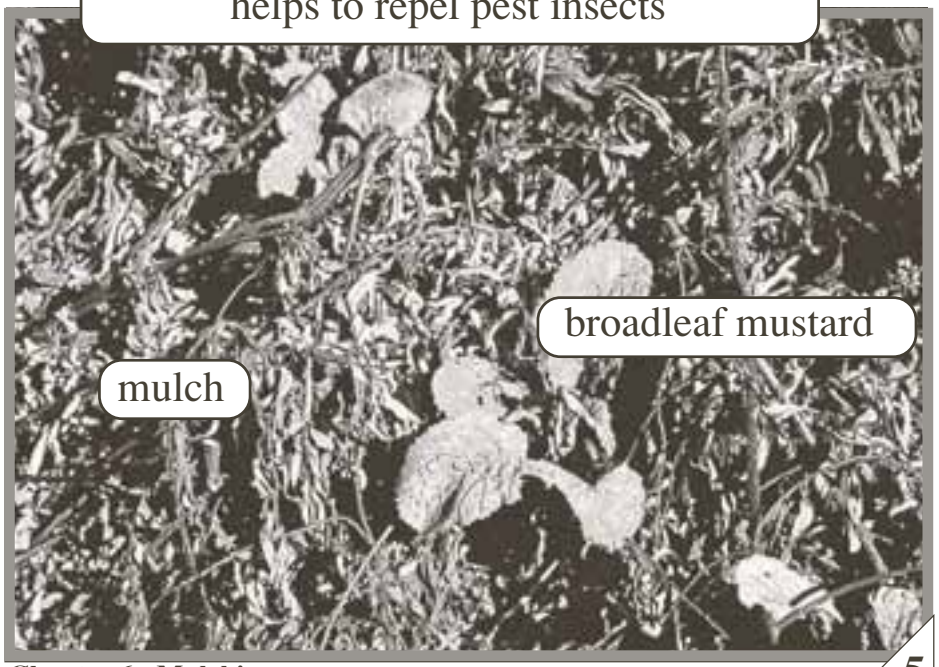


- On top of this put 6 inches of fresh, green biomass e.g. from weeding the field or trimming the hedge. Soak with water again.
- Now we can plant in the mulch bed

b. Planting Seed and Seedlings

- Using a sharp stick make a hole down through the mulch until the ground is reached. Move the stick to make the hole larger.
- Fill the hole half full with fertile soil.
- In this soil, plant seed or seedlings.
- Water the seedlings well.

In the kitchen garden, a wormwood mulch makes good compost and also helps to repel pest insects

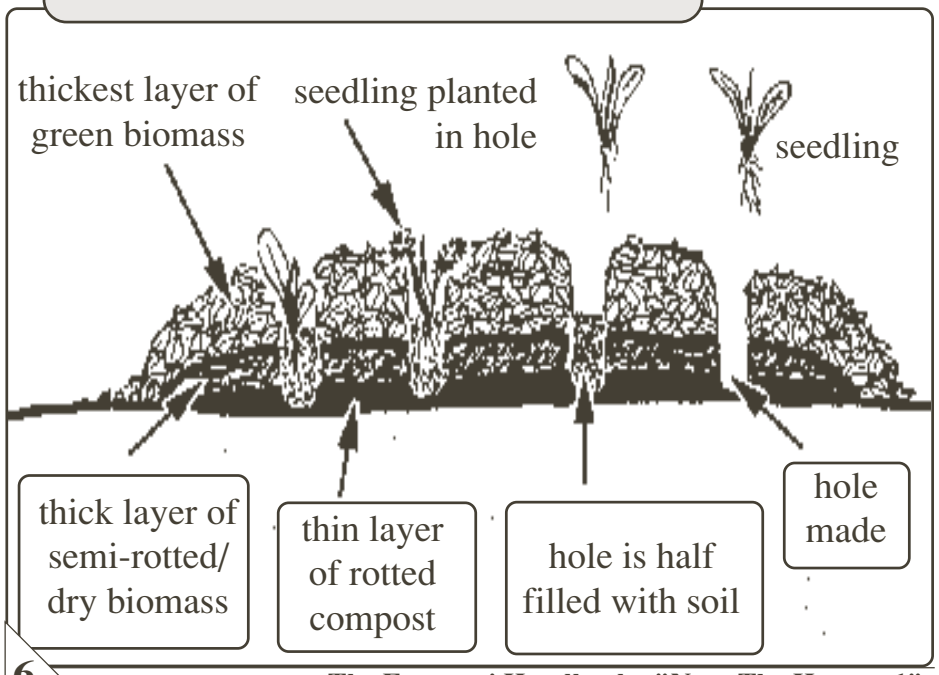


Best time to mulch

At the start of the rainy season the soil becomes wet and often heats up, causing the soil to let off steam. If a thick mulch is applied at this time the soil cannot breath properly and steam cannot escape. This can cause many types of pest and disease to occur. But if the mulch is put down and well watered 2-3 months before the rainy season, the soil and the mulch become balanced and these problems do not occur.

The best time to start a mulch is near the end of the rainy season. By this time the steam in the earth has escaped but there is still moisture in the soil to help the mulch break down into the soil. This moisture will be conserved by the mulch, and be usefull for the crops for many weeks or even months.

An inside view of a mulch bed



Let's See

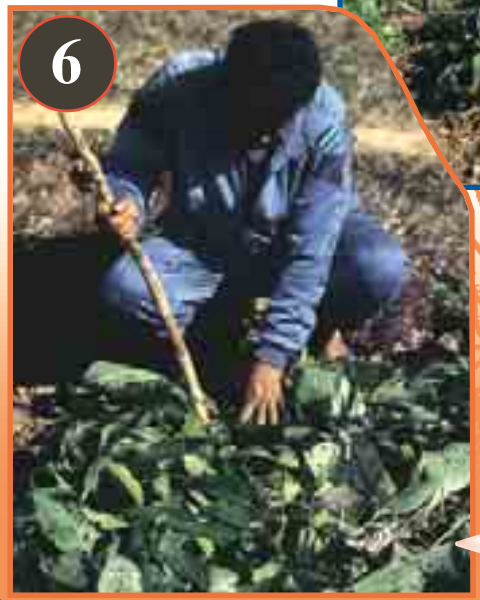
How to do mulching

Then, spread an even thicker layer of green biomass on top

Half fill the hole with fertile soil.

Now the mulch is ready and can be planted

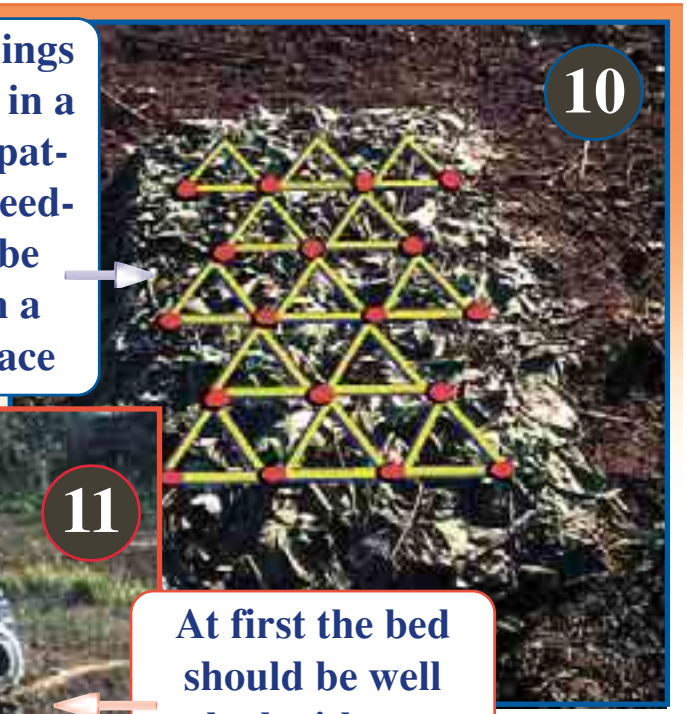
Then, seed or seedlings can be planted in the soil.

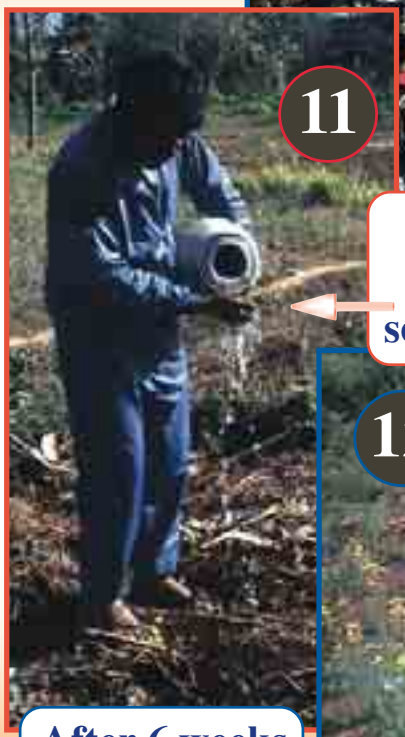


To plant, first make a hole down to the ground level.

Seedlings planted in a triangle. This saves space.

When seedlings are planted in a triangular pattern more seedlings can be planted in a smaller space





At first the bed should be well soaked with water

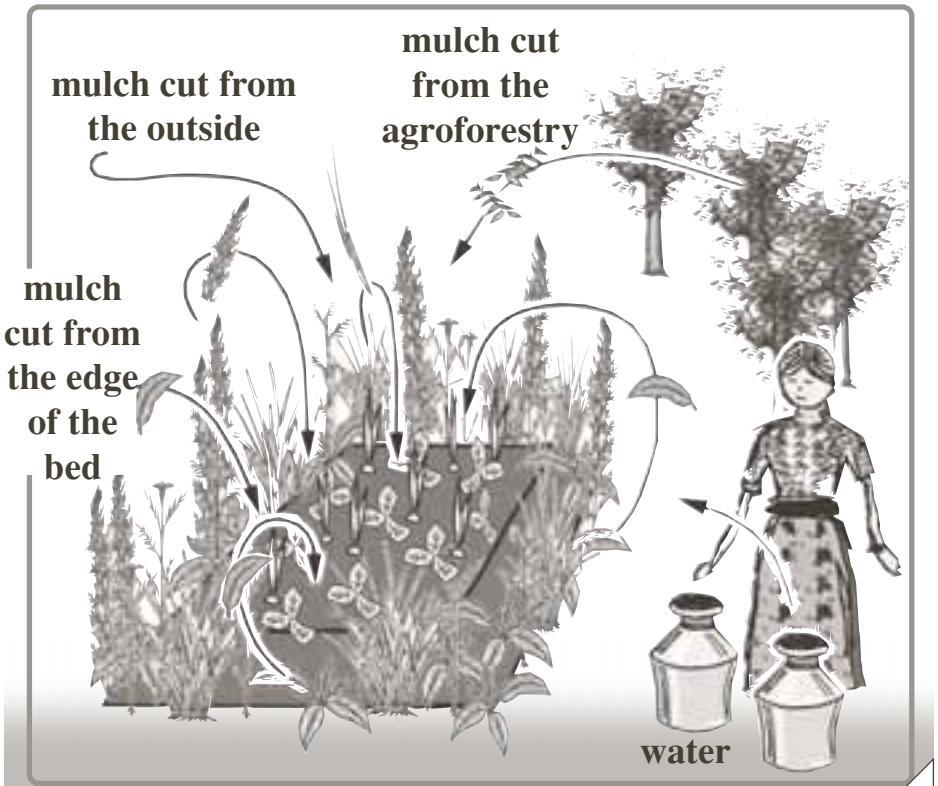
After 6 weeks the vegetables in the mulch bed are growing well

Maintenance

How to maintain the mulch

Maintenance of the Mulch

- water as necessary
- put on new green biomass about twice a year
- plant companion plants like lemon grass, comfrey, marigold, basil, wormwood, etc. around the bed
- having agroforestry or edge trees nearby makes it quicker to cut the new mulch

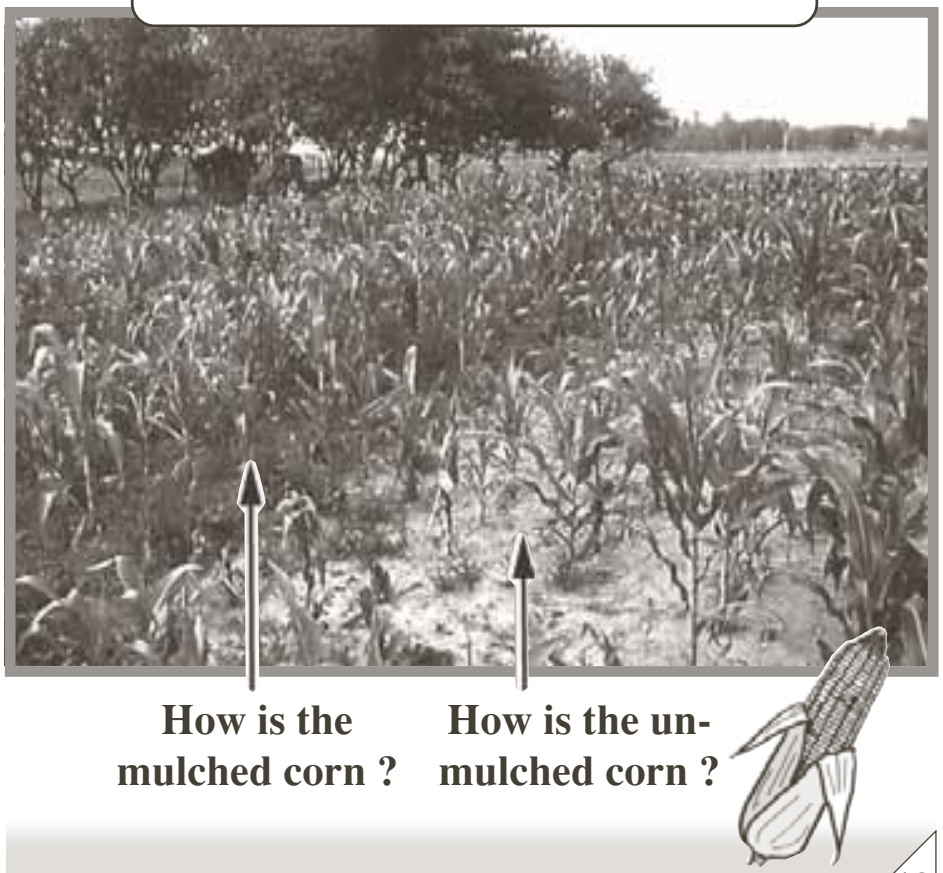


The Benefits of Mulching

1. **Mulching** stops the sun drying out the soil;
2. **Mulching** keeps the moisture in the soil so reduces the need to irrigate;
3. **Mulching** improves as well as protects the soil;
4. **Mulching** prevents weeds growing so reduces the need to weed;
5. **Mulching** keeps a balanced temperature in the soil. "Balanced" means not too hot nor too cold, and regular. This is good for plants' roots;
6. **Mulching** helps to prevent spread of pests and diseases. If water splashes on the soil, it can carry naturally occuring diseases in the soil onto the underside of leaves, where the diseases can cause damage;
7. **Mulching** feeds and protects the organisms in the soil (earthworms, bacteria, etc.);
8. **Mulching** also fertilises the soil;
9. **Mulching** prevents root crops such as potatoes, radishes, etc. from turning green;
10. **Mulching** makes use of waste resources such as banana leaves, uprooted weeds, etc. by recycling them;

11. **Mulching** reduces the need to dig and plough;
12. **Mulching** works with the principles of nature and ecology;
13. **Mulching** is beneficial for later crops in a rotation;
14. **Mulching** saves time because digging, weeding and irrigation are reduced or not needed.

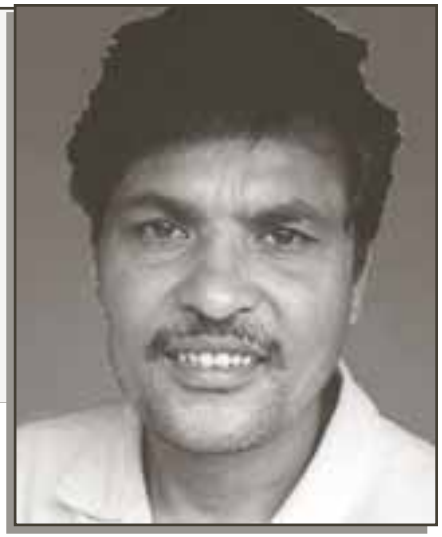
See the comparison between mulched and un-mulched farming



Farmers' Experience

Mr Purna Bahadur Nepali

From Nepal, Surkhet district, Gumi - 4, and member of "Samaj Mukti" farmers' group MrPurna Bahadur Nepali has made mulch beds. Now let's hear about his experience.



Purna Bahadur Nepali

" I learned mulching from the Homestead programme (Jajarkot Permaculture Programme, JPP). For vegetable gardening mulching is a really good method, and very easy. All the waste straw, weeds, leaves, sweepings, etc. are used on it. You don't have to do much weeding, the crops need less watering, and the soil becomes more fertile. Before starting I gave the field a good plough and then put down rotted compost. On the compost I put the mulch and made holes into it . I half filled the holes with fertile soil, planted the vegetables and watered well. Because I mixed many species of vegetable there were also less pest and disease problems. Whenever anyone has come come to see, I've been teaching them this method. "

Fertile Soil

① Farmer brothers and sisters, lets make fertile soil,
Let's keep green, Mother Nature's bare soil,
Ha hey, Mother Nature's, Mother Nature's,
Mother Nature's soil green

② On the terraces the rice drips golden,
On the bunds green fruit trees fruiting,
Ha hey, fruit trees fruiting, fruit trees fruiting,
Fruit trees fruiting,

③ Farmers are happy gathering the crops to fill stores,
Relaxing in the homestead, if they left, where would they go,
Ha hey, farmers, if they left, where would they go, if they left, where would they go?
If they left, where would they go?

④ Farmers work in the fields, sweating from their brows,
Without work, who will feed them, what will go to their stomachs?
Ha hey, farmers, what will go to their stomachs, what will go to their stomachs?
What will go to their stomachs?

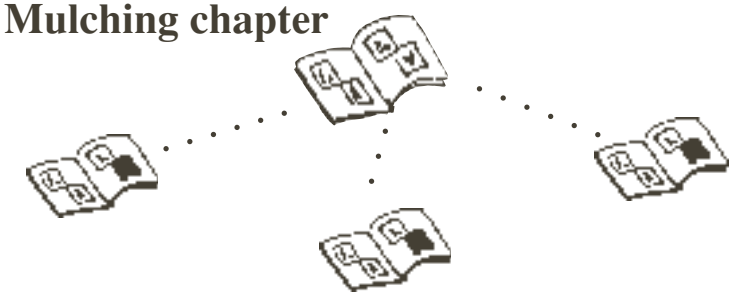
Written by Krishna Panday

See how well the potatoes grow under the mulch

Read On !

Subjects Related to Mulching

Mulching chapter



Fruit Tree Planting chapter

After planting fruit trees various companion plants can be planted around the base. Mulching is also useful. How these, and other techniques, give more benefits is explained in this chapter.

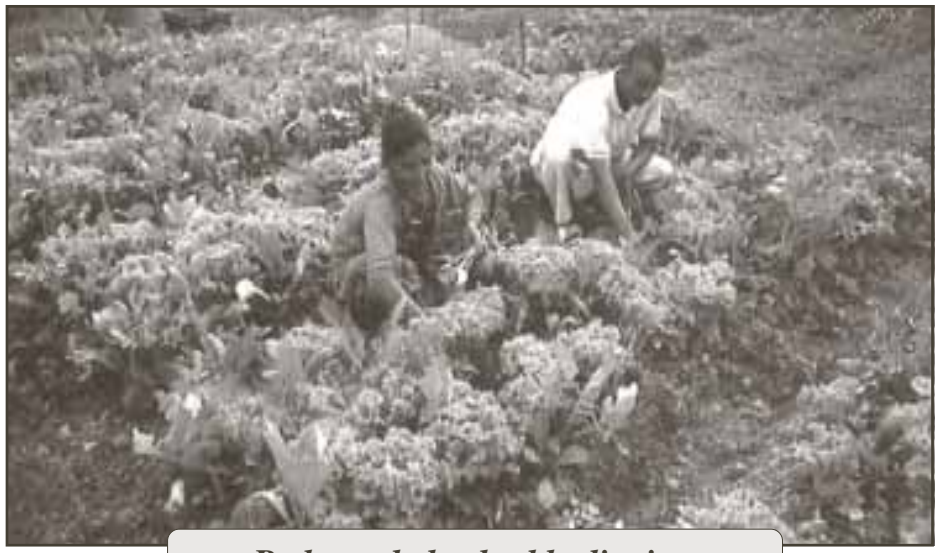
Kitchen Garden chapter

Mulching is very useful in successful vegetable gardening. Information about this and other easy methods to home-produce healthy vegetable at low cost is given in this chapter

Mixed Vegetable Gardening chapter

Grow various types of vegetables with less weeding, watering and other work, and harvest from 3 weeks to 6 months after planting. Information on this easy technique is given in this chapter

What is Double Digging ?



Beds made by double digging, AAA farm, Bhaktapur, Nepal

Double digging is a method of deep digging for vegetable beds. It means we dig twice as deep than normal cultivation. This is so we can mix compost and biomass deeper into the soil, so plant roots grow deeper and can get more nutrients. In these beds production is much higher, and though there's more work at the beginning, the beds stay fertile for a long time, and we don't have to dig again for many years.

Now let's learn about this method of how to work once to get good production for many years.

Why do Double Digging ?

Benefits of Double Digging

- makes the soil more fertile
- makes the soil able to absorb more water
- allows more air into the soil
- keeps the soil fertile for a long time
- allows plant roots to grow deeper into the soil
- keeps the soil light and soft for a long time
- dig once then do not have to dig again for 3-4 years

Shown here are double dug beds with mixed vegetable crops in Bhaktapur district, Nepal.

This Chapter's Author:

Mr Laxman Rana

Dahachaur 4, Surkhet, Nepal

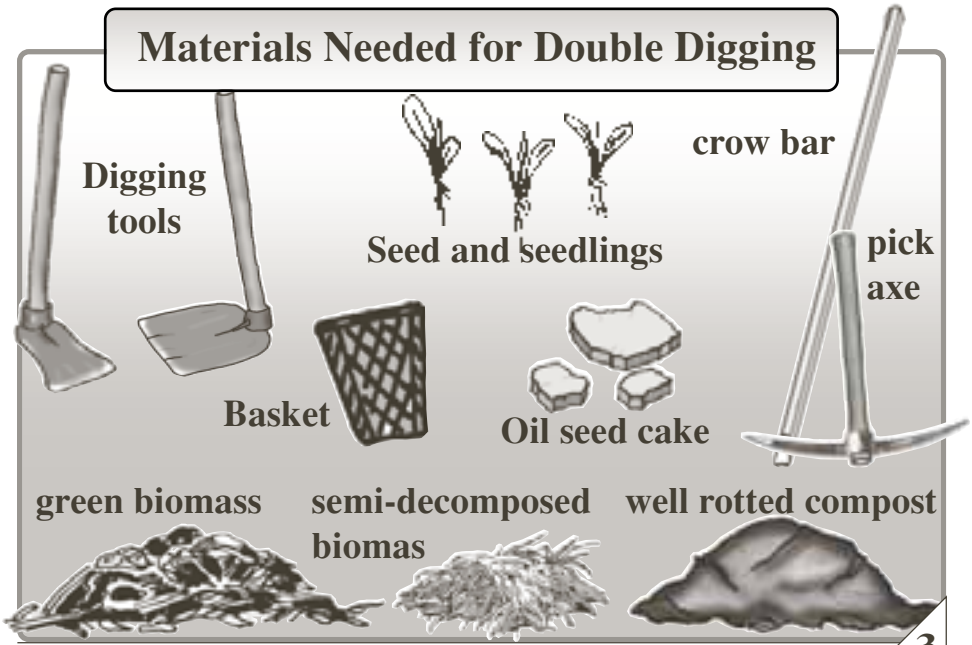
How to do Double Digging ?

With double digging at first there is more labour, but this can give up to 4 times the production of normal digging, so there is a good return on labour. Also, you don't have to dig again for 3-4 years afterwards. If double dug beds are mulched well and regularly, they may never have to be dug again. More information about this method is given in the chapter called ***Mulching***.

Where to do Double Digging ?

- where the soil is poor or shallow
- where roots can't grow deep
- in vegetable growing beds
- in very stony soil

Materials Needed for Double Digging



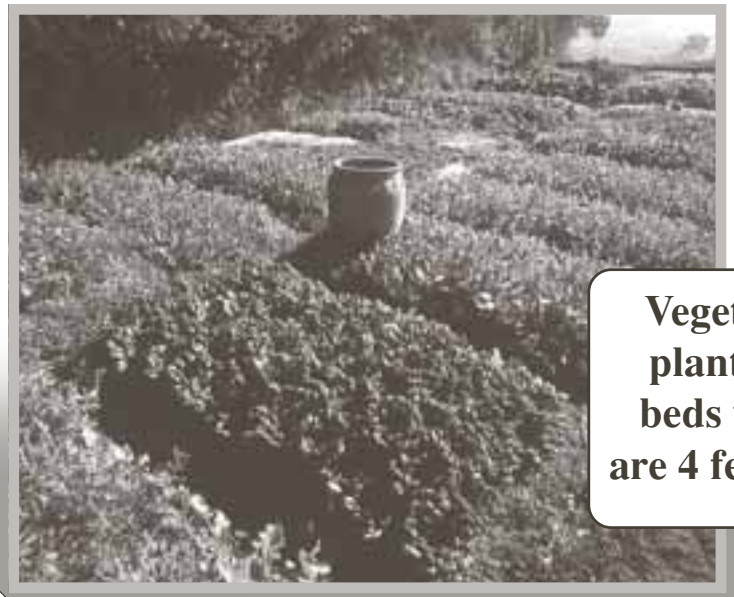
When to do Double Digging ?

Beds can be dug any time. If you have a rainy season, near the end of this is best as there's still plenty of moisture in the ground and plenty of biomass available.

How to make beds with Double Digging

1. Digging out the Beds

- Beds are 4 feet wide, and can be as long as you need in the space that you have available.
- First dig out 6-12 inches of soil and keep on the side (the deeper the soil, the deeper you can dig).
- Then dig the same depth again with the crow bar or pick axe, but don't remove the soil, just leave it in the bed.



Vegetables planted in beds which are 4 feet wide

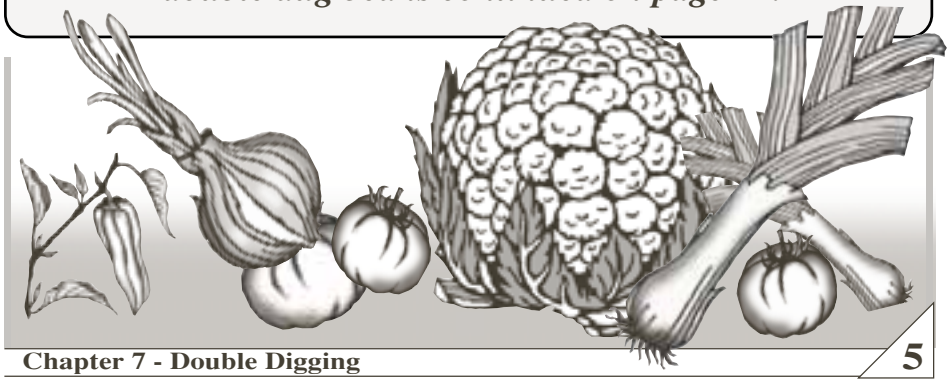
2. Filling in the bed

After digging the soil, it is replaced in layers with biomass.

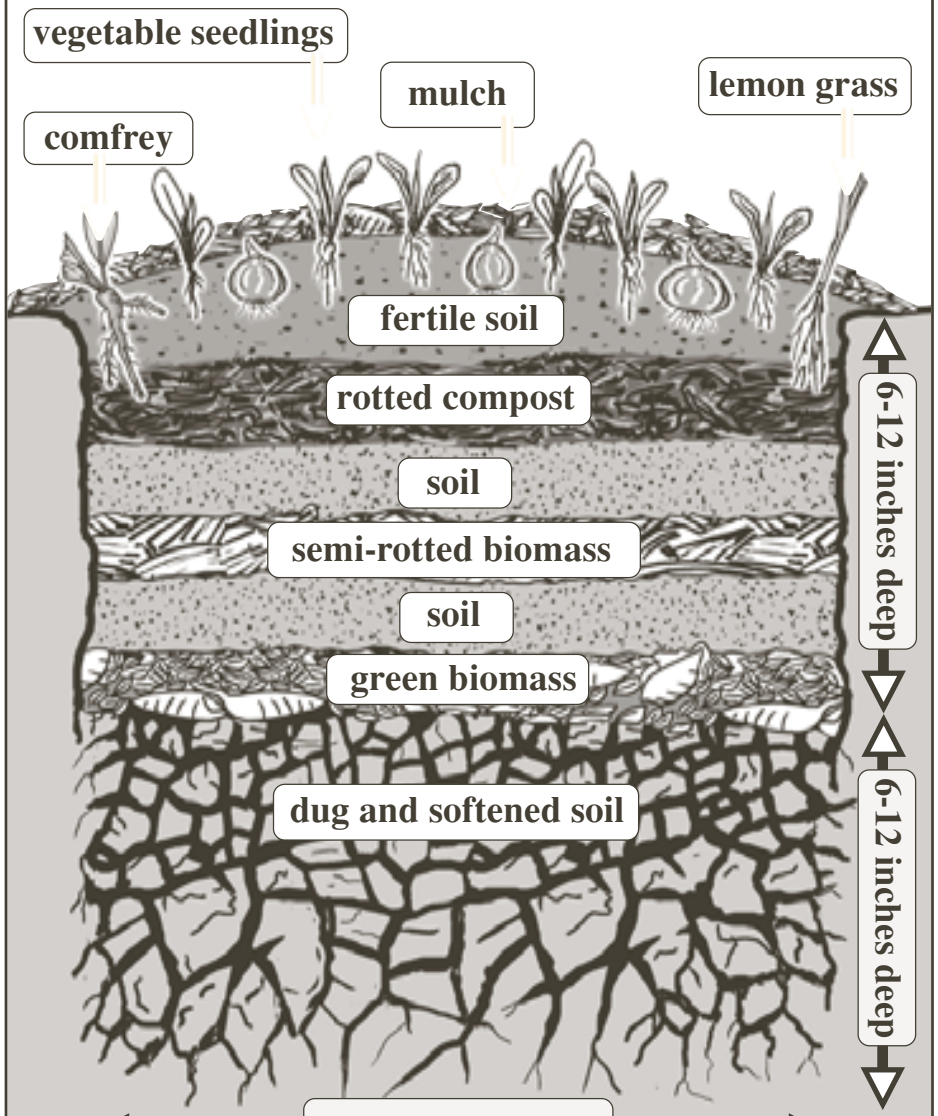
- First put a 6 inch layer of green biomass on top of the lower layer of dug soil.
- Then on top of this put a 3-4 inch layer of soil.
- Then put in a 6 inch layer of semi-decomposed biomass.
- Then put in another 3-4 inch layer of soil.
- Then put in a thin (2 inch) layer of well rotted compost.
- Finally, put all the remaining soil back on top, mixed with well rotted compost, and raked to a fine bed.

Mixing ash, oil seed cake, hair, bonemeal, etc. in with the layers of soil will increase the fertility even more. Because all this compost is mixed into the deep layers of soil, it will give nutrients to the plant roots for a long time.

The method of planting seeds and seedlings in a double dug bed is continued on page 12.

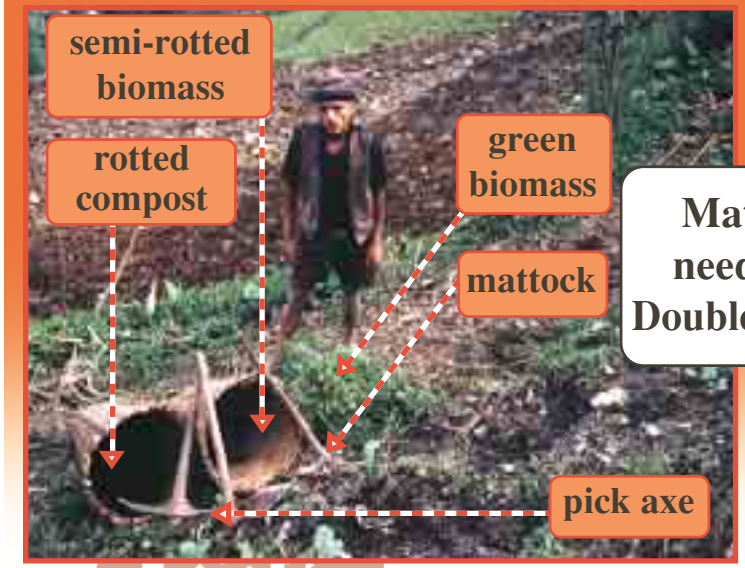


Cross Section through a Double Dug Bed



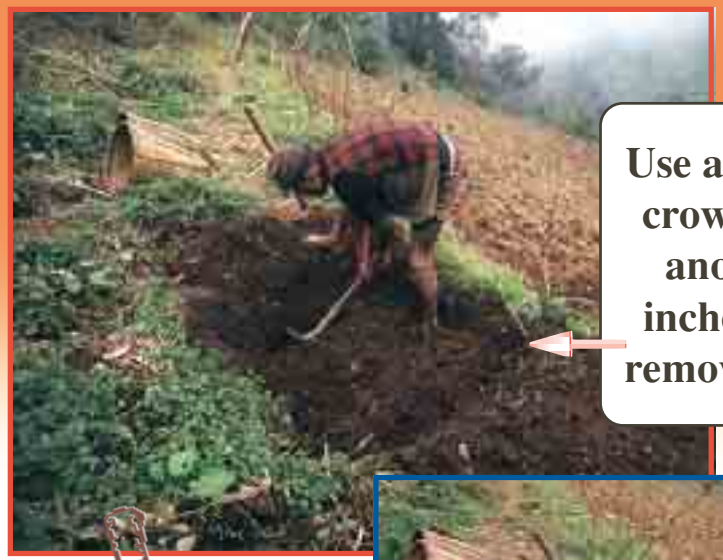
Let's See

How to do Double Digging



Materials needed for Double Digging

Dig out 6-12 inches of soil and keep to the side



Use a pick axe or crow bar to dig another 6-12 inches, without removing the soil

Then fill in. First put in 6 inches of green biomass, and cover with soil

Then add a 3-4 inch layer of soil

Then put 6 in a inch layer of semi-rotted biomass

Then another 3-4 inch layer of soil

Then put in a 2 inch layer of well rotted compost

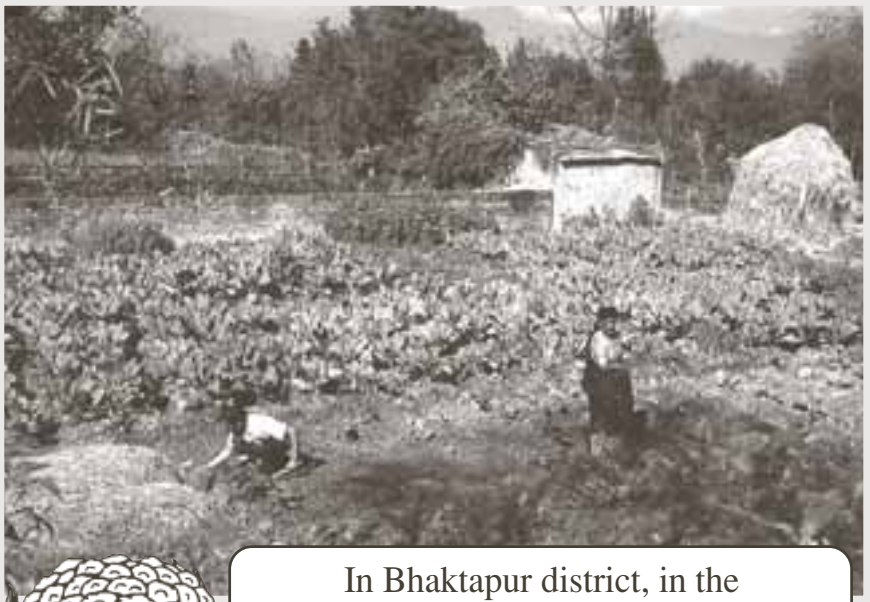
In the fertile soil of a double dug bed, plants are healthy and can protect themselves from many pests and diseases. In the bed, plant vegetables with a variety of colour, leaf shape and texture, and scent to protect against insect pests.

..... continued from page 5

3. Planting Seeds and Seedlings

On the raised bed after the top soil has been raked fine, any type of seed or seedlings can be sown or planted. Water well after planting. Then add mulch, taking care to cover the soil but not the seedlings. Adding the mulch protects the soil from rain, wind and sun, and conserves moisture for a long time.

The double dug bed is now complete. Apart from growing vegetables, this can also be used as a fruit nursery or for planting other types of crops.



In Bhaktapur district, in the Kathmandu valley of Nepal, there are many farmers who practice double digging and earn good cash from selling vegetables in the nearby city

Double digging can give 4 times the production of normal beds. The beds don't need to be dug again for 3-4 years

Maintenance

How to maintain Double Digging

On double dug beds, irrigation and weeding should be done as required. The more dense the vegetable seedlings and the mulch are, the less weeding needs to be done, and the more moisture remains in the soil. The chapters called ***Mulching*** and ***Mixed Vegetable Gardening*** give more information about this.

Beds that are well dug and well composted don't need digging for 3-4 years. But if new mulch is added thickly twice each year, and compost or liquid manure added from time to time, then it is possible never to have to dig again.

If we think about our work we can make many jobs easier and more productive. Let's use this method to make the soil more fertile and increase yield !

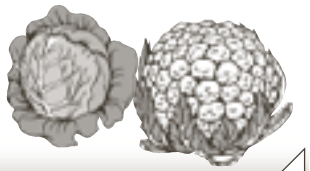
Farmers' Experience

Mrs Sarda Khadka and Mr Arjun Jangam

From Nepal, Bhaktapur district, Dadhikot - 4, Mrs Sarda Khadka and Mr Arjun Jangam have experience in double digging working at AAA farm. Now let's hear their story.

Sarda Khadka and Arjun Jangam

" We started learning the double dig method in 1994. Beds are made by digging the soil 2 feet deep, and as long as you need. The soil is arranged in layers mixed with leaf litter and compost. We also added ash and oil seed cake to the layers of soil. In the double dug beds, we haven't had to dig again or add compost for at least 3 years, often more. The green biomass rots slowly and vegetables grow really well. We dig most of our own beds this way, and we also give training to farmers in the local villages. Then together we have a cooperative to sell the vegetables in the Kathmandu markets. Buyers say that vegetables produced in this way are also more nutritious and tasty. *"*



Read On !

Subjects Related to Double Digging

Integrated Pest Management chapter

Farm production is reduced by many types of insect, disease, weed, etc. In this chapter information is given about using local resources to prevent these pests

Fruit Nursery chapter

In this chapter information is given about how to make a nursery for grafting or budding local fruit varieties

Mulching chapter

Mulch keeps the soil covered, keeps weeds down and conserves water. Information on how to mulch the soil is given in this chapter

Vegetable production, Kitchen Garden and Mixed Vegetable Growing chapters

How to make and manage a home vegetable garden for permanence, ease and simplicity ? Information about how to produce many types of fresh vegetables with less work is given in these 2 chapters

What is Seed Saving ?

Mrs Devi Khatri's Cauliflower

Farmers need to have many skills to manage both the soil and the homestead. Out of those skills, seed saving is probably one of the most important. By giving more attention to seed saving, farmers can improve the quality of their seed each year. This can then improve crop production. This can be done without having to increase inputs of fertilizer, irrigation or cultivation. So with a little extra care in seed production, farmers can easily increase their farm production.

Although this chapter mainly uses examples of vegetable seed production, the principles it describes are relevant to any species whose seed we want to save.

Why do Seed Saving ?

Many farmers have problems of either losing or not being able to acquire good, pure seeds. It's important to keep local, traditional varieties of pure and good quality. Also, there may be a need to breed and increase new open pollinated species or varieties. To guarantee good quality seed, good methods are needed. But the main benefit of saving seed yourself is that you can stand on your own feet and be more self-reliant.

Why save seed yourself, on your own land?

- so the seed required is available at the right time;
- to save the cost of buying seed;
- to trust that the species or variety of seed is the one you need;
- to produce seed that is adapted to the local climate, soil, etc.;
- to increase income from local resources, and
- to improve local varieties and conserve bio-diversity.

How to do Seed Saving ?

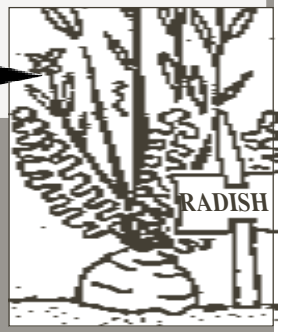
Things to pay attention to in seed saving

1. Choose healthy and disease-free plants to save seed from.
2. Select plants according to the qualities or characteristics you need. For example :-

Function	Qualities or characteristics needed
Timber	straight stems, strong, long lasting, etc
Fodder	dense foliage, nutritious, etc.
Vegetables	tasty, disease & drought resistant, etc.
Medicine	bitter, strong, stores well, etc

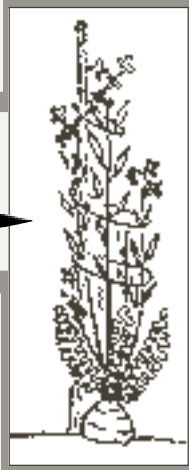
3. Seed producing plants are adapted to the local climate.
4. Select seeds from as many plants of one variety as possible. Save from at least 10 plants, in order to maintain genetic diversity and strength.
5. Once a plant has been identified to save seed, don't pick its leaves, flowers, etc. But if any part is damaged or diseased, these should be removed and discarded.

(6) Select plants for seed saving as early as possible, and label them.



(7) Give extra care to plants selected for seed saving. Provide water, nutrients, weed control, pest control, etc. according to the needs of the plant. Compost, liquid manure, ash, oil seed cake etc. can be used for this.

(8) As plants mature they may fall over, so staking may be necessary.



(9) Only allow the best plants to flower. For any variety, poorer plants should not be allowed to flower so they don't mix with the good plants, which will lower the quality of the seed. Leaving the plants for seed saving, all others should be pulled and eaten, composted or mulched before flowering.

(10) Different species which cross pollinate should not be allowed to flower at the same time. It is possible that some species will cross, so they should not flower in the same place, at the same time. To prevent cross pollination one of the following 2 methods should be used:

a. Plants that cross should be far apart, so that insects or wind will not be able to cross pollinate;

b. Plants which cross should be planted to flower at different times. For example, if a cauliflower grown for seed flowers in July, a cabbage also for seed should flower in August. This way the flowering time will be separate, and there is no danger of crossing.

Species which will cross pollinate

The species in the following families will cross pollinate

Cauliflower family : cauliflower, cabbage, broccoli, sprout, kale, kohl rabi all cross.

Turnip family : turnip, chinese cabbage and chinese mustard all cross.

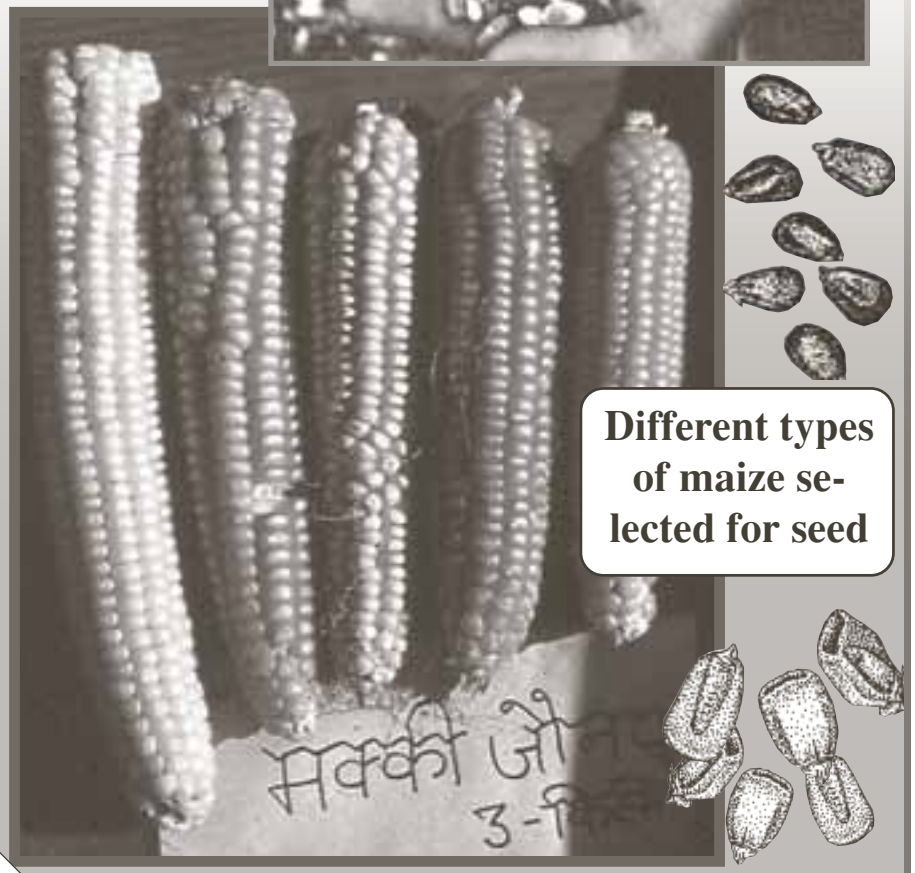
Chard family : red and green chard will cross.

Pepper family : chilli and sweet peppers will cross.

Pumpkin family : zucchini, dwarf and climbing pumpkins will cross.

When attention is paid to all these points, good quality, pure seed can be produced. But if any one is ignored, then the quality of the seed cannot be guaranteed and the work and time can be wasted.

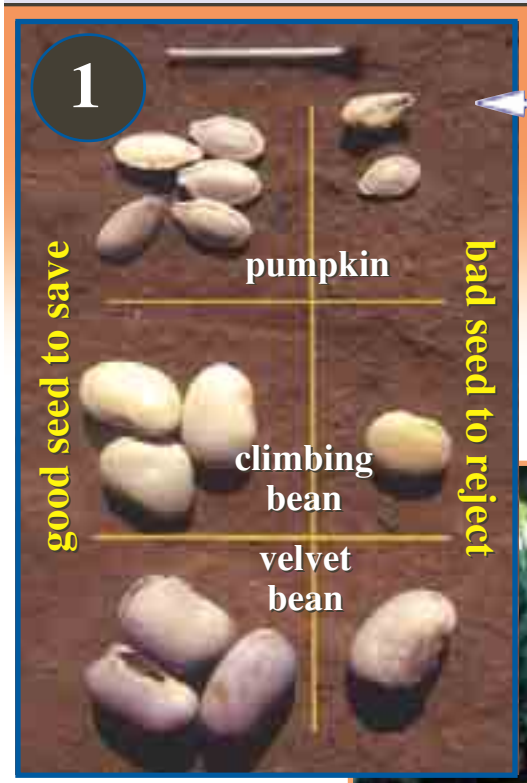
See how many types of bean in a handful !



Different types of maize selected for seed

Let's See

How to do Seed Saving



On the left side the good seeds are all similar. On the right the rejected seeds are different colour, shape and size

The best plants for seed are selected early and labelled

3

Seed producing plants should be given maximum care and attention. Here, Khamba Prasad has built a roof to protect his seed cauliflower from hail and frost

Mrs Tulisara Gyami is picking the damaged leaves off her red Swiss Chard, grown for seed

4

Select only the best plants for seed production. Here, cauliflower is shown with Man Bahadur

5

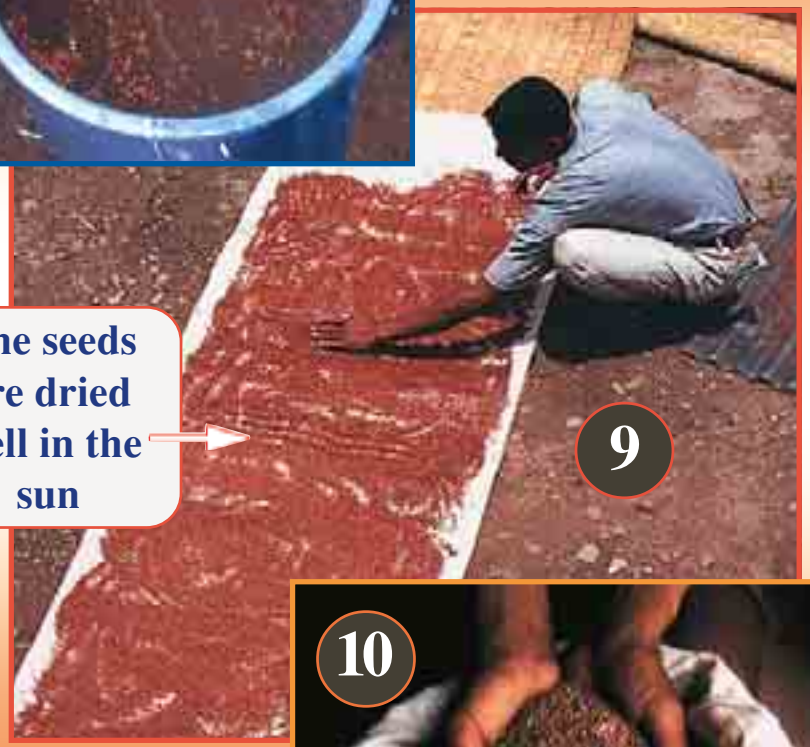
Radish seed collected

Ripe radish seed pods seen close-up

6

7

When put in water, any dead seeds will float on the top. These can be thrown away, leaving just the good seeds



The seeds are dried well in the sun

After drying, good storage is essential

Maintenance

What to do after Producing Seed

Things to consider when picking and storing seeds

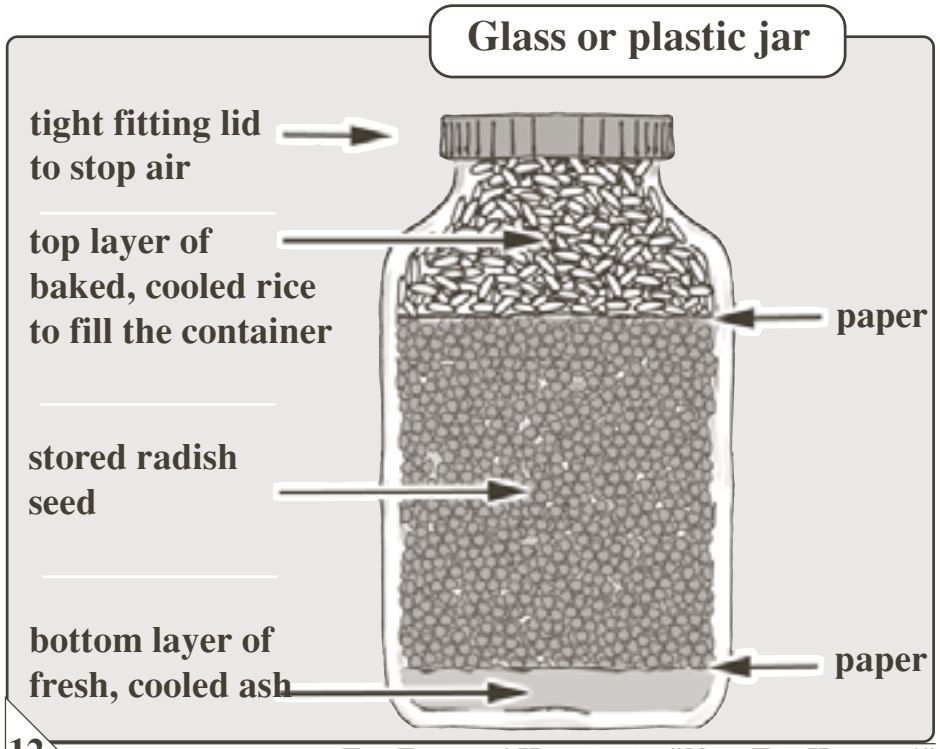
- Only pick seeds or pods when they are ripe.
- Only collect good seed or pods.
- Reject any seeds different in size, shape or colour from the average good seed.
- Dry the seeds well. Usually seeds are dried in the sun. Some types, like lemon, orange, etc. should be dried in the shade, for example above the fireplace.
- If seed is sun dried, be sure to allow them to cool before packing.
- If possible, pack seed in an airtight container, and try to fill the container full, without leaving excess air space. Add ash or baked rice, which help to keep seed dry.

- Put fresh, cool ash or baked rice in the bottom of the container. This absorbs water in the air, which helps to keep the seed dry. This can be placed on top of seed also (see drawing, page 12).

- Seed should be stored in a cool, dry, dark place.

- It is very important to protect seed from disease, insects and fungus. There are many local herbal remedies for doing this, for example mixing ash, powdered neem leaves, neem oil, powdered oil seed cake or wormwood. Another method is to store seeds of different sizes mixed together, such as wheat and mustard, or corn and millet, This is a traditional practice in many places.

- Check the seed regularly for pest damage. From time to time take the seed out and dry in the sun, or add fresh herbs.



Farmers' Wealth **Biodiversity - various types of rice seed shown in an exhibition**

Seed store made from traditional wisdom and local resources, Southern Nepal

Farmers' Experience

Mrs Pavisara Shris

From Nepal, Surkhet district, Gumi - 3, Ratadada village, and a member of "Hariyali" women's group, Mrs Pavisara Shris has produced and saved her own seed. Now let's hear about her experience.

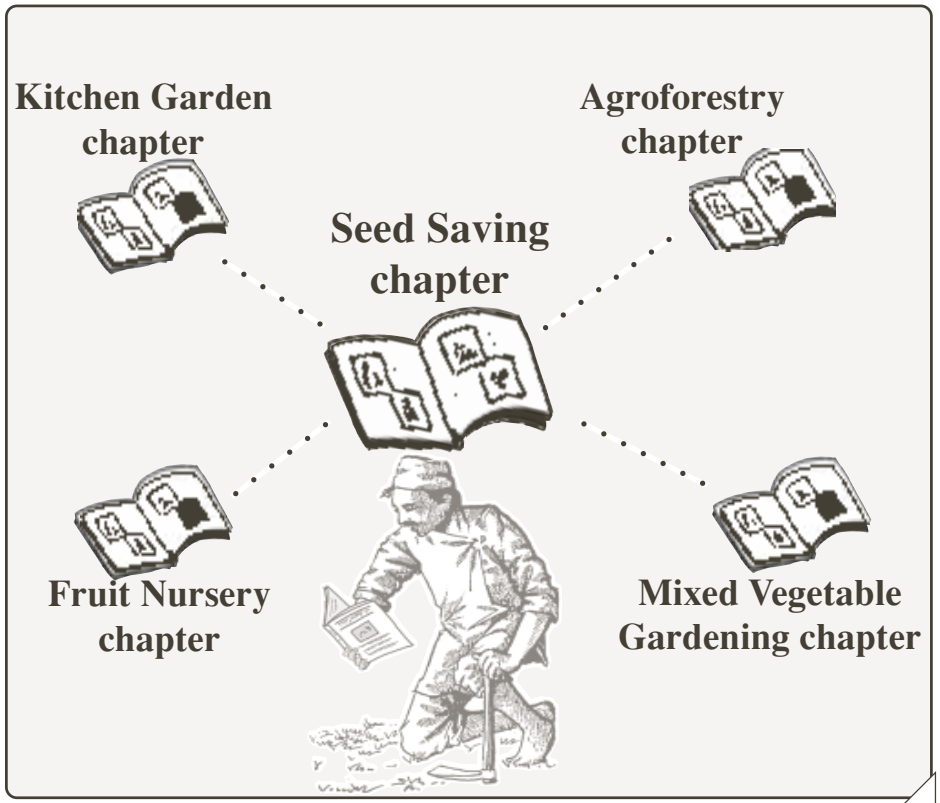
Mrs Pavisara Shris

" I first learned seed saving from the Homestead Programme (JPP). Even after saving seed for myself I have been able to sell a surplus for a few hundred rupees, which has been useful. It's no trouble to save seed. We always saved corn, wheat, mustard beans and the like anyway. And it's easy to learn more. I saved potato seed and after I kept what I needed, made 200 rupees. Timing is important, and not eating the seed, and you can save for ever. Now I've saved 40-day radish, tomato, lettuce, coriander, fenugreek and peas. I keep the seed plants separate, look after them well, and keep them labelled. Now I'll always save my own seeds, and want to learn how to save more varieties, and to teach others how to do it. "

Read On !

Subjects Related to Seed Saving

This book provides enough information to be able to save much of your own seed. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.



Related Subjects

Kitchen Garden chapter

Good seed is essential for successful vegetable gardening. Information about this, and other easy methods to home-produce healthy vegetables at low cost, is given in this chapter

Agroforestry chapter

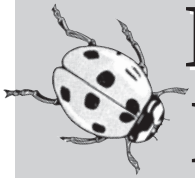
When planning agroforestry seed production and collection are very important. Information about the importance and methods of agroforestry to increase production from less land is given in this chapter

Fruit Nursery chapter

In this chapter information is given about how to make a nursery for grafting or budding local fruit varieties

Mixed Vegetable Gardening chapter

Grow various types of vegetables with less weeding, watering and other work, and harvest from 3 weeks to 6 months after planting. Information on this easy technique is given in this chapter

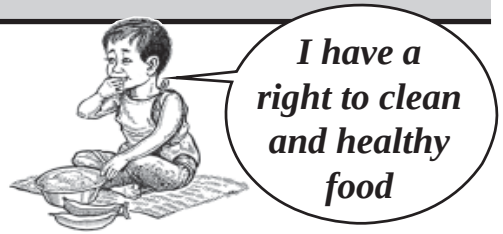


What is Integrated Pest Management ?

The spider and its web helps to control lots of harmful insects

Farmers are always concerned about their crops. After the hard work of farming, it's their worst nightmare to lose them again. There are many creatures which can badly harm crop production. A creature which does this is called a ***pest***. Bacteria, insects, fungi, birds, rats, weeds, etc. can all be harmful. Preventing, reducing or curing the harmful effects of pests can be done by management of the pest or the crop and its environment. To do this in a sustainable way often means using a range of methods together to prevent and control pests. Because these methods are all linked, the term ***Integrated Management*** of the pest is used. So this chapter gives information about ***Integrated Pest Management***.

Why do integrated pest management?



- to get healthy food
- to reduce farm production costs
- to increase production
- to protect the environment
- to reduce the need of harmful chemicals
- to prevent pests becoming resistant to chemicals
- to make sustainable farming systems

Poisonous chemicals for pest control are often banned, but not in poor countries

This Chapter's Author :
Chris Evans, advisor,
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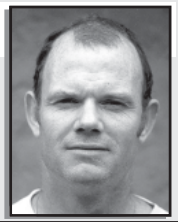


Nowadays there is much use of poisonous chemicals to kill and control agricultural pests. But this has many harmful effects. For example :-

- poisons used can remain in the environment for many years, continuing to harm soil, water, vegetation and animals.
- Poisons used on fruit, vegetables, etc. can be eaten by people. This can cause many diseases, genetic problems, and cause babies to be born handicapped.
- Farmers often don't know how to use the poisons correctly, which results in them being affected by the poisons. This causes over 400,000 people to die each year in the world.
- Poisons are used for protection of crops from harmful pests, but often this also kills beneficial plants and animals which are helpful in controlling pests, building soil or pollinating plants.
- Continuous use of chemical poisons can cause pests to develop **resistance** to the chemicals. These resistant varieties will breed, and to kill them chemicals need to become stronger, or different types need to be used. This will increase the numbers and strength of chemicals used, and encourages dependency. Integrated pest management methods are important as the solution to this problem, and to the other problems mentioned above.

How to do integrated pest management ?

Integrated pest management can be divided into 2 main areas. Firstly, (a) how to **prevent** damage from pests, and secondly, (b) how to **control** or **cure** pest damage once it has already started to occur. In this chapter we start to look at group (a) on this page, while methods for group (b) start on page 16.

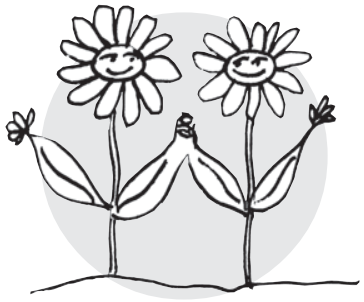
Various techniques are described below. In integrated management one method may not be enough to stop a pest, so it is important to use as many methods as possible.

(a) How to Prevent Pests ?

Need	Methods used
1. Healthy Soil	compost, mulch, irrigation, rotations, green manures, etc.
2. Healthy plants	compost, irrigation, weeding, species selection, green manures, etc.
3. Fencing	living fences
4. Diversity	mixed cropping and rotations
5. Companion Planting	mix aromatic/smelly plants e.g. coriander, fennel, marigold, lemon grass, basil, onion, garlic etc.
6. Decoy planting	providing alternative plants for pests to attack
7. Helping pest predators	providing habitat and food for beneficial pest predators
8. Repelling pests	liquid manure, herbal controls

1. & 2. Healthy Soil and Healthy Plants

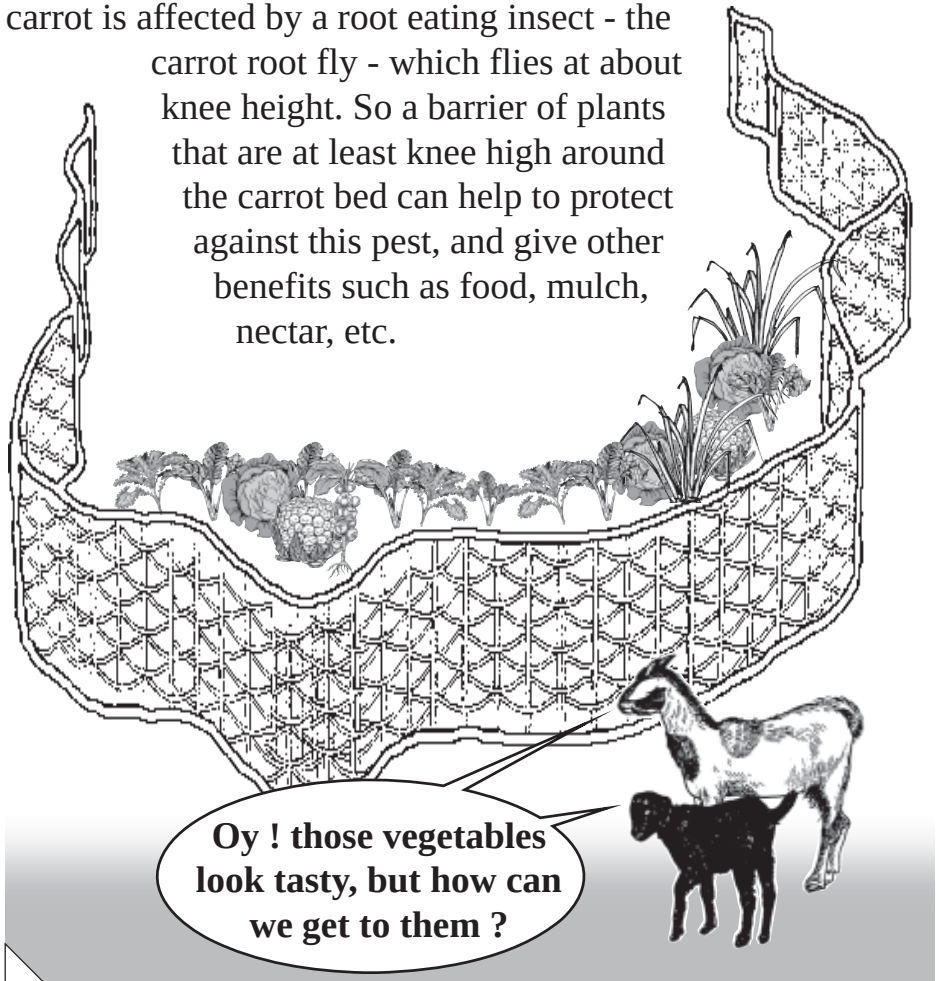
- Just like people are healthy with a nutritious and balanced diet, the soil is also healthy with plenty of organic matter, nutrients, micro-organisms, etc. It then supports healthy plants, which can resist disease.
- Unrotted compost can cause pests and diseases in the soil, so always use well rotted compost.



- Water is essential for the soil and plants. Having the right amount of water at the right time helps plants to grow, stay healthy and resist pests and disease.
- Crops attract certain types of pest and disease. Always planting the same crops in the same place causes those pests to increase and damage the crops. This is why crop rotations are beneficial. For example, potatoes and their relatives - tomato, aubergine, sweet pepper, etc. shouldn't be planted in sequence on the same piece of land for up to 2 years. The rotation helps to break the pest and disease cycle so they will not harm the next crop. After crops that attract many diseases are harvested, such as potatoes and other vegetables, planting onions or garlic for a season helps to clean the soil of the many pests and diseases attracted by the previous crop.

3. Fencing

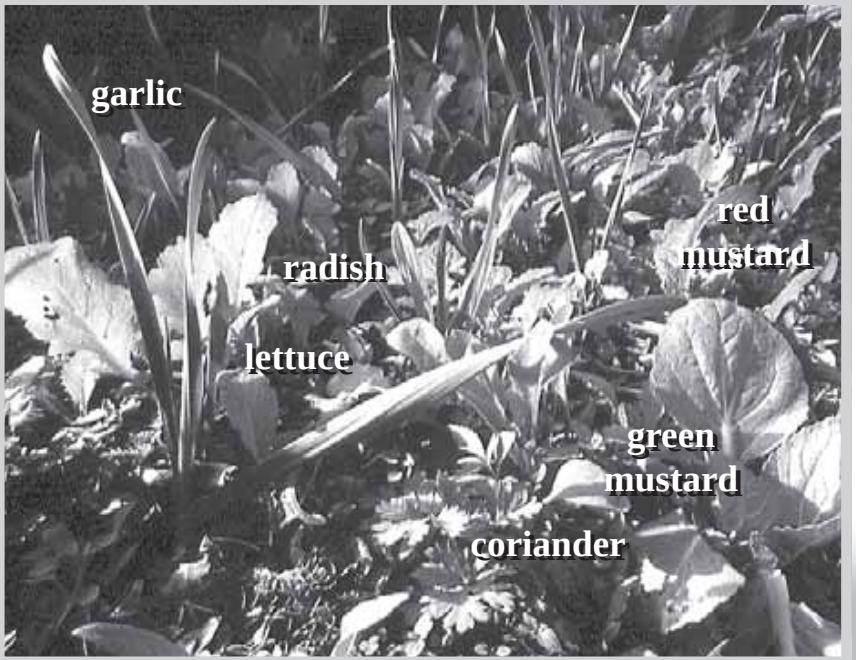
Without a fence, many types of pest can get on to the land and damage crops. So a fence is very important. The most beneficial type of fence is a **living** or **green fence**, or **hedge**. This is not just a barrier, but can give other benefits as well. For example, a barrier of lemon grass around the vegetable bed will help to protect against weeds and other pests, and also can be cut as mulch to put on the bed. Similarly, carrot is affected by a root eating insect - the carrot root fly - which flies at about knee height. So a barrier of plants that are at least knee high around the carrot bed can help to protect against this pest, and give other benefits such as food, mulch, nectar, etc.



4. Diversity

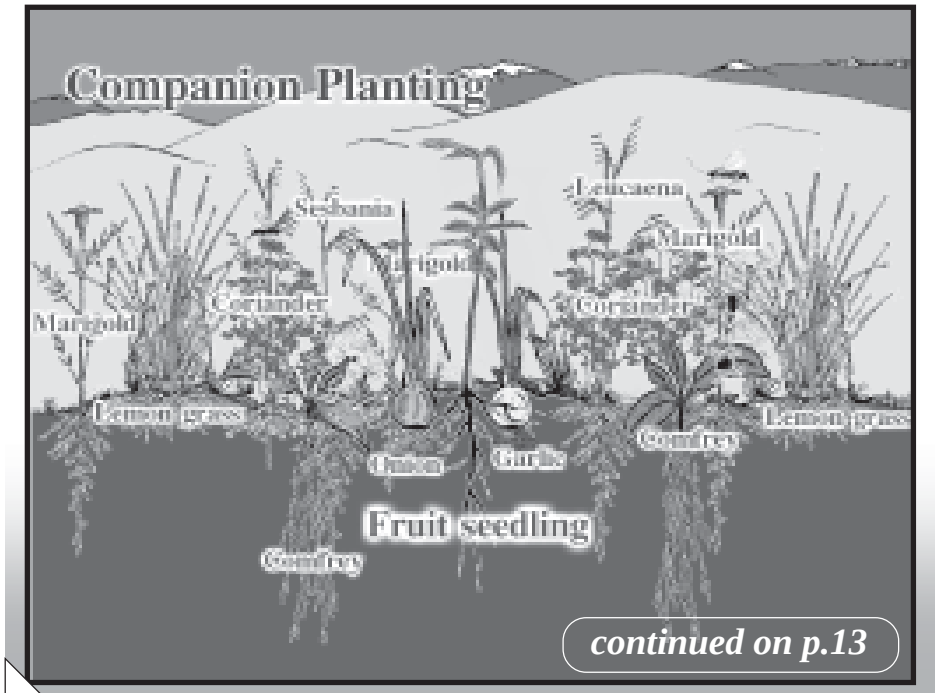
Continuous monoculture planting of the same crop will always suffer more from pest attack. For example, if only cauliflower is planted, a fungus or insect which feeds on cauliflower can destroy the whole crop in a very short time, and is difficult to control. This why it's good to plant a variety of crops together, called **mixed cropping**.

It's possible to plant many types of vegetable in the kitchen garden. For example, cauliflower, Swiss chard, radish, carrot, peas, broad bean, lettuce, turnip, coriander, fennel, dill, kohl rabi, spinach etc. can all be planted together. If any one of these is attacked by a pest, there are all the others that will still give production. The chapter ***Mixed Vegetable Gardening*** gives detailed information on this technique.



5. Companion Planting

Plants give each other various types of support. For example, the scent of garlic helps repel many types of pest. Marigold gives a chemical from its roots which helps to repel soil nematodes which otherwise eat plant roots. The flowers of marigold also give a strong smell which help to repel insect pests. Some insects recognise the smell of the plants they eat, so strong smelling repellent plants help to protect these vegetables. Legumes such as peas and beans help to provide extra nitrogen to other plants. Mixing these plants with grains, vegatables, fruits or any type of crop to help protect them is called **companion planting**. Marigold, mint, basil, lemon grass, wormwood, garlic, onion, coriander, fennel, dill, nasturtium, tansy, etc. are all companion plants and it is beneficial to mix them with and around other crops.



continued on p.13

Let's See — How to do Integrated Pest Management

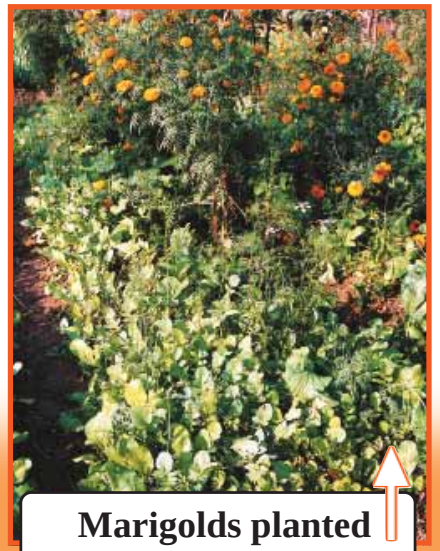
The fence around a kitchen garden can be made of local resources.

Home made pens to keep chickens in the right place. These can be moved around.

In fertile soil, plants are healthy and can resist many pests and diseases themselves.

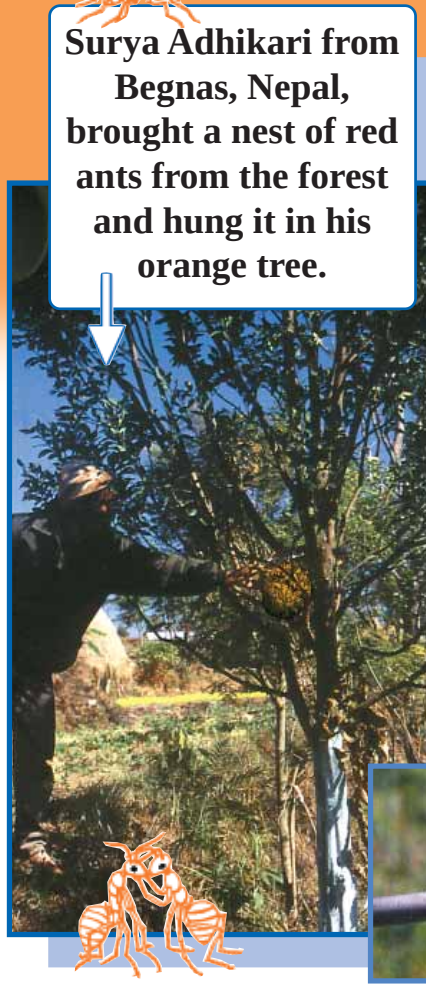
Red coloured vegetables have less pests

A variety of colour, leaf texture and scent help to protect vegetables from insect pests

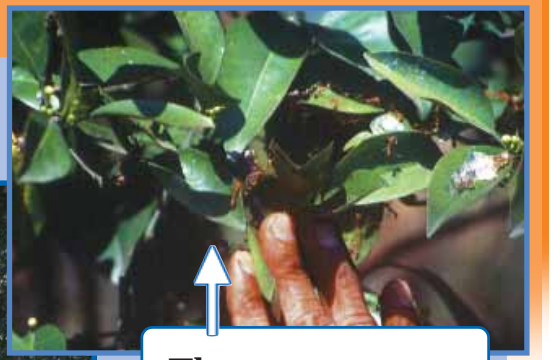


Marigolds planted around the vegetable bed help to protect against some harmful insect pests

The smell of liquid manure on the vegetables helps prevent and repel pests



Surya Adhikari from Begnas, Nepal, brought a nest of red ants from the forest and hung it in his orange tree.



These ants protect the oranges from any type of pest

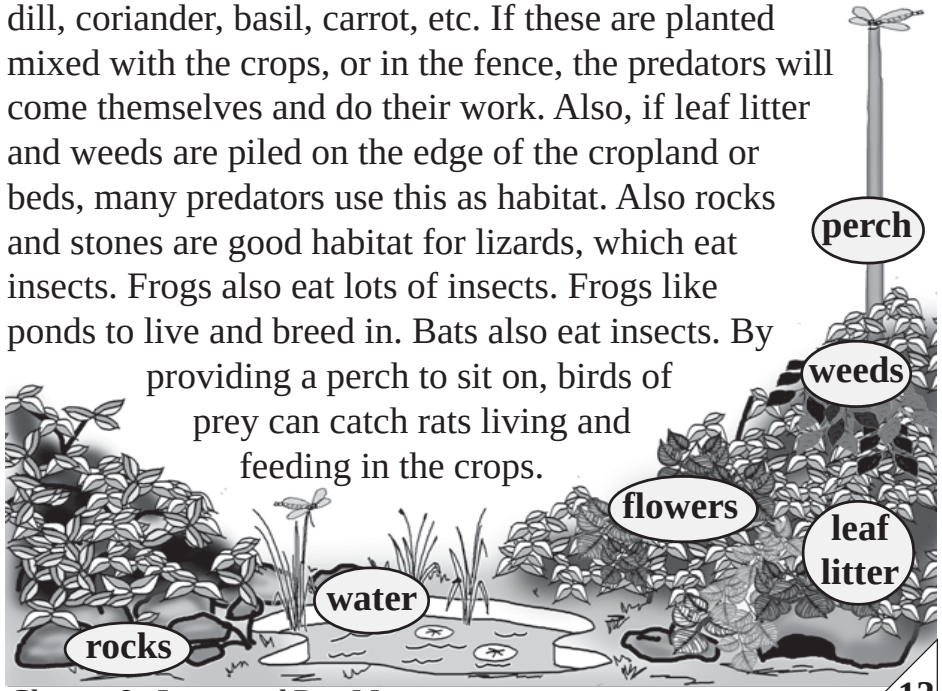
The tree is protected for free, and the ants also get free meals !

This hoverfly visits coriander and similar aromatic plants for nectar, and lays its eggs inside harmful catepillars, which kills them.

6. Attracting Predator Insects and Animals

Ninety five percent of insects are useful, and only five percent cause damage to crops. There are many insects and other animals which will attack harmful pests. These are called **predator insects** or **animals**. ***Predator animals are farmers' friends***. The more they are present on farms, the more they can help controlling pests.

How to help predator animals ? If there is the right habitat, they will arrive and stay themselves. Their food are the pests on the crops. Many types of predator insects feed on nectar from flowers. They like flowers of marigold, fennel, dill, coriander, basil, carrot, etc. If these are planted mixed with the crops, or in the fence, the predators will come themselves and do their work. Also, if leaf litter and weeds are piled on the edge of the cropland or beds, many predators use this as habitat. Also rocks and stones are good habitat for lizards, which eat insects. Frogs also eat lots of insects. Frogs like ponds to live and breed in. Bats also eat insects. By providing a perch to sit on, birds of prey can catch rats living and feeding in the crops.



7. Decoy Planting

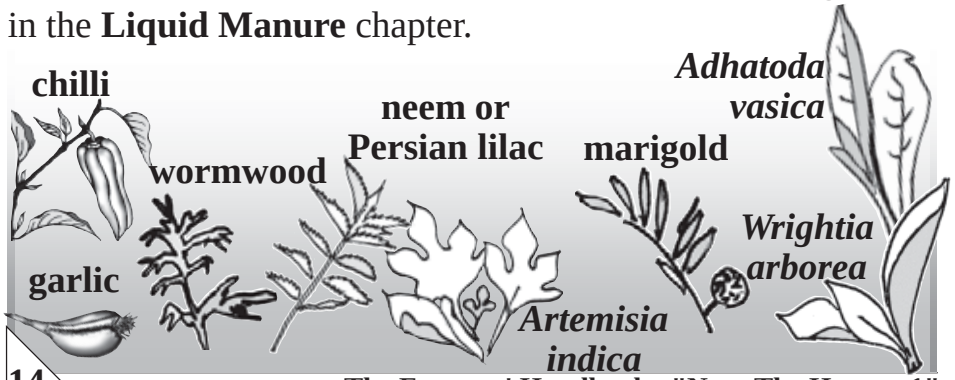
Harmful insect pests will eat other plants as well as the crops farmers plant. So if these are added to fences around the crops, or even mixed in with the plants, these will be attacked instead of the crops. This is called ***decoy planting***. For example, an insect that attacks cotton plants also eats the castor oil plant. So by planting castor around the cotton plants, the cotton can be saved. Like this, nettles will attract caterpillars, which prevent them eating vegetable crops.

castor

nettle

8. Liquid Medicine

Wormwood, neem, persian lilac, chilli, garlic, onion skins, marigold leaves, cow dung, ash, oil seed cake, khirro, *Adhatura vasica* and tobacco are examples of plants which can be used to make a medicine which repels pests and also acts as a fertilizer. Information on how to make this is given in the **Liquid Manure** chapter.



Experience from the Philippines

Sesinando Masajo

Mr Sesinando Masajo farms 28 hectares of rice paddy in the Philippines. Before 1973 he used lots of chemicals on his rice. He would apply chemicals 5-6 times on each crop. But he observed that the rice was suffering from more and more pests. Because the pests were in different stages of their life cycle, it became very difficult to control them with chemicals. He thought that the poisons were also killing the beneficial predator insects, and so the pests were able to increase in numbers.

After 1973, Mr Masajo stopped using poisons, and he saw that his rice production started to increase. At that time he was getting 5.2 tonnes per hectare rice production. In 1993, that had increased to 9.6 tonnes.

Mr Masajo has now taught these methods to his neighbours. Because of this, by 1996 there were 550 local farmers who had stopped using poisons. All these farmers experienced an increase in rice yield, and at the same time they found the quality of the grain had also improved.

Women farmers from Nepal visit farmers in Indonesia to see and learn about integrated pest control in rice

(b) What to do once pests start to attack ?

It may be that even after using all the techniques given above, pests still attack the crops. Below are examples of methods used after problems have started :-

- **Liquid Pest Repellent** (see page 14)

- **Cow's Urine :-** mix one part fresh cow's urine with 3 parts water and spray to control various insect pests.

- **Neem Oil :-** mix one part neem oil with 3 parts water to make a strong pest repellent. Add soap to help the neem to stick to leaves. Kerosene can also be added.

- **Wood Ash :-** adding ash to the soil surface helps to protect against many insects, and also provides fertilizer.

- **Oil Seed Cake :-** mix one part oil seed cake with 3 parts soil to protect against red ants.

- **Tobacco Juice :-** boil a handful of tobacco leaves in 2 litres of water like making tea. Sieve, and spray the tea onto the pest, which will kill them. Only spray when there are not any beneficial insects on the plants, otherwise they will also be killed. Beware: tobacco juice is very poisonous !

Appropriate Agricultural Alternatives (AAA) farm from Bhaktapur District in Nepal have the following experience :

- Make a strong tea from ground mint leaves and spray on brassicas to repel butterflies, which produce harmful catepillars.

- Mix together 1 kg oil seed cake, 5 kg wood ash and 1 kg mint leaves and soak the soil to a 2 inch depth. This helps to control stem cutting insects.

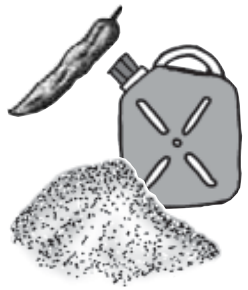
- Grind 250g of wild basil and mix with 1 litre of water and boil to reduce the liquid . Spray this to repel leaf eating pests.

- When stem borers have attacked and made holes in fruit trees, use wire or a needle to push cotton wool soaked with kerosene into the hole to kill them.

Healthy and protected vegetable beds at AAA Farm

From Kavre District in Nepal, INSAN'S Model Farmer Mrs Jipmaya Tamang has this experience :-

- Take equal quantities of wormwood, *Adhatoda vasica* and nettle, soak in cow's urine and spray on plants every other day. For small plants, dilute with 10 parts of water and spray. For large plants, dilute with 6 parts water. This protects plants against sucking and eating insects.



- Mix 1 part chilli pepper, 2 parts kerosene and 10 parts wood ash and apply on the soil. This protects against red ants and other insects which live in the soil.

If you know of other remedies like this, please send us the information.

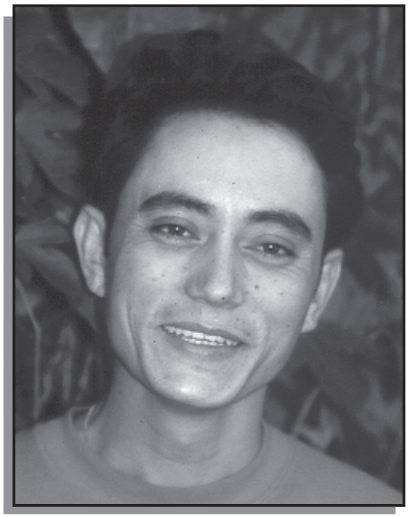
Observation

The most important work in integrated pest management is **observation**. Which pests are harmful, to which crops, at what time ? Where do they come from ? How do they breed ? What can be done to prevent them coming ? By understanding these things, the life cycle of the pest can be understood and so can be interrupted to prevent the pest becoming a pest. In this way pests can be prevented early on from being harmful to our crops.

Farmers' Experience

Mr Ramesh Khadka

From Nepal, Bhaktapur district, Dadhikot VDC, Gamcha, and manager of Appropriate Agriculture Alternatives (AAA) farm, Mr Ramesh Khadka has experience of integrated pest management. Now let's hear his story.



Ramesh Khadka

" On this farm no chemicals or poisons are used at all. Everything used is made from organic material. We use vegetable compost, goat manure, bonemeal, oil seed cake, chicken manure and rabbit manure. We also use liquid manure against pests. For this we use various types of strong smelling plants, like *Wrightia arborea*, wormwood, Persian lilac, etc. squashed into a container to partially decompose, then we use the liquid that comes from this. It helps to repel many pests. Most problems disappear when you have good, fertile soil. We also use mixed vegetable cropping to prevent pests, and teach the local farmers the methods we use. All our vegetables are sold at organic markets in Kathmandu. "

Read On !

Subjects Related to Integrated Pest Management

Living Fence chapter

In this chapter see how to plant not just a fence but also produce fodder, fuelwood, mulch and other benefits

Fruit Tree Planting chapter

Information on how to plant and manage valuable fruit trees for best production is given in this chapter

Kitchen Garden and Mixed Vegetable Growing

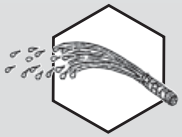
Information on great vegetables produced for less work is given in these 2 chapters

Integrated Fruit Orchard chapter

Fruit trees can be mixed with other types of tree to make an integrated orchard more productive. Find out how in this chapter

Liquid Manure chapter

Use local plants to make a liquid for fertilizer and pest control from information in this chapter



Compost chapter

Information on how to make good compost quickly is given in this chapter

What is Liquid Manure ?

Nowadays, the use of poisonous chemicals to control pests and diseases on crops is very common. These chemicals don't only kill pests, they can harm us as well. To protect us and the environment from this harm, we can use locally available herbs for pest control instead. This doesn't cost anything, we just need to learn the method.

Janga Bahadur sprays liquid manure

In this chapter, liquids made from local herbs are called ***liquid manures***. Liquid manure can work as a pest control, and also provides nutrients for the plants.

Why make Liquid Manure ?

Why use liquid manure ?

- to protect crops
- to prevent pests and diseases
- to avoid using harmful, manufactured chemicals
- to provide nutrients
- to provide irrigation

The benefits of this

- uses local resources
- saves cost
- protects beneficial insects
- uses local knowledge
- protects the environment
- helps us to be self reliant
- improves the soil
- saves our health by reducing use of harmful chemicals.

This says "Medicine for pests made from local aromatic plants".

This Chapter's Author:
Mr Laxman Rana
Dahachaur 4, Surkhet, Nepal

How to make Liquid Manure ?

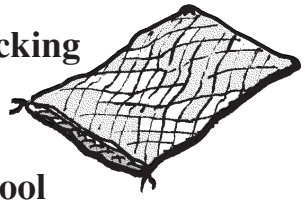
The elements listed below are all useful for making liquid manure. Out of these, some are good for pest control *and* soil fertility, but some work just to provide fertility and are not pest medicines. You can use many more plants and local substances, according to what's availailable in your area.

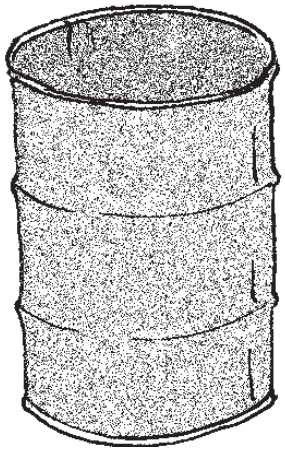
local resource	quality	function
neem	bitter	medicine + nutrients
wormwood	bitter	medicine + nutrients
garlic	smell	medicine + nutrients
Adhatoda vasica	bitter	medicine + nutrients
Wrightia arborea	poisonous	medicine + nutrients
Persian lilac	bitter	medicine + nutrients
Artemisia indica	bitter + smell	medicine + nutrients
marigold	smell	medicine + nutrients
chilli	hot	medicine + nutrients
Xanthoxylum	hot	medicine + nutrients
nettle	fertile	medicine + nutrients
lemon grass	scent	nutrients
morning glory	fertile	nutrients
papaya	fertile	nutrients
comfrey	fertile	nutrients

Materials Needed to make Liquid Manure

Various plants, fresh cow dung, ash

For more information on these ingredients see pages 5, 6 & 7



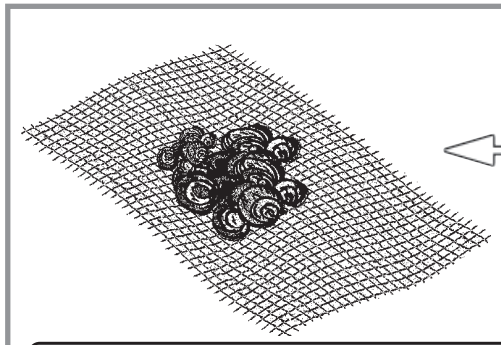


How to make it

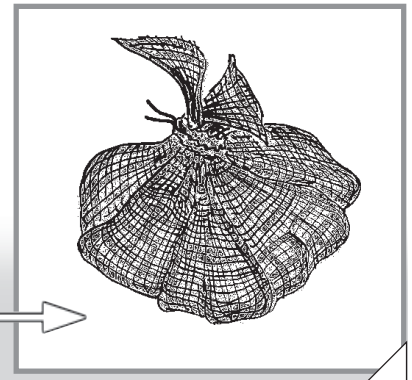
- Collect as many plants as you need, or will fit in the container available.
- Cut the plants into small pieces and fill the container. Add water to fill up to the top.
- Add ash, and the cow dung wrapped in a sack. This helps to produce micro-organisms.

- When the mix starts to smell, it is ready to use
- When the weather is hot, the preparation will be ready in 5 days, or in 2-3 weeks if it is colder.

This is how to cut the plants into small pieces



Put the ash and cow dung on a piece of cloth or sack

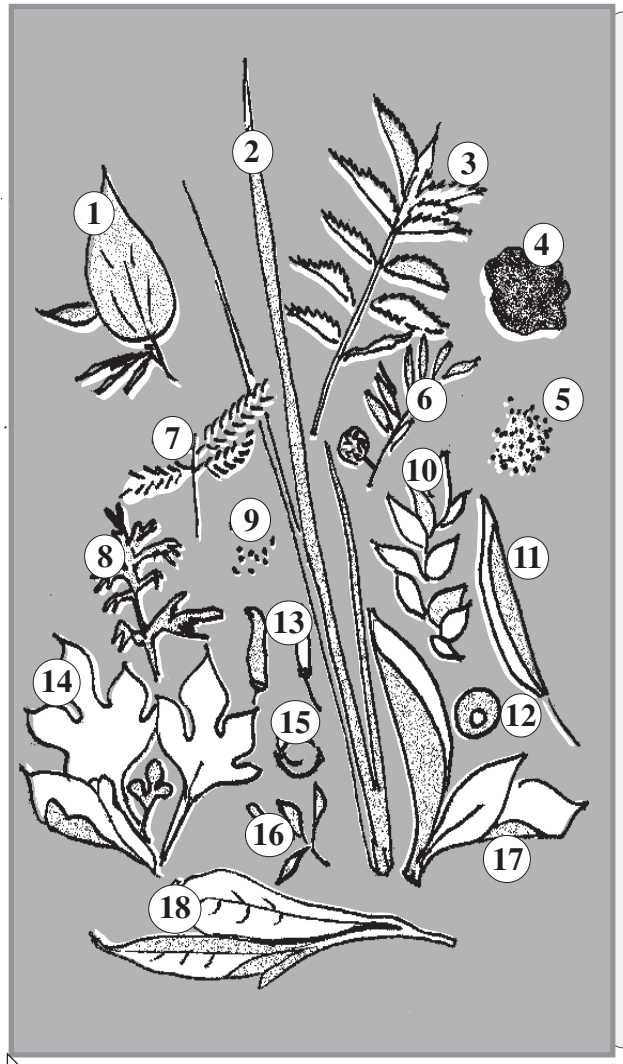


Tie the cloth up with string and suspend in the container with the water and other materials

Ingredients to make Liquid Manure

On the opposite page is a photo of some ingredients which can be used to make liquid manure.

Below is a copy of that photo with numbers to identify the different ingredients

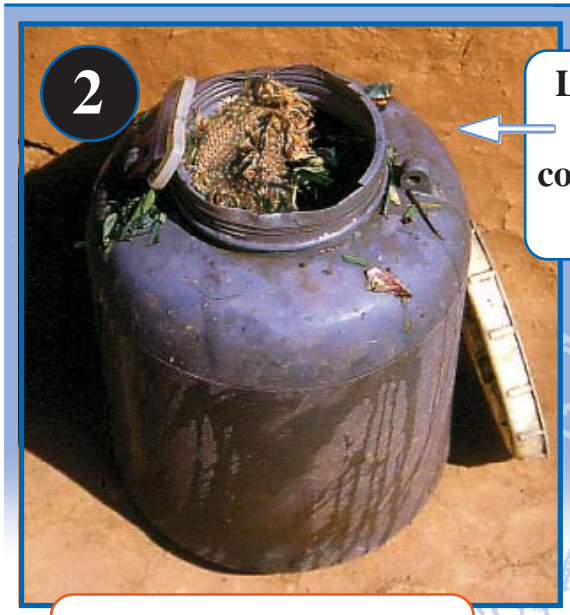


1 nettle
2 lemon grass
3 neem or Persian lilac
4 fresh cow dung
5 wood ash
6 marigold
7 *Lucaena* (ipil ipil)
8 wormwood
9 *Xanthoxylem*
10 *Cassia*
11 comfrey
12 onion
13 chilli
14 *Artemisia indica*
15 garlic
16 wild basil
17 *Adhatoda vasica*
18 *Wrightia arborea*

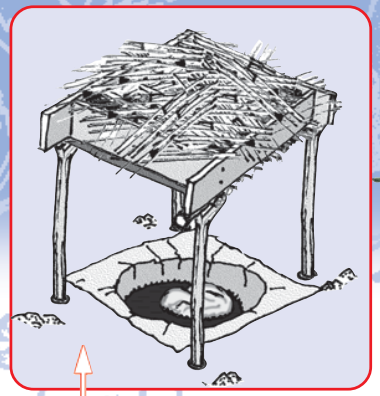
Let's See

How to make Liquid Manure

Ingredients to make liquid manure. Are these resources local, or do they need to be purchaced from overseas ??

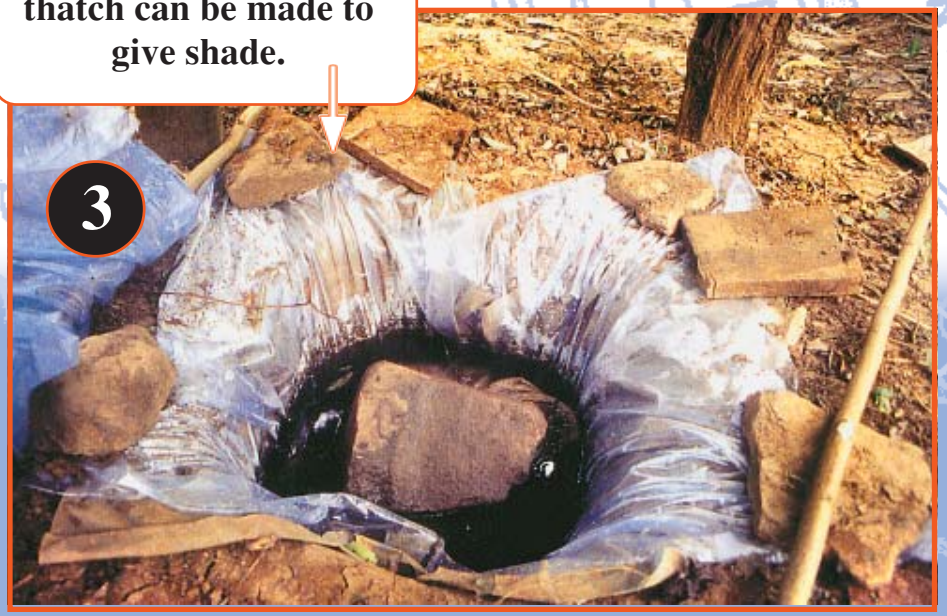


Liquid manure made in a plastic drum. The sack containing cow dung can be seen at the top.



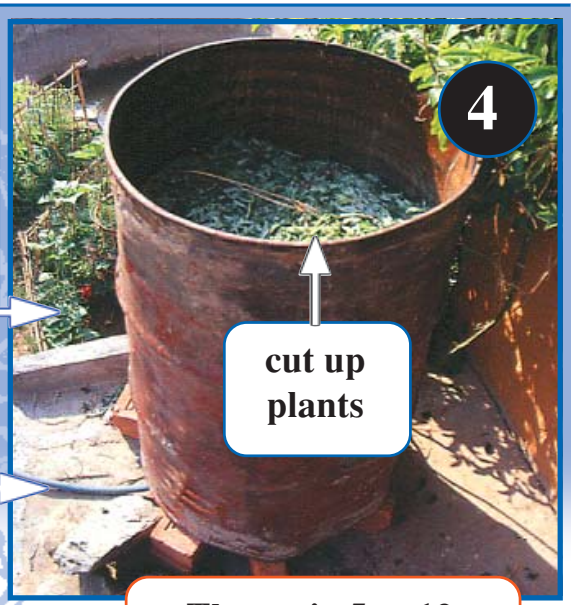
An air nursery can also be made above the liquid manure.

An easier way - line a pit with plastic and make the liquid manure in this. A small thatch can be made to give shade.



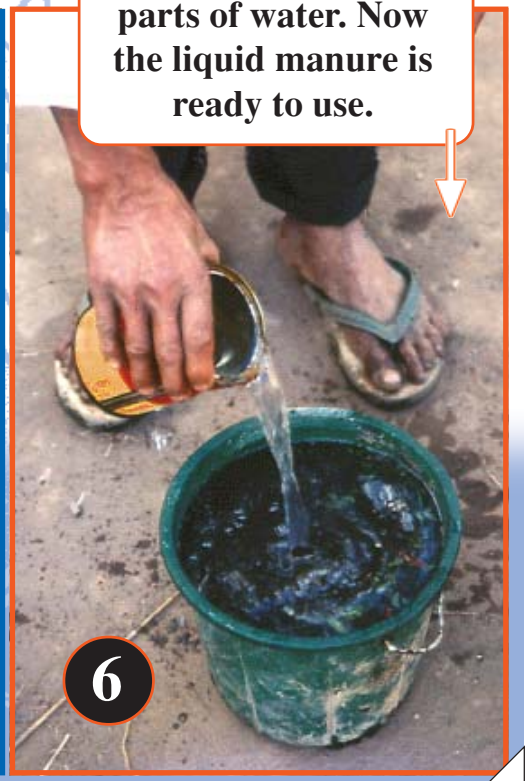
Enough liquid manure for 10-15 households can be made in one big drum.

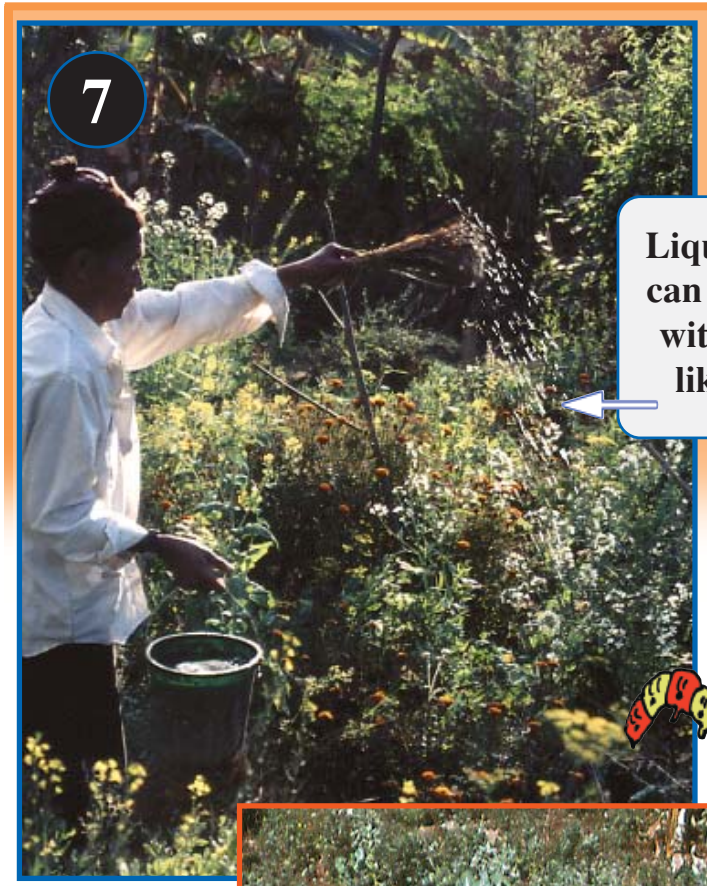
Pipe which drains the liquid from the drum into a bucket below.



Pour one part of prepared liquid manure into a bucket.

Then mix 5 to 12 parts of water. Now the liquid manure is ready to use.





Maintenance

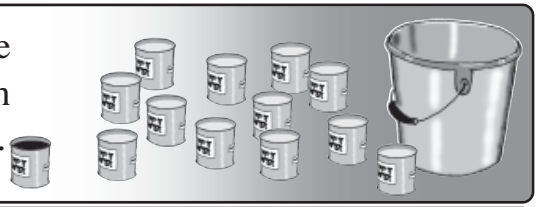
How to use Liquid Manure

Using Liquid Manure

1. How to use on young plants

Newly made liquid manure is very strong so it needs diluting with more water. When the liquid is used up, water is added again to the biomass in the container, which becomes less strong each time water is added.

- The first time, mix one part liquid manure with 12 parts water to spray.



- The second time, mix one part liquid with 8 parts water to spray.

- The third time, mix one part liquid with 4 parts water to spray.

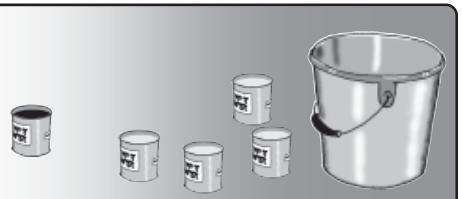
- The fourth time, mix one part liquid with 1 part water to spray.

2. Using liquid manure on older plants

When they are bigger and more mature, plants can stand stronger liquid manure. Insects are often stronger as well. Liquid manure helps to repel these insects. Plants can take in nutrients from liquid manures through their leaves. On the soil, liquid manure also acts as irrigation.

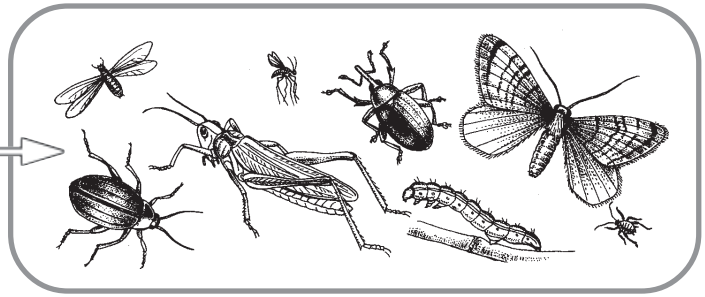
- The first time, mix one part liquid with 8 parts water to spray.

- The second time, mix one part liquid with 4 parts water to spray.



- The third time, mix one part liquid with 1 part water to spray.

Harmful insects

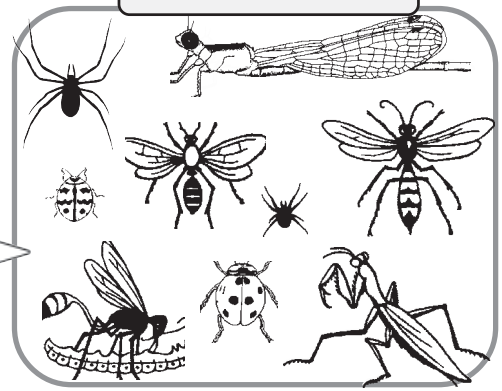


When to spray liquid manure

Mix in a suitable container according to 1. and 2. above and spray the liquid manure. Spray whenever pests are present, or before they are expected to arrive. Our objective is to repel, not to kill. The pests may come again, so liquid manure needs to be re-applied from time to time. Pests are repelled because of the various smells and tastes. And the plants get some food as well as water.

Don't use liquid manure when there are useful insects present otherwise they may be harmed.

Beneficial insects



Time to eat

Vegetables, fruits, etc. can be eaten at any time, but you need to wash them well in water.

Do your own research

There are many plants which are useful for making liquid manure. Farmers can experiment and find out by trying themselves. Plants that are soft and rot quickly, and make good mulch can be good for making liquid manure. Plants which are bitter and aromatic or smell, or are not eaten by livestock may be good to make liquid manure for repelling pests.

Farmers' Experience

Mrs Durgi Gharti

From Nepal, Surkhet district, Gumi - 5, Ratadada village, and a member of "Protect the Forest" women's group, Mrs Durgi Gharti has made and used liquid manure. Now let's hear about her experience.

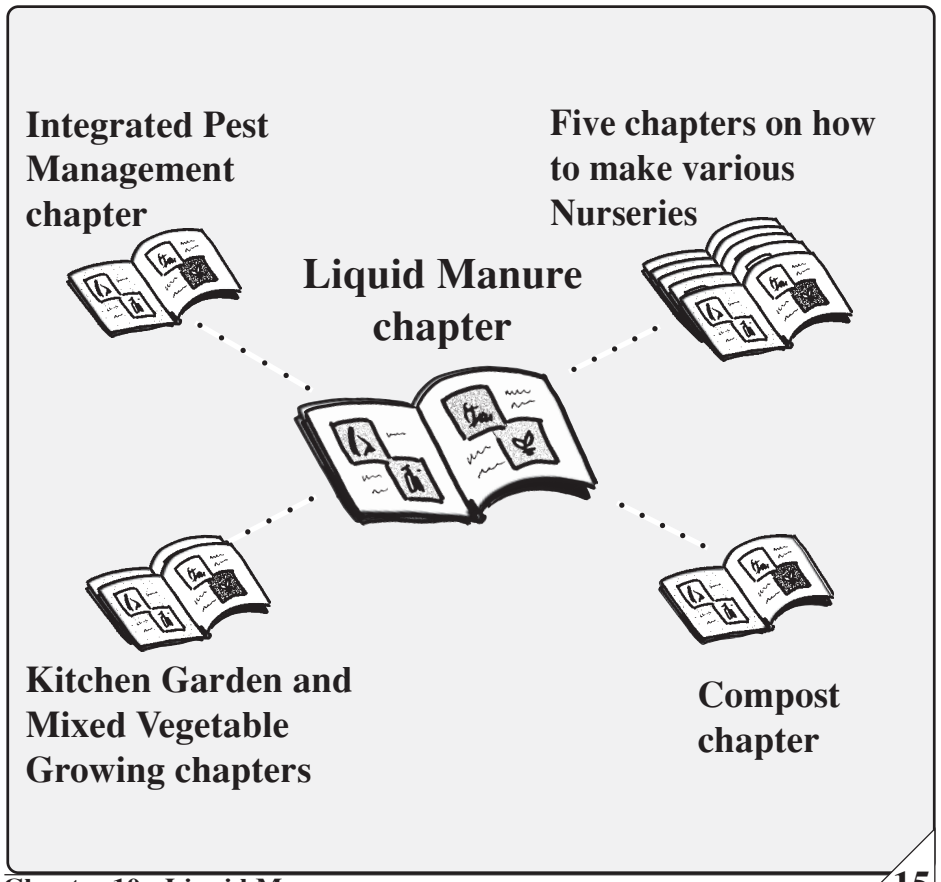
Mrs Durgi Gharti

" I learned how to make liquid manure from the homestead programme (JPP). It's been very useful for me. Various types of local species are used, such as wormwood, neem, *Adhatoda vasica*, etc., which are cut up small and put in a container with cow dung and water. After 5 days it's diluted with water and sprayed on the plants with a broom. You can use it on greens in the kitchen garden. We had a greenfly attack, so I sprayed the plants, and they never came back ! Liquid manure is easy to use, making it is light work, and it doesn't cost anything. It's easy to learn about, and also easy to teach others. I made it last year, and again this year, and I'll continue to make it and show others how. "

Read On !

Subjects Related to Liquid Manure

Good benefits can be had from the information in this book about making and using liquid manure. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.



Integrated Pest Management chapter

There are many types of pest and disease which affect farm crops. In this chapter information is given about preventing these problems using local resources.

Five chapters on how to make various Nurseries

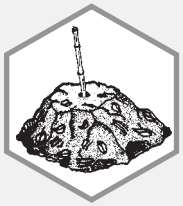
Different types of plants need different types of management to grow them, but all will benefit from using liquid manures . Information on how to build and manage the home nursery, fruit nursery, air nursery, hot bed and leaf pots is given in these chapters.

Kitchen Garden and Mixed Vegetable Growing chapters

How to make and manage a home vegetable garden for permanence, ease and simplicity ? Information on doing less work for more production while also being able to produce a wide range of fresh vegetables is given in these chapters.

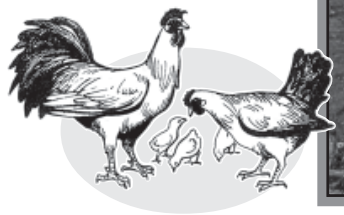
Compost chapter

As well as liquid manure, animal compost is also useful for plant food, but needs to be produced in a well-managed way. Information is given in this chapter about fast and good quality compost production.



What is Livestock Management ?

Healthy livestock makes life on the farm easier and more productive



People do various types of work to sustain themselves. Within farming and the homestead, a major work is keeping livestock. Often, more work and expense goes into livestock than any other task. Cutting and feeding fodder, watering, mucking out, maintaning the stalls and taking out to graze all takes a lot of farmers' time. Often it means there is no time to do other work, or learn, or play. With livestock, we can't say "leave it until tomorrow" for any work. But compared to all the time, work and cost farmers put into their livestock, the production is often too small. And there's often no time to grow vegetables, fruit, crops, keep bees, etc.

In this chapter, we will tell you of simple improvements to traditional livestock management, which can be made by every farmer.

Why manage livestock ?

Nowadays there are many problems with livestock management. Livestock are more sick. There's no fodder on the farm. The people get more sick. But they still have to send their children to school. So in order to get the benefits from livestock, we need to pay attention to this. This chapter offers some suggestions as to how to make livestock management easier and more productive.

Reasons for lack of benefits from livestock

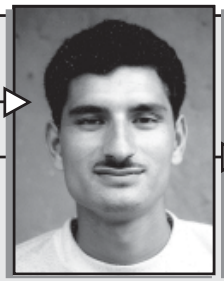
- lack of healthy forests
- lack of good grazing land
- sickness and disease
- poor stall and feeding management
- poor quality breeding stock
- lack of attention to livestock management
- lack of nutritious fodder well suited to the livestock

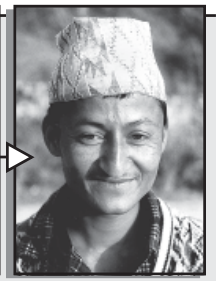
This Chapter's Authors :-

Bhuvan Khadka

Lal Bahadur Budhathoki

Rural Livestock Health Programme, Jajarkot & Surkhet, Nepal





How to manage livestock ?

In order to keep our livestock healthy and gain more benefits from less work, there are 3 areas to pay attention to. These 3 areas are :-

1. Stall Management

Like people, livestock need dry, clean, light but shaded, and airy places to live. How many farmers keep their livestock in dark, damp, airless sheds ? If the sheds are like this, without sunlight, and dirty, of course livestock will be weaker, and get more disease. If livestock are not happy in their place then this can lead to many problems, some of them big ones. So to get benefits from the livestock, their sheds must be built and managed to be cool in the summer, warm in the winter, dry, airy and clean. The stalls need cleaning every day, and the muck collected properly in one place to make good compost. More information about this is given in the ***Compost*** chapter.

2. Diet and Nutrition

(a) The importance of fodder

A balanced diet of grains and fodder is important for livestock. Livestock are more healthy and resist disease better with a mixed diet of grain and fodder, and will be more productive.

What fodder to feed ?

There are many types of fodder. Legume and non legume, tree leaf fodder, and fodder grasses, etc. are the main types. These are best mixed together. Especially, never feed just legume fodder, but mix it with other types so there is not more than 30% legume.

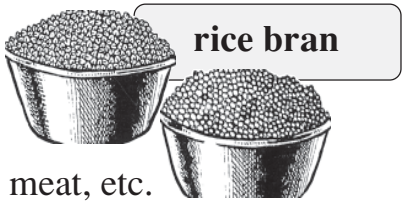
How to feed ?

Straw or dried grass is best cut into short lengths about 2 inches long. This makes it easier to digest for the livestock, so they use less energy. So, less fodder gives the same benefits, or the same amount of fodder gives more benefits. In this way 2 loads of fodder can give the same benefits as 3 loads.

Dried, cut straw etc. should be mixed with green fodder and a little salt to feed to livestock. This mix should be fed in a trough (manger) made of wood or another suitable material. This way the fodder doesn't spill on the floor and go to waste, the livestock eats it all, and it doesn't mix with dirt and muck on the floor. See also the pictures on page 8 for more information.

(b) Balanced Grains

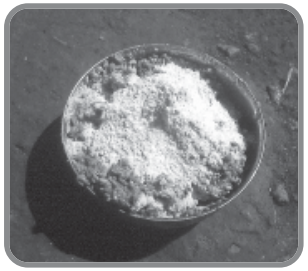
Livestock need nutritous food to grow well, stay healthy and stay productive. To obtain these nutrients they need the right quantities of mixed grains, or balanced grains.



Why feed mixed grains ?

- to increase output of eggs, milk, meat, etc.
- for healthy bones and hair
- to heal wounds and bruises quickly
- to give energy for working animals
- to protect from disease and stay healthy
- for healthy pregnancy and birth of young
- for the young animals to grow well

How to prepare ?



Balanced grains can be made at home. They can be prepared in the following way :-

- 2 parts rice bran
- 1 part corn, millet, wheat or barley flour
- 1 part oil seed cake or pulses (lentils, soya, etc.)
- mix the ingredients together

In this picture balanced grains made at home are fed to the pigs in a wooden trough

How much to feed ?

For cows, buffalos, sheep, goats or pigs the more you can feed mixed grains, the quicker they will grow to give benefits. But of course it's not enough just to give grains - leaf and straw fodder should also be provided.

- cows and buffalos producing milk, or about to calve, should be fed 2 to 4 kilos of balanced grains a day.
- sheep and goats should be fed half to one kilo of balanced grains per day.
- pigs should be fed 1 to 2 kilos of grain per day.

Things to remember :-

- oil seed cake should be baked and ground to a powder before mixing with grains.
- prepared balanced grains should be stored in a dry place in an air tight container
- if there is fungus in the grains, or they have formed lumps, they should not be used.

Let's See

How to manage livestock

Goats fed by hanging fodder near their shed

Livestock should be checked regularly for signs of illness, wounds, etc. If found, these should be treated as soon as possible. If treatment is delayed, the cost will increase.

Health problems can result from livestock being fed off the floor.

If fodder is fed from the floor, it may contain dung. If the dung is from diseased livestock, the disease will spread.

Goats fed in a manger

Disease can be prevented if fodder is given in a clean trough, free from dung, mud and dust

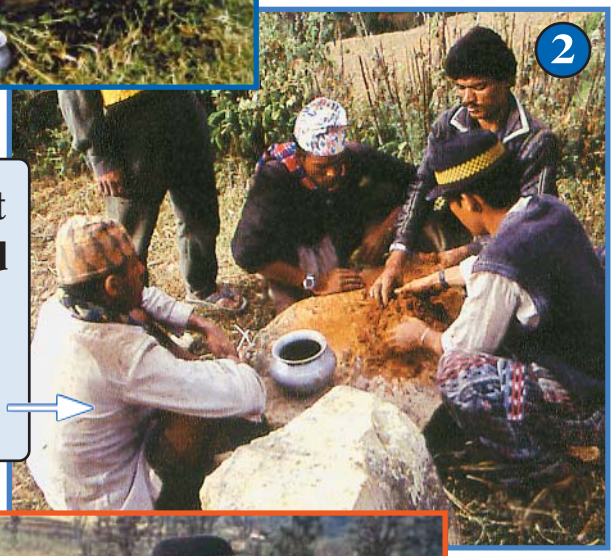
When fodder is cut into short pieces, less amount gives more benefits.

For communities, it's worth investing in a large fodder cutting machine

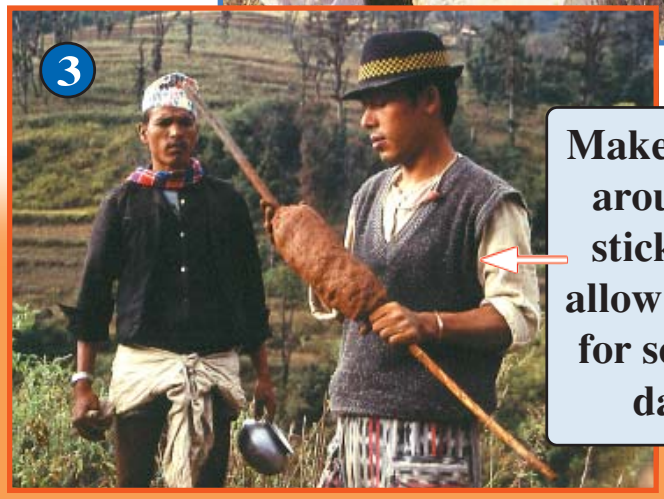
Here the compost pit is dug close to the livestock to make removing the muck easy. And it keeps the place clean.

Salt Lick

Grinding salt to a powder to make a salt lick. This can be mixed with garlic.



Add the salt to powdered clay, add water and mix well



Make a ball around a stick and allow to dry for several days

(c) Salt Lick

Like people, livestock need to eat salt. It's often traditional to feed salt once a week or even once a month, so livestock cannot eat salt as they want it. The health of livestock can be seriously affected if they are not able to eat salt when they need it. They will start to eat less fodder and grains, and drink less water. They become thin, and as a result of being weak can suffer from diseases, and have less strength. Females do not seek males to mate with, and other problems can start to appear. But too much salt can also cause problems. This is why it is good to make a salt lick.

How to make ?

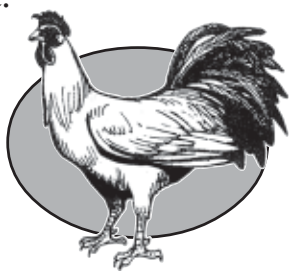
Take half a kilo of clay, half a kilo of salt, 5 egg shells, and grind to a powder. Add a little water and mix well. When the mixture is like stiff dough, make into a ball around a stick. Dry in the shade for 2 days and then in the sun for 7 days. When it is well dried, hang the ball in a place where the livestock can reach it easily. They may need to be taught to use it at first, but when they develop the habit, they will lick it whenever they need salt. The salt lick helps to keep the livestock healthy and free from disease.

Hung in the stalls, the salt lick can be used any time it is needed

3. Breed Improvement

What is it ?

To produce better offspring of any species, a male and female with very qood qualities are mated together. This method of increasing output through the production of better offspring can be called breed improvement.



Qualities of the male :-

- the right weight and height according to age and breed.
- must have the characteristics of the species or variety.
- have a strong, vibrant and healthy body.
- a male goat is best chosen from a mother which has had many kids.

In Pokhora village, Jajarkot district of West Nepal, the local Farmers' Leader Tek B. Khadka with his improved bull

Qualities of a good female :-

- have a strong, vibrant and healthy body.
- goats or pigs should have the ability to bear many young.
- the right weight and height according to age and breed.
- for cows/buffalos, the blood vessels should be large; in pigs there should be many teats.
- thin skin and fine hair.
- broad pelvises and rear end.
- the habit of seeking males at regular times.

Ways of Breed Improvement

(a) cross-breeding between relatives

Breeding between male and females which are close relatives (within 6 generations) is called **interbreeding**. For example, breeding between brothers & sisters of the same mother, or crossing father and sons with mothers and daughters.

This is not good breeding because :-

- Bad characteristics can be passed on and increased.
- Strength, stamina and ability to resist disease is reduced.
- Breeding ability is reduced.
- Offspring can be deformed or mutated.
- Production, such as milk, will gradually decrease.

(b) breeding between non-relatives within a variety

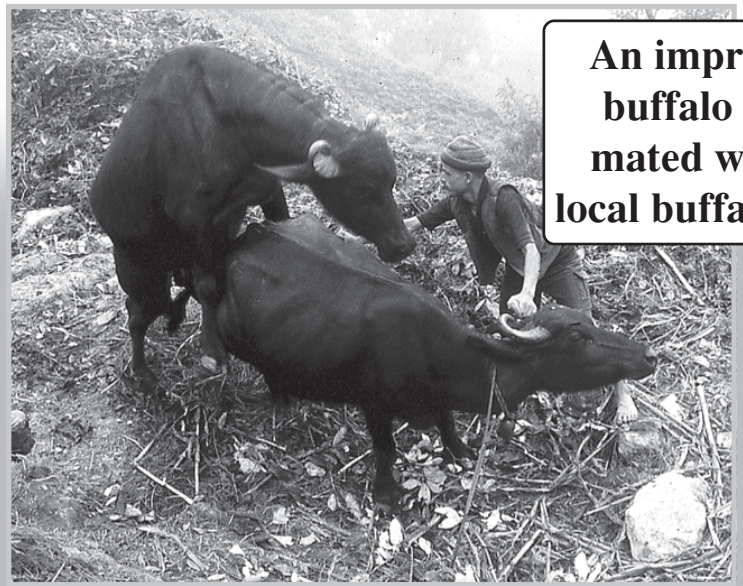
It is better to breed between males and females which are not related. For example, breeds that are the same but which have no relations over several generations. With this method, there are no disadvantages, but often there is little breed improvement.

(c) breeding between different varieties

This is when a local variety is crossed with a different, often improved variety, for example crossing a local cow with a Jersey bull, or a crossing a local goat with an improved billy.

Benefits of crossing between male and female of different varieties :-

- the offspring can have the best characteristics of the parents.
- resistance to disease increases.
- a low productivity variety can gradually improve its production



An improved buffalo bull mated with a local buffalo cow

Farmers' Experience

Mrs Dhanmaya Gyami

From Nepal, Surkhet district, Lekh Pharsa -2, Purano Gaun village, and a member of "Creative Women's Group" Mrs Dhanmaya Gyami has learnt improved methods to manage her livestock . Now let's hear about her experience.

Mrs Dhanmaya Gyami

"At first we had to go to the forest a lot. We had to go to watch the grazing livestock. There was no time to do the work at home. The livestock (our cows, buffalo, sheep and goats) were also not so strong. Also, we didn't give the livestock regular check-ups. And we had to go far to bring fodder. Now, the fodder from trees in the fields is enough. There's much more spare time than before and we have started to attend non-formal education classes. We check the livestock regularly, and now they are fat, strong and healthy. I also teach others that they should check regularly and treat their animals quickly if they are sick. It's better to spend a little on this to prevent disease rather than being greedy over 10-20 rupees, then find you lose a buffalo worth 10,000 rupees. The people in our village now have good experience about this."

Read On !

Subjects Related to Livestock Management

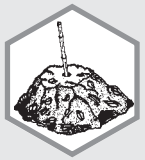
Good benefits can be had from the information in this book about livestock management. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.

Agroforestry chapter

Fodder is a very important resource for livestock. This chapter gives information on how to create good tree fodder and leaf litter production close to the home.

Compost chapter

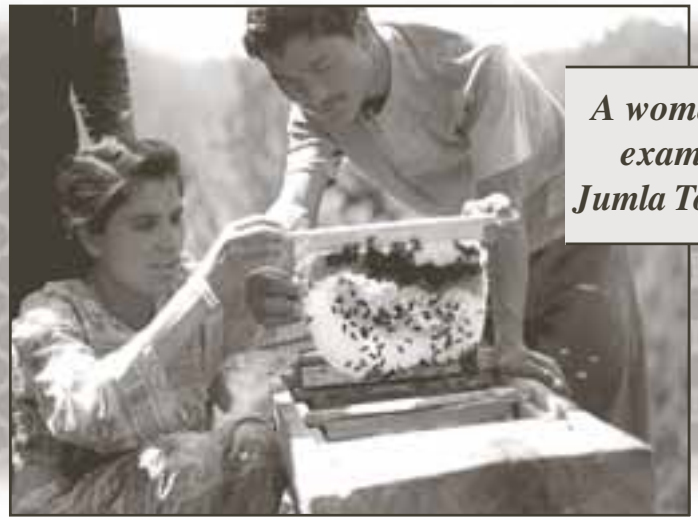
Livestock eat at one end, and at the other produce compost. Information is given in this chapter about how to make good quality compost quickly and easily.



Living Fence chapter

By planting a fence made of trees producing fodder and bedding for livestock, these essential resources can be increased locally. This chapter gives information about this.

What is Beekeeping ?



A woman trainer examines the Jumla Top Bar Hive

Bees live naturally in hollow tree trunks, under branches and on rocky outcrops in the jungle. By copying the natural needs of bees, people have kept bees in hives at home for centuries. There are direct and indirect benefits from beekeeping. Honey, wax, pollen, medicine, etc. are direct benefits. By pollinating crops bees also help increase farm production. In the jungle, bees help to maintain biodiversity by pollinating many wild tree species. These are all indirect benefits.

With small improvements to traditional beekeeping, production can be increased and diversified. This chapter provides information about how these low cost improvements can be made to traditional beekeeping.

Why improve Beekeeping ?

In this chapter improvements are described in 3 areas of traditional beekeeping :- 1. bee management, 2. honey extraction, and 3. processing of bee products (honey, wax, etc.). With better bee management, bee populations increase, and bees are more healthy and productive. Improvements to honey extraction mean better quality and quantity of honey & other products. Improvements to processing also means increasing the quantity and quality of bee products. Pure honey, wax and pollen have natural nutritional and medicinal qualities. Having more, healthier bees also improves pollination and so helps the environment. The 3 diagrams below illustrate the 3 areas of improvement.

1. Management

Increase in hives, bees, bee health & production

Pollination of fruit, oil crops & wild trees

2. Extraction

Better and more honey, wax, etc.

3. Processing

Better production & use of bee products

- better honey
- more fruit
- more wax & pollen
- better health for people

all for home production and selling

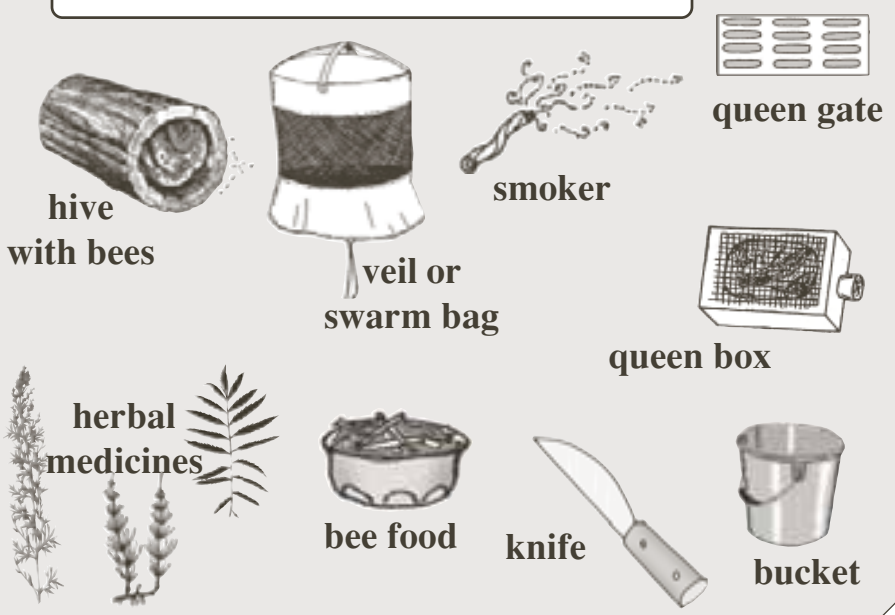
How to improve Beekeeping ?

Anyone can easily keep bees. For this you don't need lots of land or big investment. To improve the quality and quantity of bee products it's important to pay attention to bees' protection, health, hygeine and diet. Just small improvements to management can give many benefits.

Important things to consider in Beekeeping

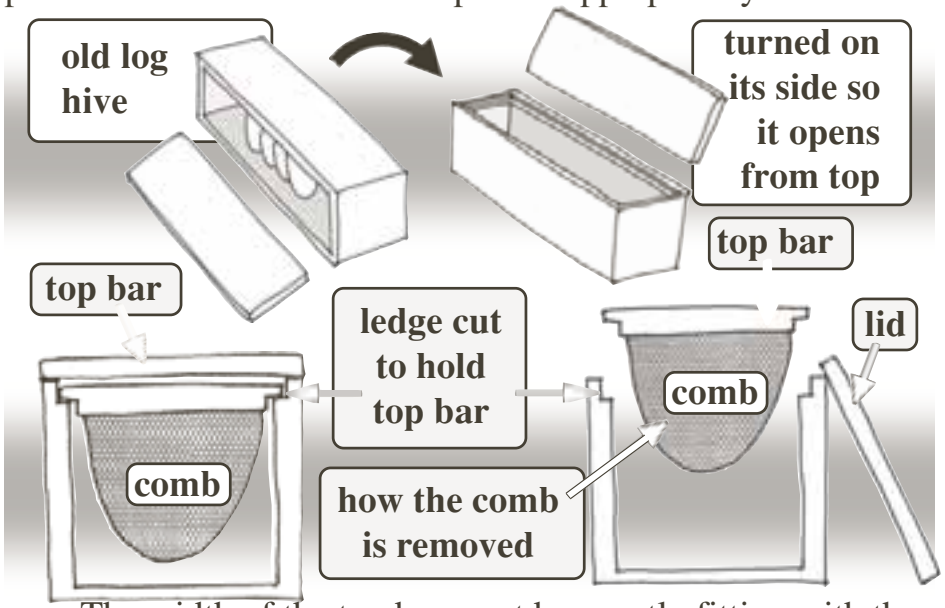
1. **Choice of beehive**
2. **Caring for bees**
3. **Problems with bees**
4. **Product management**

Materials Needed for Beekeeping



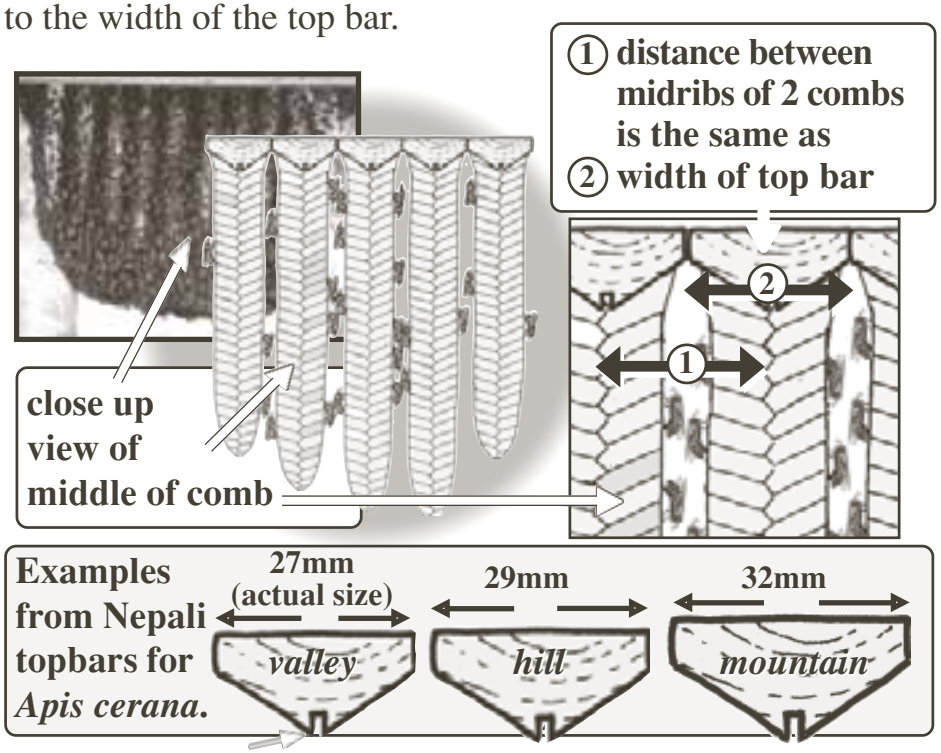
1. Choice of Beehive

When choosing a hive, the timber liked by bees, a cheap and easy method of making the hive, and its durability are all important. There are 2 main types of hive: traditional, and improved. In the traditional hive the combs can't be taken out to look at, while in the improved hive the combs can be removed and replaced without damage. In Jumla district of Nepal, farmers have improved their traditional hives by making top bars to which combs are attached. These can be removed for inspecting combs and replaced again. This is a good example of local hives which are improved appropriately.



The width of the top bar must be exactly fitting with the width of the comb, and there must be room between combs for 2 bees to move up and down. The size of bees may change according to altitude (the higher, the larger), bee species and variety, so the width of the top bar should also change accordingly. Examples of different sizes of top-bars in Nepal are given in the following diagram. In nature, the distance

from the centre of one comb to the centre of the next is equal to the width of the top bar.

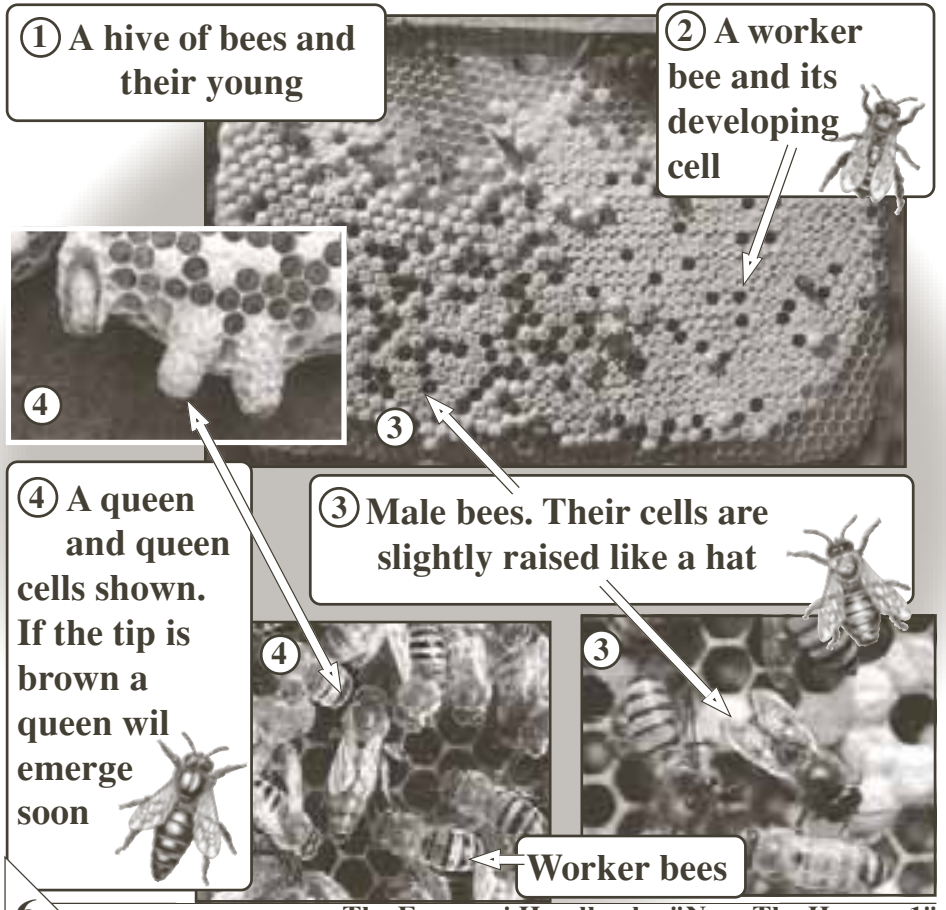


The base of the top bar is pointed. This helps the bees to build straight combs.

2. Caring for Bees

Swarming

Swarming is the natural way for bees to reproduce. It happens when the number of bees in the hive becomes large and a new queen is made. When the new queen hatches, half the colony will leave along with a queen. The old queen goes with the first swarm. When bees are about to swarm you will see more males flying outside the hive. A cluster of bees may be seen hanging near the entrance to the hive. Inside the hive the combs contain many male bees and queen cells. If the tips of the queen cells are a brown colour then bees may swarm within 2-3 days.

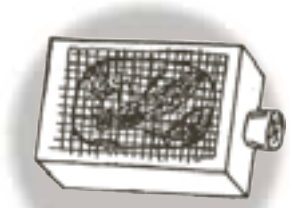


Putting a swarm of bees in the hive

It is traditional knowledge to spray swarming bees with water or ash. Improvements to traditional practices are suggested below.

- Use walnut, citrus or lemon grass leaves to clean the old hive. Wipe with honey and wax.
- plaster any holes or cracks in the hive
- Put the queen in a box if she can be found. When the bees are all in the hive, place a queen gate over the entrance and let the queen mix with the other bees in the hive.
- Be careful not to damage the queen.
- Put the swarm into the hive in the evening.
- Feed in the evening only.
- If the queen is new, don't add the queen gate because she must fly outside to mate. Watch the hive from 10am to 2pm for about 5 days to check that they don't fly away. If bees are seen bringing pollen this means they are settled, and it is safe to take the queen gate off, or to stop watching the bees in the daytime.
- There may be a tradition of clipping the wings of a new queen, but this should **not** be done because the queen may not have mated. The queen mates with the male bees outside the hive while flying. If she can't fly, she can't mate or lay eggs, and the colony may slowly die out.

A swarm bag or veil can be used to capture a swarm



queen box

queen gate

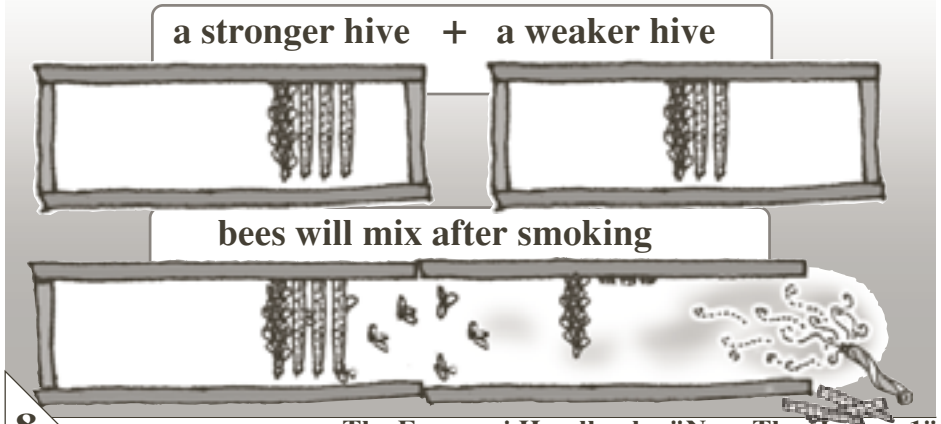
Uniting bee colonies

Beekeepers like as many hives as they can keep. But it's not just the number of hives that's important, there must be plenty of bees inside also. It is better to unite 2 weak colonies to make one big one, because :-

- by uniting 2 weak colonies neither die
- uniting increases honey production
- it takes less to feed a united hive
- a stronger colony is less susceptible to disease
- a bigger colony has a more balanced temperature
- if one colony has no queen, it can be saved.

How to unite colonies

To unite 2 small or weak colonies place the 2 hives close to each other. Put the frames of the weaker hive in the stronger hive and smoke the weaker hive to remove all the bees and drive them into the stronger hive. By doing this, the stronger queen will kill the weaker queen - you don't need to do it. It's best to unite colonies at the start of winter, or the start of the monsoon, or when there is no queen in the colony. If bees start to fight, give more smoke.



Robbing

One problem is that bees from different colonies sometimes fight each other. Why ?

- food is spilt outside or given outside
- honey is spilt during harvesting
- there is no food and bees are hungry
- food is given in the daytime, and the hive is mishandled
- the colony is weak

how to stop a swarm

Preventing robbing

- spray water on the hive
- never feed outside the hive
- take steps to strengthen the hive (feeding, uniting with a stronger hive, etc.)

Absconding

Signs that bees are ready to abscond	Reasons for absconding
• bees stop bringing pollen • bee traffic at the hive entrance slows down greatly • bees may form a ball hanging at the entrance • the queen stops laying • there are no or very few eggs or larvae - only adult bees are found in the hive • bees usually abscond between 10am and 2pm	• lack of food • too hot or too cold • too much disturbance • smoke, bad smells or water getting into the hive • opening, moving or disturbing the hive too much • robbing (bee fighting) • attack by predators or disease

Feeding Bees

Why Feed Bees ?

It's very important to feed bees. To get good benefits from bees, it's necessary to feed them according to their needs. Although it costs to feed bees, the honey production payback makes it worthwhile. As a result of feeding, the bees can increase in number and be strong to resist diseases. Bees must be fed when flowers are unavailable, or if the colony becomes too weak to collect enough food.

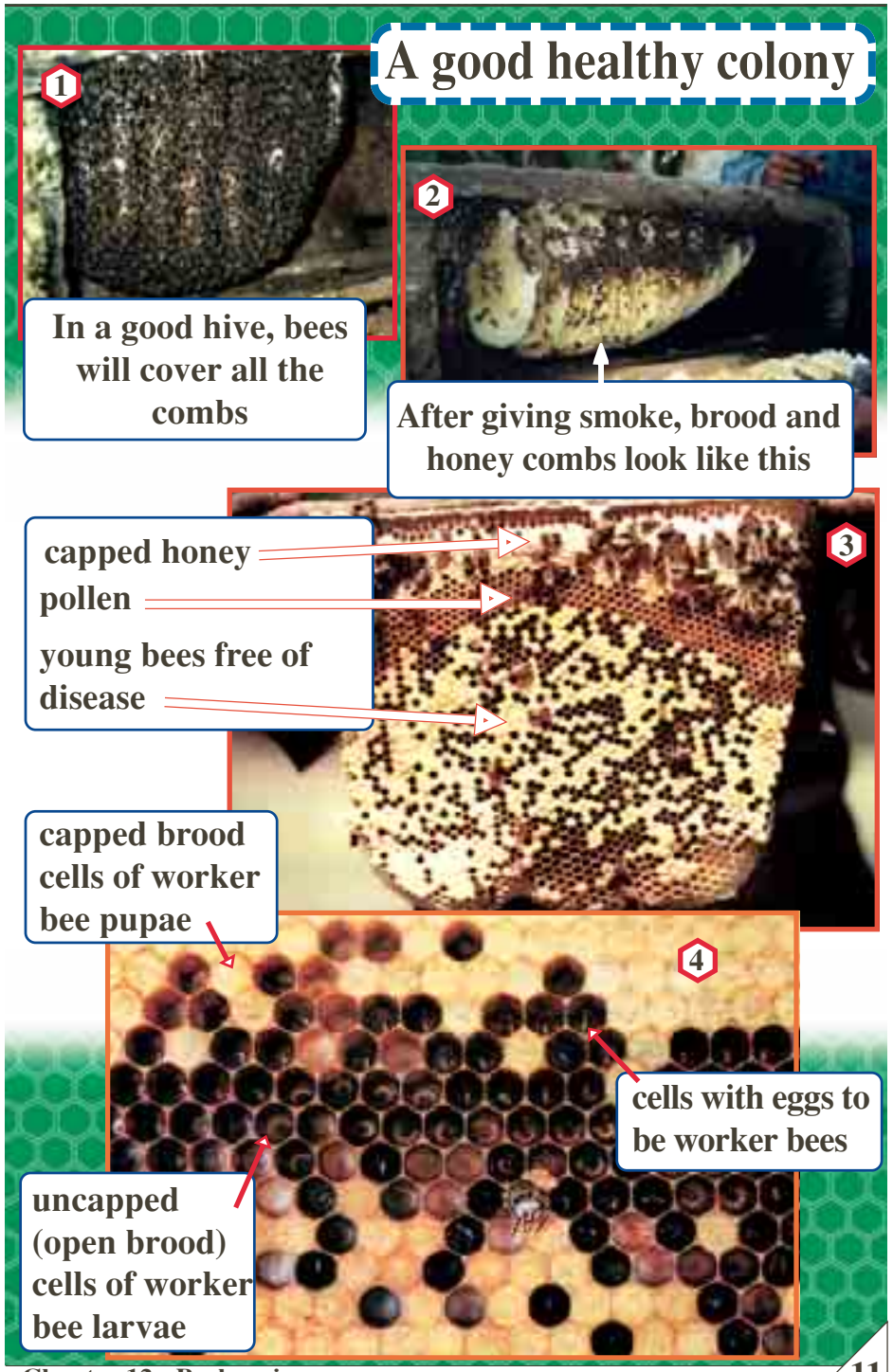
What can Bees be fed ?

The best foods for bees are honey, sugar water or candy (sugar, honey and water solid food). However if these are not available in your area other sweet substances can be used. Sweet pumpkin or buckwheat pancake can be mixed with honey, or pear or apple jam can be given. Food should always by given inside the hive in the evening, and taken out in the morning. Sugar water is made by mixing one part boiled water to 1-2 parts sugar. Don't give food if older than 2 days. Photo 17 on p.14 shows feeding technique.

To judge the colony's condition and see what management is needed, check the hive regularly.

Signs of a Healthy Colony

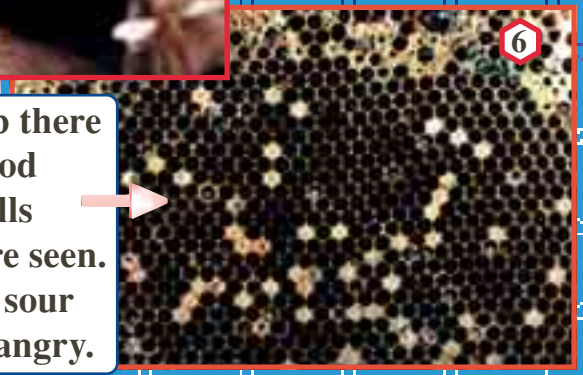
- Seeing single eggs in comb cells is a sign that the queen is active. If open brood (larvae) and capped brood (pupae) are both visible, the colony is in a good condition (page 11, photo 4).
- Bees flying in and out & moving quickly is a good sign.
- Bees bringing plenty of pollen means they are busy raising young - this is a good sign.
- Bees being light in colour is a sign of good health.
- Lots of male bees is a sign of potential swarming



A diseased, unhealthy colony


5

In an unhealthy colony bees cannot cover all the combs


6

On a diseased comb there are few capped brood cells. Un-capped cells with dead larvae are seen. Combs may have a sour smell and bees are angry.


7

Combs with *European Foul Brood* disease seen close up show dead larvae. These dry up and stick to the base of the cell.


8

Compare the diseased combs (6&7) with this healthy one, where many capped pupae are seen and healthy larvae are white and fat.

When seen close up, bee pupae with *Thai Sac Brood* disease look like a sharp tipped bag


9


10

Wax moths occupy combs not covered by bees, and eat holes in them, leaving silky threads as they go. Later, the comb looks like a spiders' web. Wax moth's larvae look like maggots.

This tiny red insect on the bee's body is called a *Varroa mite*. This sticks to larvae and adult bees and is harmful to them.


11


12

In a colony without a queen, several eggs are seen laid by the workers bees in each cell. The colony should be mixed with another, or a new queen added

3. Problems with Bees

Symptoms of bee problems are also shown on colour pages 12 and 13

Symptoms that bees are in bad health (photos 5 to 12)

- Bees leave combs uncovered
- Bees are angry
- Bees move slowly
- If bees are dark and shiny they may be diseased or queenless
- Because of lack of food, combs are dry and empty of honey. If starved, bees are seen dead with their heads buried in the comb cells.

"Brood" Diseases of young bees

Like people, bees suffer from a variety of diseases. In Nepal there are 2 main diseases. These are called ***European Foul Brood*** and ***Thai Sac Brood***. These effect young bees while still in their cells. Nowadays these are common diseases.

Symptoms of European Foul Brood : (photos 6 and 9)

- Tiny white lines (the tracheal beathing tubes of the bees) can be seen on uncapped larvae
- Too much water is seen around the larvae
- Twisted, dead larvae are seen
- Very few capped cells are seen
- Dead larvae form scales which are brown and stuck to the base of the cells

Symptoms of Thai Sac Brood : (photo 7)

- This disease effects the pupae stage and young uncapped larvae are less affected
- Capped brood cells may have jagged holes
- In the capped brood cells pupae look pointed and sometimes discoloured
- The head of these pointed pupae turns black and dries out

- When taken out, these pointed pupae look like a tiny plastic bag filled with water
- Worker bees are seen throwing the diseased larvae out of the hive. It may look like they carry grains of cooked rice.

This is a bees' friend. It eats lice found on bees' bodies, but doesn't harm them.

Diseases of Adult Bees

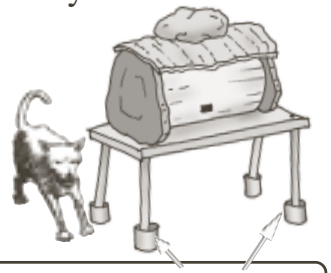
Worker, male and queen bees suffer from various diseases such as acarine, nosema, amoeba and paralysis. These are caused mainly by lack of hygiene, old sugar water, lack of food and being too hot or cold. Prevention of these diseases is the same as for preventing disease in young bees. If the disease spreads, infected combs should be removed.

Preventing Disease

- Keep combs strong and prevent too much swarming
- Unite weak colonies with stronger ones
- If hives are hot, make small holes to allow air flow
- If the weather is cold, cover the hive with pine needles, moss, sacking, or other insulation
- Clean out dirt from the hives every month
- Take out old, black combs
- Dispose of these carefully (use for wax extraction)
- Take out combs not covered by bees
- Process the cut combs and keep covered away from wax moths
- Provide food if not available

Curing disease after it has struck

- Take out uncovered combs
- Give food and herbal medicine continuously for at least a week



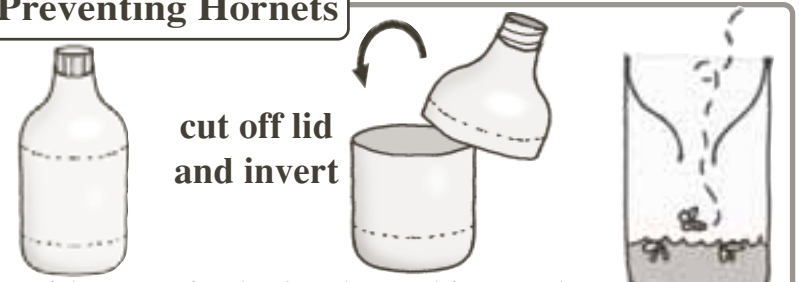
Preventing ants with bowls filled with water

- Transfer the diseased colony to a location where there are no other beehives to avoid spread of the disease
- Take out combs with diseased young, and burn them to prevent the disease spreading
- As cutting out diseased brood comb can cause the colony to abscond, put a queen gate on the entrance
- Mix and cook chopped Persian Lilac or Neem, horsetail, Jasmine flowers and raw tumeric with water, strain and mix with 2 parts sugar until dissolved. Feed in the evening of every other day for at least 10 days (5 doses). This is shown on page 14.

Preventing Wax Moth

Keep the inside of the hive clean. Take out uncovered, old combs. Dispose of them carefully and never throw them around the apiary. Process the wax quickly. Store re-usable combs and processed wax well, in sealed containers. Maintain strong colonies by feeding, uniting etc.

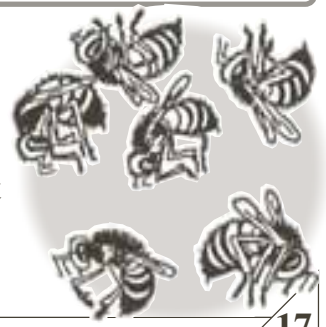
Preventing Hornets



Put fruit with water in the bottle, and invert the top so it points down. Hornets can get in but not out.

How to tell if bees have been poisoned

- Many bees die in a short time
- Bees can be seen dead around the hive
- Bees die with their tongues sticking out
- Poisoned live bees walk around in circles
- Fewer bees arrive at the hive



How to prevent poisoning ?

- Use local herbs for pest control instead of toxic chemicals
- Don't use poisons when plants are flowering
- If it is essential to use chemicals, first inform beekeepers and only use in the evenings or at night.

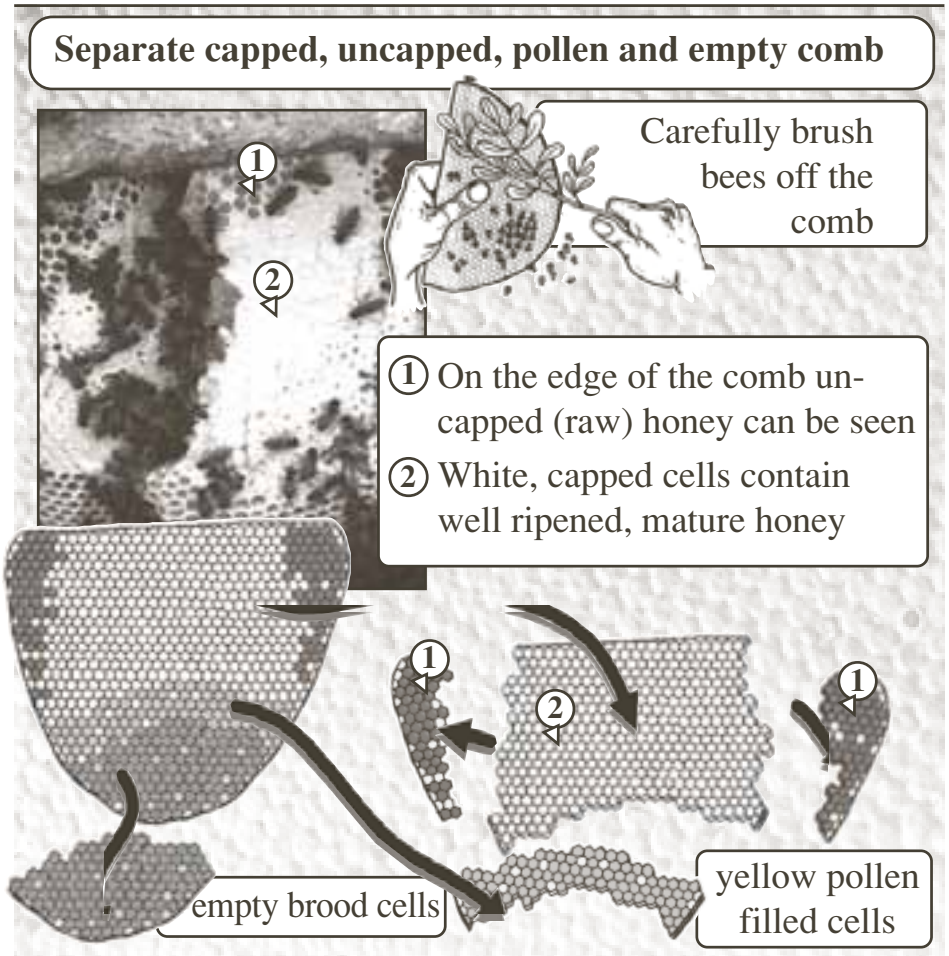
If signs of poisoning are seen, close the hive immediately and keep the bees in the hive for at least 24 hours, providing air flow and feeding regularly.

4. Processing Bee Products

Things to consider when extracting honey

- Never allow honey or cut combs to touch water (not even small drops) as this will increase the water in the honey and make it spoil.
- Wash any utensils (buckets, knife, etc.) with hot water and soap or ash, and make sure washed utensils are well dried.
- Extract honey in the evenings but before dark
- Slowly give smoke from the edge of the colony
- Once bees have moved away from the smoke, gently cut the combs from the edge
- Look closely and only cut combs with honey, don't cut combs with brood
- Gently brush any bees off the cut combs, but don't use water on the brush
- Put the cut comb in a clean, dry bowl or bucket, and cover well to prevent bees getting into it

Combs, or parts of combs containing capped ("ripe") and uncapped ("raw") honey should be separated because uncapped honey will ferment quickly. Use uncapped honey first.



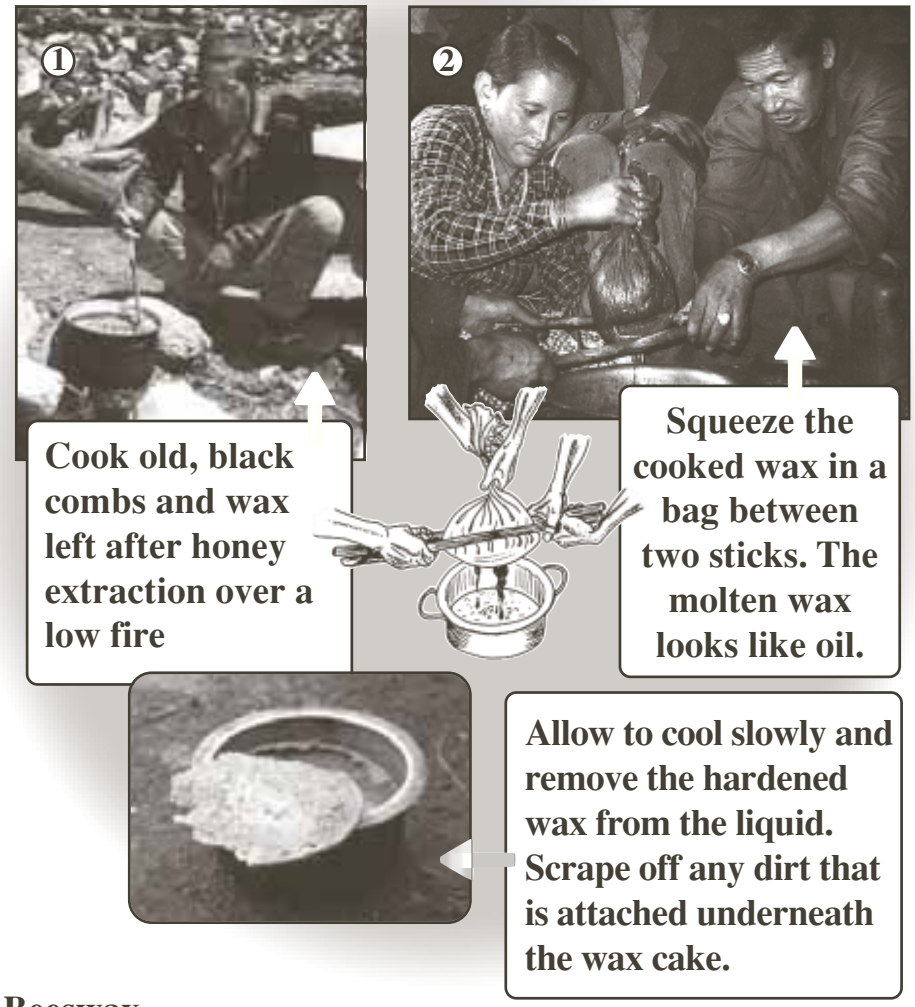
What to do after extracing the honey

- Because uncapped honey has a higher moisture content, it shouldn't be mixed with capped honey. This means they shouldn't be processed together, and uncapped honey should be used quickly because it soon ferments due to the water content.
- Cut the capped combs into small pieces and keep in a deep, air tight container for up to a week.

- After 7 days the honey has sunk and the wax rises to the top. Skim the wax off the surface. Seive the honey through a fine, clean cloth. Only use clean, dry hands to squeeze through the seive. The wax mixed with honey that is skimmed from the surface can also be squeezed for home use, or fed to the bees.

Extracted honey seived into a clean, dry bowl

- Put the seived honey into clean and dry containers as needed. These can be glass, clay, wood or good plastic containers that are airtight. If airtight containers are not available, seal the lids with wax.
- Honey should **not** be cooked because this destroys its nutritious and medicinal qualities. There is **no** value in cooked honey.
- Remaining comb with pollen should be cut into small pieces, covered with liquid honey and stored in the same way as honey in an airtight jar. This is very nutritious. Feed one piece once a day as needed to pregnant or suckling mothers, babies over 6 months, old or sick people. It may be difficult to digest at first so feed small pieces until used to it.
- Pure honey can also be used as a medicine. It is useful for burns, cuts, sores, ulcers (including gastric), indigestion, stomach ache, urinary tract infections, tonsilitis, infected eyes and ears (for eyes and ears dissolve honey in a drop of boiled, warm water and seive well before using).

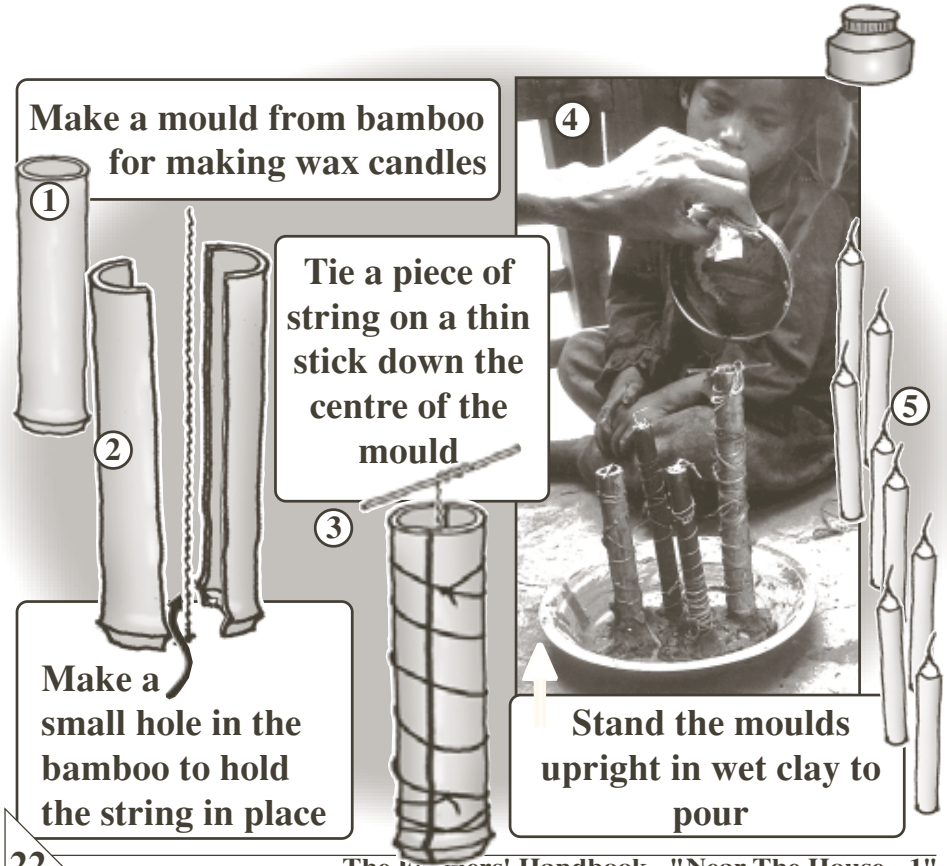


Beeswax

Wax is produced from glands on the underside of 12-18 day old worker bees. Bees use it to build their combs. Some Nepali beekeepers believe that a tiny scorpion-like red insect makes wax, but this is untrue (but this is a useful insect, see p.16) as bees make it themselves. Many beekeepers also carelessly discard old combs. This wastes the wax and attracts the wax moth. Better to process the wax to make ointments, candles or polish.

Processing Wax

Soak old, dark combs or wax from honey processing in water for a day. Then, put the old combs or wax in fresh water and heat slowly. When wax melts and becomes like oil on the water surface, pour the wax and debris mixture into a cloth bag and squeeze it between 2 sticks to seive it into another container. Let it cool and harden without disturbing. Take the clean wax, break into small pieces and put in a steel or aluminium pot. Boil water in another pot and place the pot of wax in this to melt. When melted, seive through a clean cloth. This wax can be used to make cream, candles, polish, etc. To make cream, add one part wax to 3-4 part vegetable oil. The method to make candles is shown in the diagram below.



Farmers' Experience

Mr Karnabir Sunar

From Nepal, Jumla district, Chandanath - 4, Dandakot village, Mr Karnabir Sunar keeps bees in his improved Jumla Top Bar Hive. Now let's hear about his experience.

Karnabir Sunar

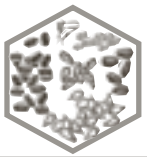
" I've been keeping bees since 1995. In our culture, lower castes like me aren't supposed to keep bees, so the custom goes, but I've been keeping them successfully. There are good benefits in bee-keeping, especially with the Top Bar hive. To make the hive I upturned the old log hive and put top bars on without any cost at all. With this hive I can inspect the bees easily, watch for diseases, feed the bees, and extract honey without harming the bees. I can sell the honey and wax because it's good quality. Before I kept bees I hadn't been able to have children. After keeping bees and eating honey and pollen my strength increased and my wife had a son, and I fed him with honey from when he was only 8 months old ! Now, I have 9 hives. The work's easy and low cost, and so I plan to have more in the future. "

Read On !

Subjects Related to Beekeeping

Chapters related to Fruit :- how to create, grow and manage improved fruit trees with practical information on fruit nurseries, grafting, budding, stone grafting, top grafting, air layering, planting fruit trees and orchard management.

Seed Saving chapter :- information on methods to produce and store various quality seeds at home.



Nutrition chapter :- information about needs and sources of a healthy diet for all the family.

Agroforestry chapter :- information about how to plant and manage trees on farmland without decreasing farm yield.

This Chapter's Authors :

Mr Narayan P. Acharya
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What is Non-Cement Drinking Water ?

Making an intake tank without cement, Jajarkot, Nepal

It is so important to have clean drinking water for a healthy life. Because of modern development and population increase, forest is decreasing and water springs are drying up. Problems have been seen of cement-made drinking water tanks causing the springs below to dry up. Also, if the cement cracks, all the water in the tank leaks away, and this is too expensive to fix. So as an alternative to this, we describe in this chapter a way to build drinking water systems without using cement. Instead, they use local resources and skills to make systems which are safe, cheap to build, and long-lasting.

Why make Non-Cement Drinking Water ?

Many people think that beneficial development can only come by importing and using resources from far-away foreign countries. Few people believe that it's posssible to build a drinking water system for a village without using cement. But since 1991 in Jajarkot and Surkhet districts of Western Nepal, the Jajarkot Permaculture Programme (JPP) has made many such village systems to provide safe drinking water, and all are being maintained and still running to this day.

Benefits of building drinking water systems without cement

- to build clean drinking water systems
- to do this without damaging other springs
- to build cheaper drinking water systems
- these use less time and labour resources to build
- local people can build and maintain these systems
- this means that everyone in the village can be involved in building and maintaining their own drinking water system
- this helps the local economy

This Chapter's Author:

Mr Bhuvan Khadka

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How to make Non-Cement Drinking Water ?

Drinking water systems can be made from springs near to the villages without using cement. It's best to build these during the winter when farmers have more free time. At this time, springs are also low due to lack of rain, so it is easier to measure the flow. There are 3 steps to building the non-cement drinking water system :-

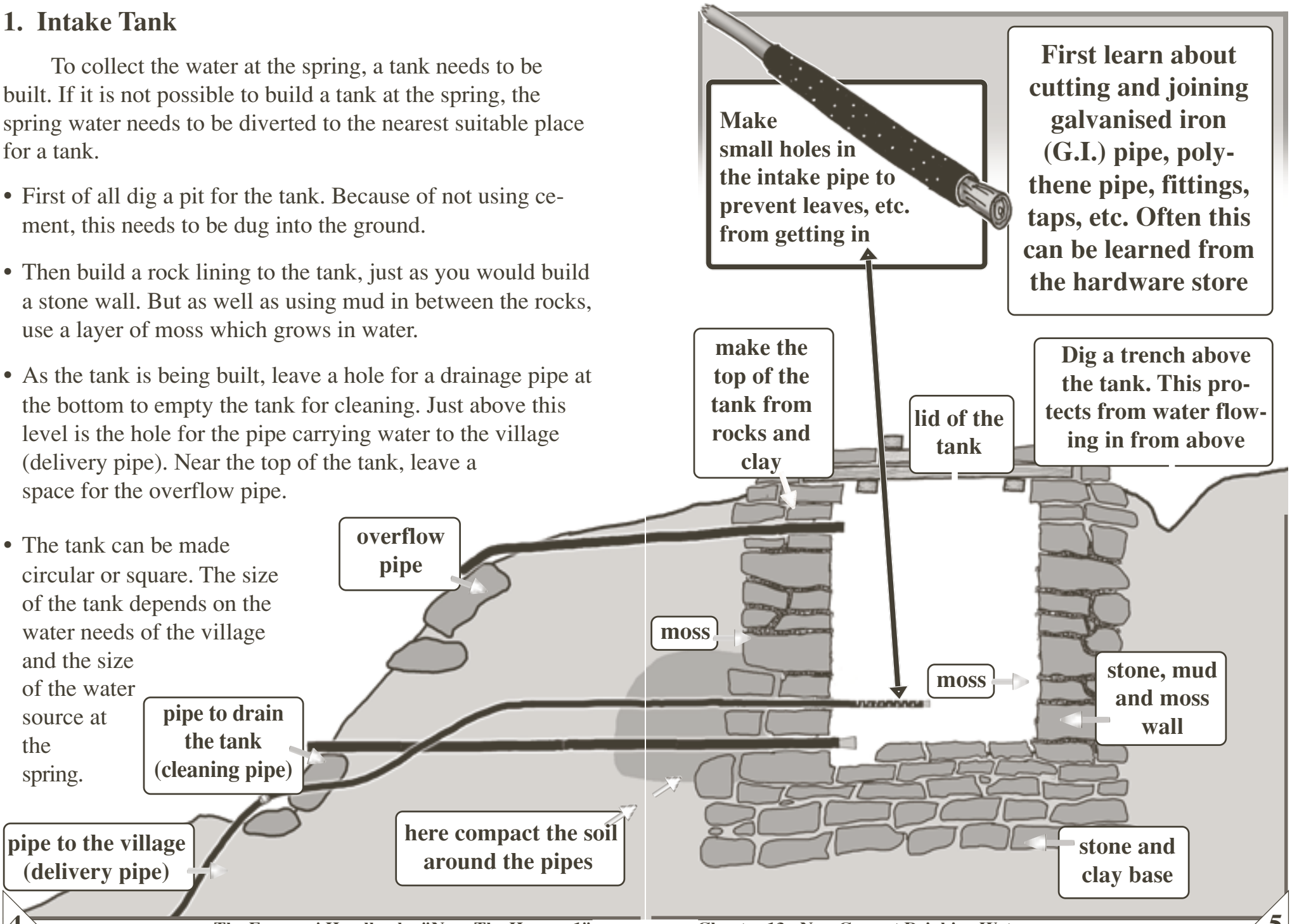
1. Building and managing the spring intake tank;
2. Laying the pipe to the village, and tanks in between, if any;
3. Building the tapstands in the village.

Materials Needed to make a Non -Cement Drinking Water system

1. Intake Tank

To collect the water at the spring, a tank needs to be built. If it is not possible to build a tank at the spring, the spring water needs to be diverted to the nearest suitable place for a tank.

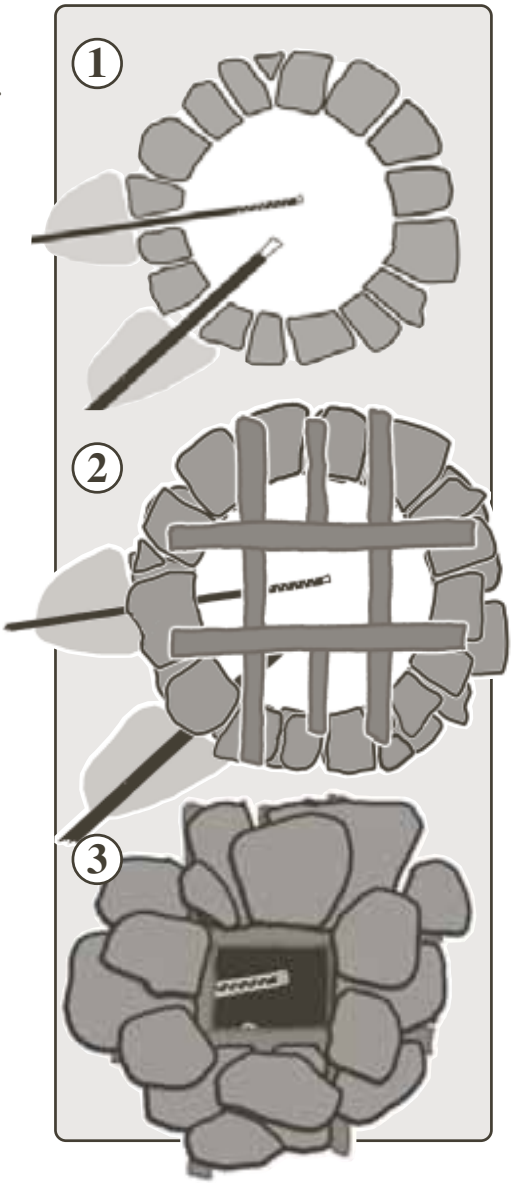
- First of all dig a pit for the tank. Because of not using cement, this needs to be dug into the ground.
- Then build a rock lining to the tank, just as you would build a stone wall. But as well as using mud in between the rocks, use a layer of moss which grows in water.
- As the tank is being built, leave a hole for a drainage pipe at the bottom to empty the tank for cleaning. Just above this level is the hole for the pipe carrying water to the village (delivery pipe). Near the top of the tank, leave a space for the overflow pipe.
- The tank can be made circular or square. The size of the tank depends on the water needs of the village and the size of the water source at the spring.



- When the wall is built up, leave a hole big enough for a person to get into the tank. If the pipes become blocked, it may be needed to clean the tank.

- Make a strong frame to cover and close the tank with timber or rocks.

- When the tank is finished join a gate valve to the pipe taking water to the village (delivery pipe) and to the cleaning pipe at a suitable place outside the tank. This means the water supply can be cut off if the pipeline needs maintenance at any place. Instead of a gate valve, a wooden bung can be used to block the pipe from the inside of the tank



After this work is finished, the area around the tank needs protection. If possible, prevent livestock from walking in the area, and prevent people from cutting trees there. If the area is bare, a tree plantation should be made.

Let's See — How to make Non-Cement Drinking Water

Starting to make the top after the tank has been built.

Leaving a hole big enough for a person to fit in, the lid is made.

Showing the position of a tank in the forest.

An intake tank with a stone lid.

For protection and maintenance, a well fitting wooden door is made.

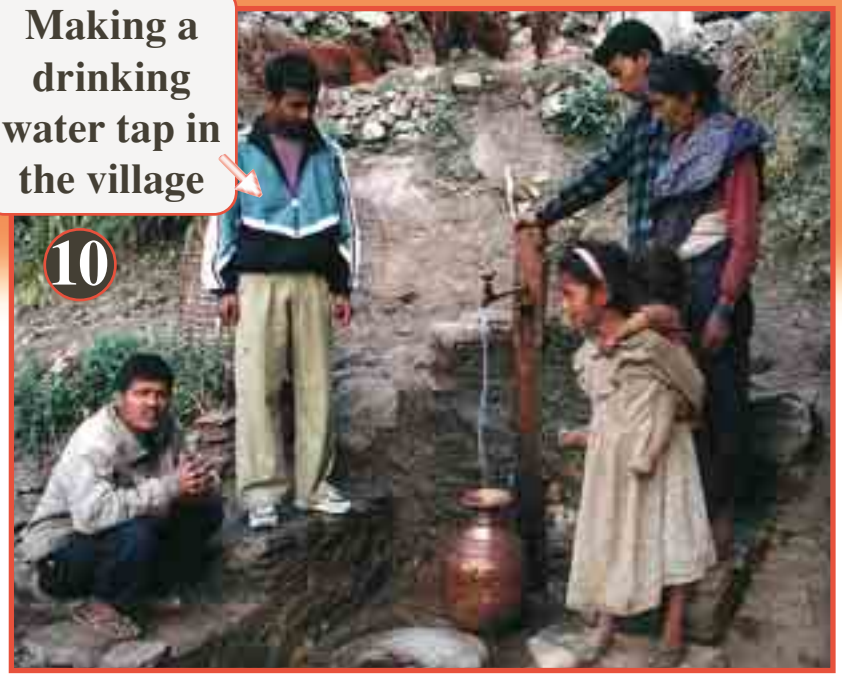
Overflow pipe

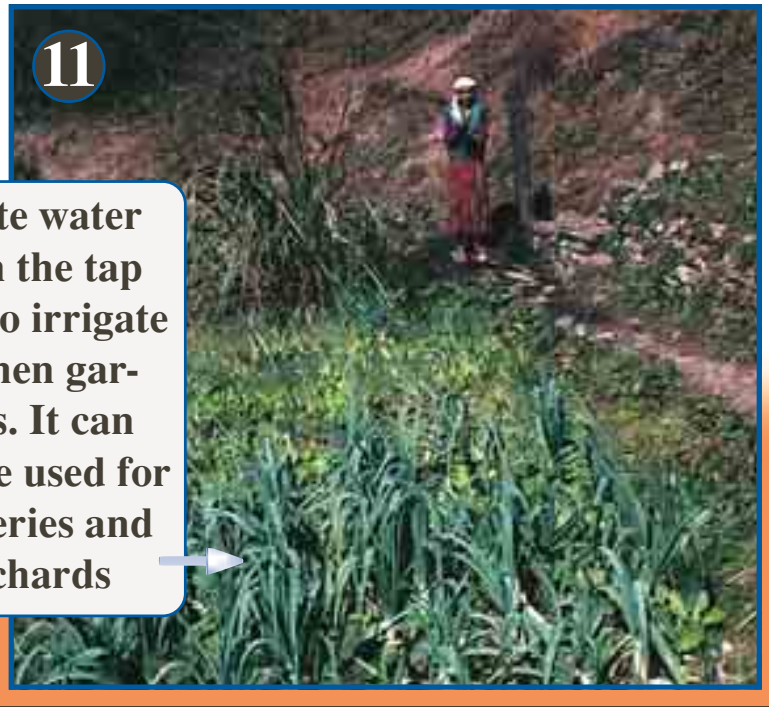
1 intake tank

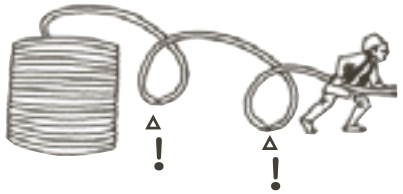
2 overflow pipe

3 cleaning pipe

4 delivery pipe



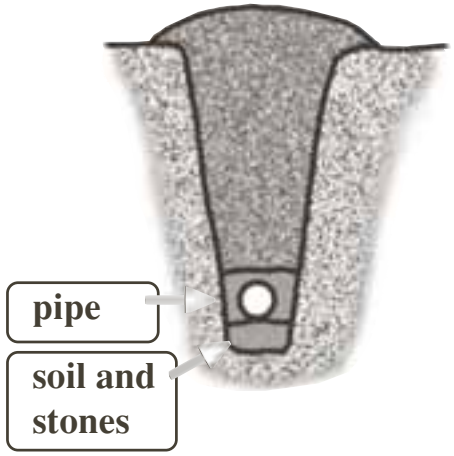




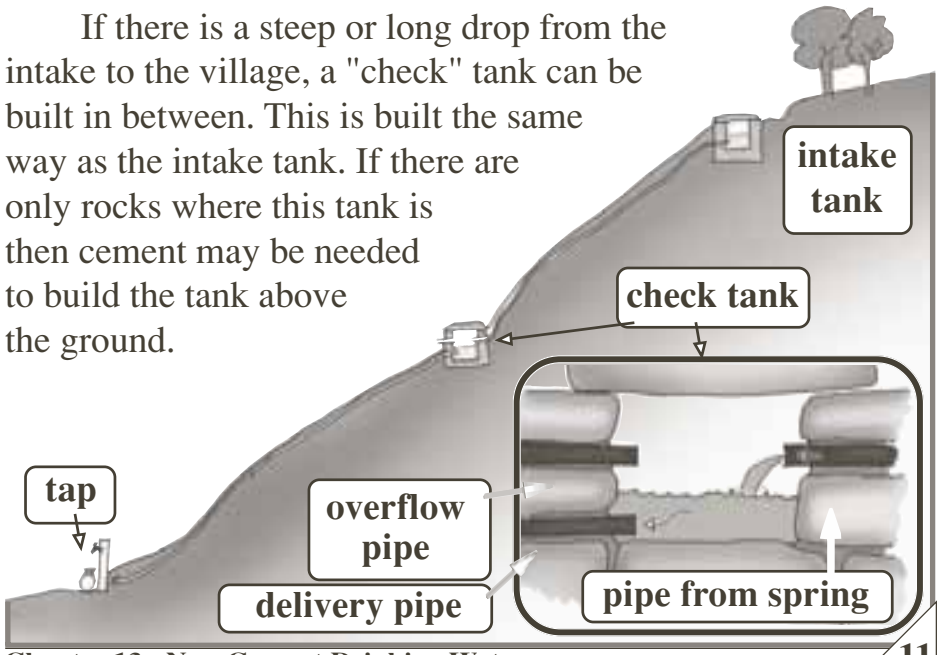
don't uncoil pipe like this, it will develop kinks and may split

uncoil pipe like this

Dig a trench to bury the pipe from the tank to the taps in the village. The pipe should be buried 3 feet deep. In the bottom of the trench first put loose soil and stones. Use G.I. pipe where there are rocks and so a trench cannot be dug.



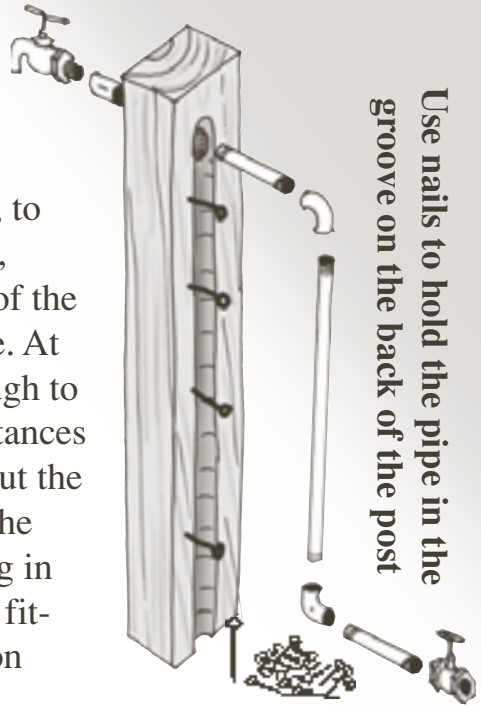
If there is a steep or long drop from the intake to the village, a "check" tank can be built in between. This is built the same way as the intake tank. If there are only rocks where this tank is then cement may be needed to build the tank above the ground.



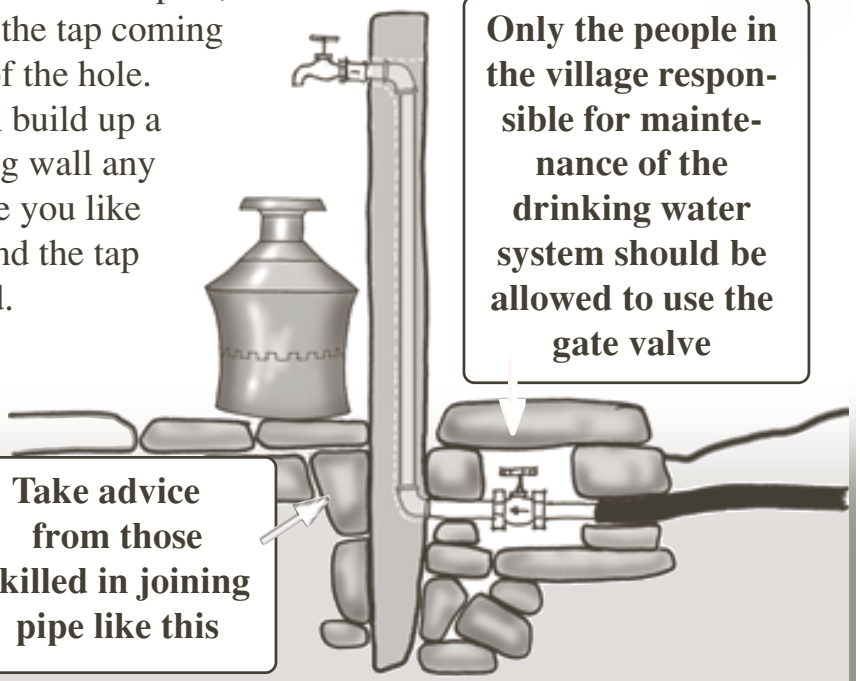
Making the Tapstand

After the site for the tapstand has been prepared, make a smooth wooden post.

On the back of this post, to the height that the tap will be, chisel a groove in the centre of the post in which to hold the pipe. At the top, make a hole big enough to hold the tap. Measure the distances cut in the wooden post, and cut the pipe according to this. Bury the post so it is upright and strong in the ground. Join the pipe and fittings and fit into the groove on the back of the post, with the tap coming out of the hole. Then build up a strong wall any shape you like around the tap stand.



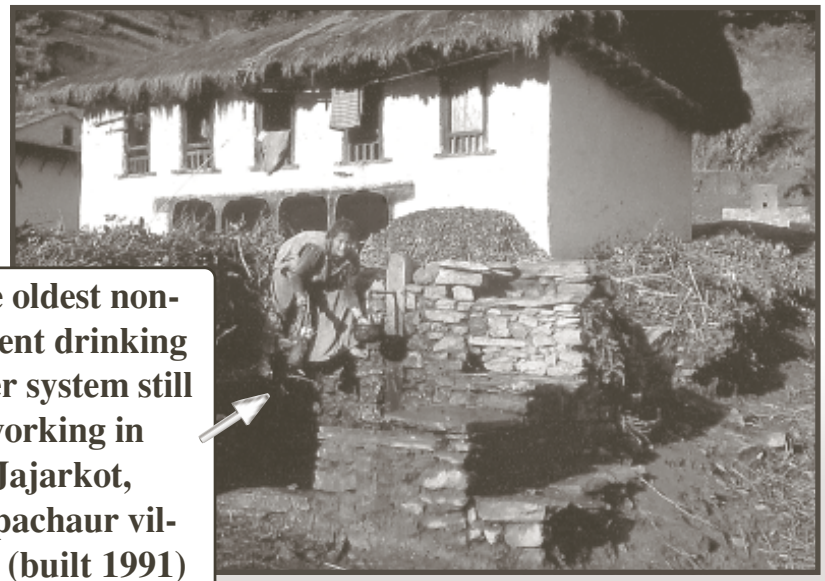
Use nails to hold the pipe in the groove on the back of the post



Only the people in the village responsible for maintenance of the drinking water system should be allowed to use the gate valve

Take advice from those skilled in joining pipe like this

Making a tapstand in the villages



The oldest non-cement drinking water system still working in Jajarkot, Sirpachaur village (built 1991)

Make a design to use the waste water from a tap stand for kitchen gardens or a community nursery

Maintenance

How to maintain Non-Cement Drinking Water

The tanks may leak a little but as the moss grows it will block all the holes. The older the system is, the stronger it gets and the less it leaks. The tanks should be cleaned if leaves or mud get in. Any leaking or split pipes should be repaired and re-sealed immediately.

To help to maintain and run the drinking water system in a sustainable way the village committee should set up a fund according to the number of households. If a community nursery is made, this can generate income from seedlings distributed which can go into the fund. The fund can be used to replace any fittings which may break, such as a tap, gate valve, pipe, etc.

If the forest is protected around and above the spring, the flow of water will increase. This is because the forest catches the rain and allows it to soak into the soil instead of running off the land.

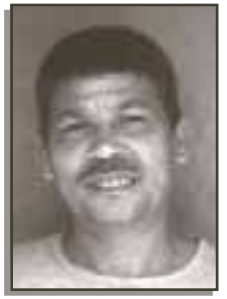
Farmers' Experience

Mr Bir Bahadur Khatri

From Nepal, Surkhet district, Gumi - 9, Ghuyalpani village, Mr Bir Bahadur Khatri is a member of "Shiva Shakti" group. His village has made a non-cement drinking water system. Now let's hear about their experience.

Bir Bahadur Khatri

" Our village is on a high ridge. Though there are water resources it was very difficult to get them to the village. With the help of the Homestead Programme (JPP) we made an intake tank. This uses moss instead of cement. With cement, the tank will crack and water will leak out, but with moss this covers all the cracks. Because the system's made out of local resources we could build it ourselves, and up until now we haven't had to repair it. But if this is needed, we can do it ourselves. There are 5 small springs feeding 7 taps, and they're all working very well. "



JPP's Drinking Water Engineers:- Janga B. Gharti (left) and Ammar B. Nepal (right) have made more than 20 non-cement systems in Nepal's villages since 1991.

Read On !

Subjects Related to Non-Cement Drinking Water

This book provides enough information to be able to build your own drinking water system. However, this information is also linked to other methods. For extra benefits let's read, learn and practice from other related chapters.

Waste Water Chapter

Information in this chapter about how to make use of household and tapstand waste water for irrigation.

House Hygeine Chapter

Don't think that health improvement comes ony from drinking clean water. If the house and kitchen are dirty, even more diseases can spread. Information about easy methods to keep the house clean are given in this chapter

Kitchen Garden and Mixed Vegetable Growing Chapters

How to make and manage a home vegetable garden for permanence, ease and simplicity ? Information on doing less work for more production while also being able to produce a wide range of fresh vegetables is given in these chapters.