

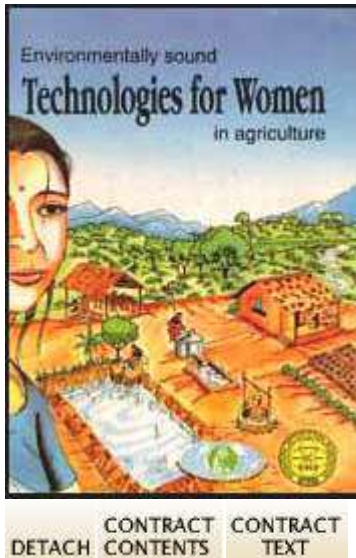
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-  List of resource institutions
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Environmentally sound technologies for women in agriculture (IIRR)

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Farm women, extension workers and scientists who have assisted **in** the development **of** these materials

Preface

Women are critical to the well-being **of** farm households. Aside from raising children, women are expected to prepare all meals, maintain the homestead, and assist **in** crop and animal production, all the while tending to the general health **of** their families. Perhaps, ironically, it is because women have so many responsibilities that they have been over-looked by agriculturalists and policy makers-it has been more convenient to label men as farmers and women as child raisers and cooks. **In** truth, women are involved **in** all aspects **of** agriculture, from crop selection to land preparation, to seed selection, planting, weeding, pest control, harvesting, crop storage, handling, marketing, and processing. Whatever the reason for this neglect, the importance **of** developing farming technologies relevant to women has only recently been recognized.

In 1992, the International Federation for Women **in** Agriculture (IFWA), New Delhi, and the International Institute **of Rural** Reconstruction (IIRR), Silang, Cavite, Philippines, agreed jointly to develop simple, science-based resource materials which could be used by female and male extension workers. The result is a manual **of** 60 simple environmentally sound technologies which will help reduce drudgery and increase efficiency while helping to maintain a clean and healthy environment.

The manual was produced using a modified version **of** an approach developed by IIRR to prepare information and training materials quickly and efficiently. Topics were solicited from author experts all over India. They represent national institutes such as the Indian Agricultural Research Institute, New Delhi; the National Dairy Research Institute, Karnal; the Central Institute **of** Fisheries Education, Bombay; Haryana Agricultural University; Delhi University, and several other agencies. A number **of** manuscripts were also contributed by respected NGOs. Still others were gleaned from published works. The raw manuscripts were presented, critiqued, and revised **in** a sixday editorial and illustration workshop **in** New Delhi **in** June 1995. The revised manuscripts were taken to IIRR's headquarters **in** the Philippines where they were edited, laid out, and scrutinized again by IPWA and IIRR specialists. The camera-ready product was then sent to India for printing.

The topics have been edited and laid out with care to make them interesting and easy to understand. Illustrations have been used wherever possible to explain technologies. While it was written for extension agents, it is hoped that even neo-literates will be able to make good **use of** this manual.

A complete list **of** participants, contributors, and contributing agencies is given at the back **of** this manual.

Animal husbandry and dairying

Selection and breeding of cattle buffaloes

Animal management **in rural** areas is generally the job **of** farm women. Their opinion, therefore is important when selecting and breeding livestock. When you select an animal for purchase, consider the following points.

General health

The animal is **in** good health if:

- it is taking its feed and water well with normal rumination.
- it passes normal dune and urine.
- its eyes are bright, it appears alert, and its muzzle is moist.
- its skin is smooth, its coat glistens, and the animal twitches its skin and swings its tail around to drive off flies..
- the animal walks normally with no signs **of** lameness.

Age

Count the animal's teeth to determine its age.

Teeth	Approximate age
8 milk teeth	birth to 2 years
1st pair of permanent teeth	2-3 years
2nd pair of permanent teeth	3-4 years
3rd pair of permanent teeth	4-5 years
4th pair of permanent teeth	5 or more years

Testing

If you are considering purchasing a milch cow, milk the animal two consecutive times **in** order to determine its daily milk production.

Milch animals

For milch animals, look for the following:

- Udder should be large and well developed with a prominent milk vein leading from the udder to the abdomen.
- Four teats, well separated, without cracks or blockages.
- Normal milk flow from all four teats.
- Hind legs should be parallel and spaced well apart, allowing enough room for the udder.
- Angular body, high and wide **in** the back and sloping slightly downward to the neck.
- Deep chest, well supported.

Reproduction

Here are some questions which will help you choose a good animal.

- How many times has it calved? Preferably, buy an animal which has calved once or twice. Buy freshly calved animals.
- Is it pregnant? If the animal is pregnant, try to determine the stage **of** its pregnancy.
- What was the time gap between previous calvings? Avoid animals which have aborted.
- How often does it come into heat? Cows (cattle and buffaloes) should come into estrus 45-60 days after calving. A cow should come into heat regularly, every 3 weeks, until conception.

When to breed

If you notice signs **of** estrus **in** the morning, mate the animal (or have it artificially inseminated) **in** the afternoon. If signs **of** estrus are noticed **in** the evening, mate the animal early the next morning, 10-12 hours after the onset **of** estrus.

Have a veterinarian examine your animal 2-3 months after breeding to make certain that the animal is pregnant.

Signs **of** estrus

- Bellowing Animal becomes restless
- Animal's vagina becomes swollen and discharges mucus Animal mounts other animals
- Animal stands still when mounted
- Frequent urination

Selection and breeding of goats and sheep

When selecting a goat or sheep for purchase, consider the following points:

General health

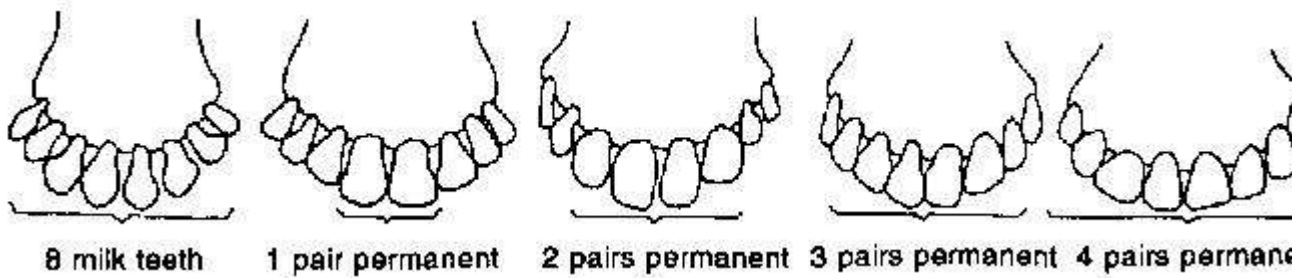
The animal should:

- take its feed and water regularly and display normal rumination.
- have normal skin and coat, bright eyes, alert ears, and moist muzzle.
- pass well-formed, normal dung, and normal urine.

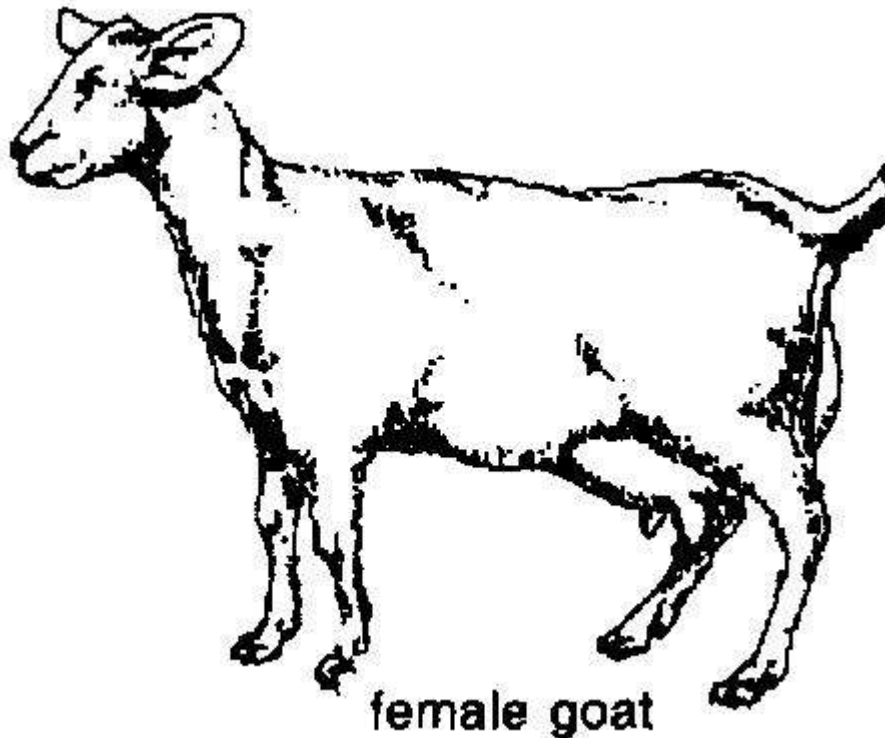
Age

Always select young animals. Count their teeth to estimate their age.

Number <u>of</u> teeth	Sheep	Goats
8 milk teeth	birth to 1 year	birth to 1 year
1st pair permanent teeth	1 year to 1 year and 9 months	1 year and 2 months to 3 years
2nd pair permanent teeth	1 year and 9 months to 2 years and 6 months	3 to 4 years
3rd pair permanent teeth	2 years and 6 months to 3 years	4 to 5 years
4th pair permanent teeth	3 years and above	5 years and above



Teeth structure



Female goat

For milch goats For milking goats, look for:

- a well-developed udder with two teats, without defects or disease.
- an angular body, sloping slightly downward from the hind section to the neck.
- hind legs well-apart, allowing ample space for the udder.

Reproduction

Some goats and sheep give birth twice a year, some once a year, and others three times **in** 2 years. Animals which give birth three times **in** 2 years are preferred. Choose animals which:

- have high twinning rates (produce twins).
- produce a lot **of** milk, for quick growth **of** offspring.

Offspring

Sell kids and lambs at between 3 and 6 months **of** age. Keep the best animals for replacement stock.

Breeding

Mate your animal 14-20 hours after the onset **of** estrus. Your breeding ram (male sheep) or buck (male goat) should be strong and healthy with a muscular physique, typical **of** its breed. Look for good loins, strong quarters, and well-developed testes. One male can serve 30-50 females.

Heat detection

A ewe **in** estrus will:

- bleat (cry loudly).
- wag its tail frequently.
- stand still when mounted.
- try to join the ram.

Selection and breeding **of** swine

Consider the following points when purchasing a pig:

- Look for sows (female) and boars (male) which are good examples **of** their breed. **In** particular, check their length and width.
- Make sure the animal has a good appetite for feed and water.
- The animal should be active, have bright eyes, and alert ears.
- Select a sow with 10-14 well-spaced, functional teats.
- Select sows which farrow (give birth) twice a year, with litters **of** 8-10 healthy piglets.
- Select sows with a breeding history **of** producing healthy litters **of** fast-growing piglets. Ask how many **of** the sow's piglets **in** a litter have died.

Breeding

Normally, a sow will exhibit the following signs **of** estrus 12 months after farrowing.

- Sow is mounted by young boars (but she will move away if not **in** full heat).
- Sow **in** full heat will mount other sows.
- Sow becomes restless.
- Sow's vagina becomes swollen and discharges sticky mucus.
- Sow stands still when mounted by other animals.

Mate your sow with a healthy boar 12-30 hours after the onset **of** estrus. Breed again every 12 hours for 1 1/2 - 2 1/2 days.

Community pasture management

Inadequate feed is a major constraint to livestock productivity. Little scope remains for putting more good lands into fodder production. One solution lies **in** improving the sustainable production levels **of** community pasture lands through better management. Women are often responsible for collecting fodder and raising livestock, especially dairy cattle. Improving pastureland can reduce the amount **of** time women spend collecting fodder and feeding livestock.

Management practices

It is possible to increase the productivity **of** community pastures through one or a combination **of** the following practices.

Rehabilitation and management

Rehabilitate pasture land with improved grass varieties and legumes for higher yield, higher nutritive value, and palatability. Grasses can be transplanted or grown from seed. Legume seeds are sown between grass lures. Multipurpose trees can also be planted to provide fodder, fuel, and timber. (See the glossary for a list **of** improved grasses and legumes.)

Protect pasture from overgrazing. Consider erecting a stone wall, making a trench and mound barrier, or planting a live hedge.

Adopt proper soil and water conservation measures to improve site quality. Field lands can be ploughed and developed across the slope to retain water and prevent soil from being washed away.

Surplus fodder during monsoon can be conserved **in** the form **of** hay or silage for **use** during lean periods. (See *Make hay to preserve fodder* and *Make silage to preserve green fodder*.)

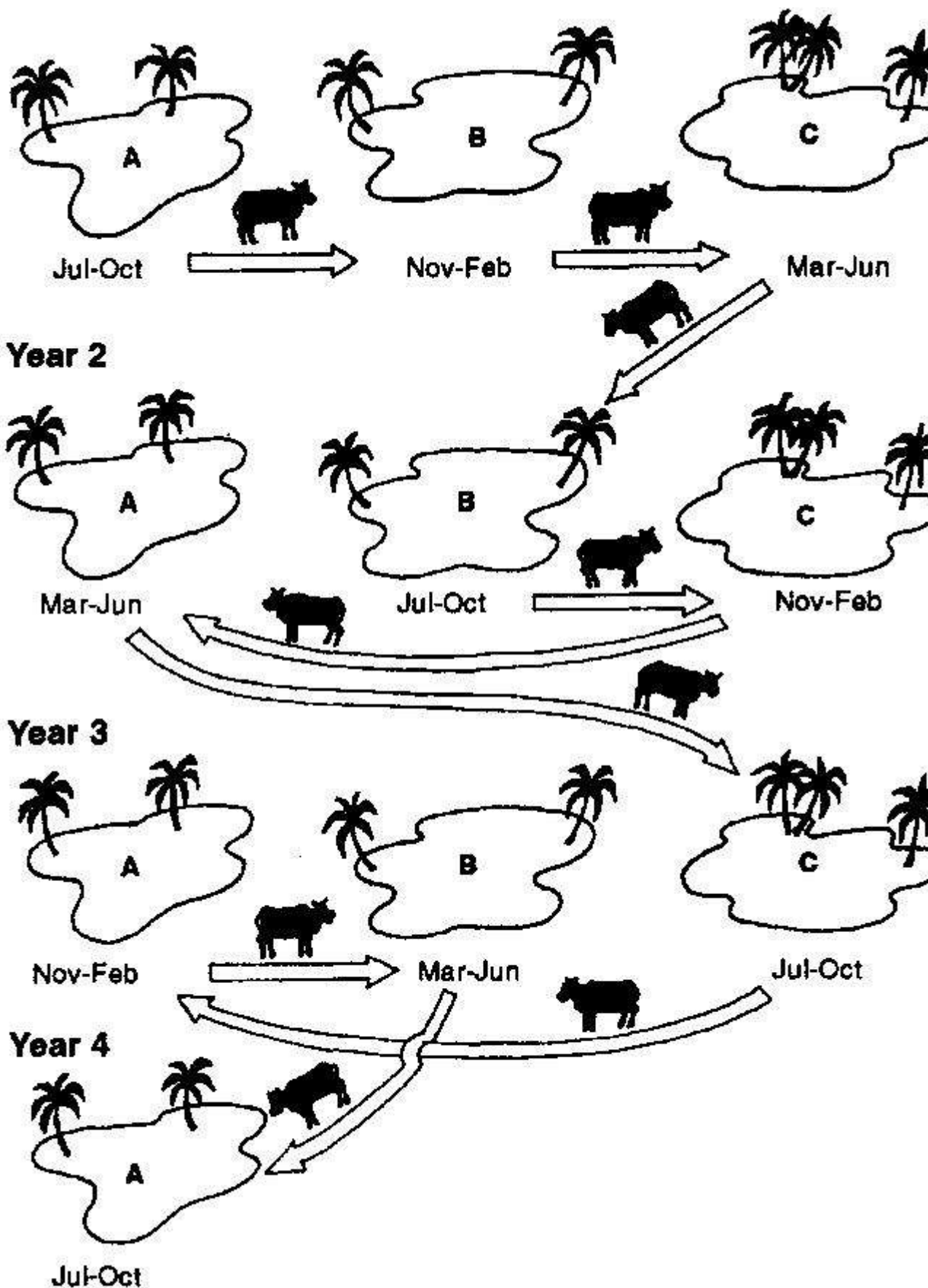
Encourage stall feeding—feed livestock **in** their sheds without letting them out for grazing.

Management **of** grazing land

Regulated grazing is useful **in** locations where the regeneration capacity **of** perennial grasses is fast and prolific.

- Fencing. **Use** live hedges, stone walls, bamboo poles, and wire fencing to help regulate the movement **of** livestock.
- Bush cleaning. Remove thorny and unwanted bushes to improve forage production.
- Burning. Burn during the summer to destroy weed seeds and dried and cut bushes. Burning also promotes growth **of** grasses.
- Herbicides. Particularly heavy weed growth can be controlled with herbicides during early monsoon. Follow safety and application instructions carefully. Herbicides can be dangerous to humans and livestock.
- Fertilizer. Application **of** 40-80 kg urea per ha (20-40 kg nitrogen/ha) during the monsoon can increase forage yield by 30 to 70 percent.
- Grazing. Do not graze a pasture **in** the first year after fencing **in** order to allow perennial grasses to regenerate and produce seeds. Resume grazing **in** the second or third year, depending on the amount

of regrowth. To prevent overgrazing, graze just one or two head of cattle (or 6-10 sheep or goats) per hectare. Or practice deferred rotational grazing: shift your animals from place to place, allowing each grazing site enough time to regenerate before returning.



Deferred rotational grazing

Deferred rotational grazing

This grazing pattern uses three areas **of** pasture (A, B, and C **in** the diagram).

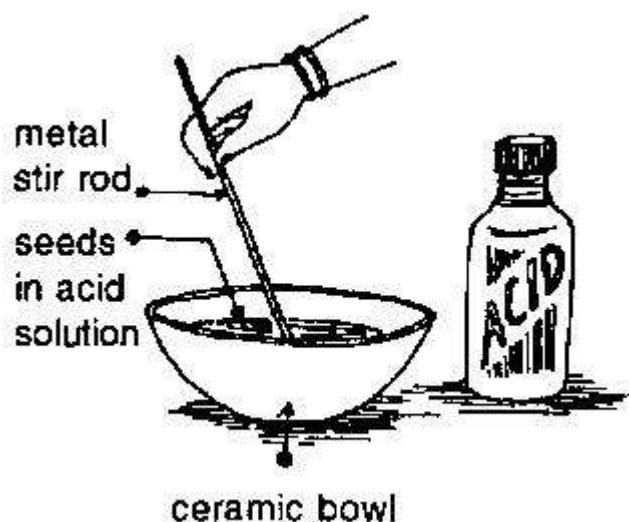
From July to October **in** the first year, graze the animals **in** pasture A. At the beginning **of** November, move them to pasture B, and graze them there until the end **of** February. From March to June, graze them **in** pasture C.

In July **of** the second year, instead **of** moving them to pasture A, put them back into pasture B. **In** November, move the animals to pasture C, and **in** March, return them to pasture A.

This deferred rotational grazing system allows each **of** the pastures to recover for more than a year.

Establishing improved varieties

Highly deteriorated pastures must be re-established. This involves ploughing and land-levelling, followed by sowing **of** improved varieties **of** grasses and legumes. Such pastures will give high forage yields for 5-6 years.



Soak legume seeds **in** 20-30 percent sulphuric acid for 4-5 minutes. Be careful not to splash acid on your hands or clothes.

Improving germination. Legume seeds have hard seed coats. To improve germination, put seeds **in** boiling water for 60-90 seconds or soak them **in** acid (20-30 percent sulphuric acid) for 4-5 minutes.

Seed treatment. Legumes are able to take nitrogen out **of** the air. This is done **in** nodules on legume roots. To increase the growth **of** these nitrogen-fixing nodules, after soaking and just prior to planting, mix legume seeds with rhizobium culture powder.

To help grass seeds grow, make pellets out **of** a mixture **of** 3 handfuls **of** clay, 1 handful **of** seeds, 1 handful **of** sand, and 1 handful **of** farmyard manure.

Sowing. Seeds can be broadcast or sown **in** lines. For best results, sow alternate lines **of** grasses and legumes. Or, try planting alternate strips, each 1-2 m wide, **of** grasses and legumes.

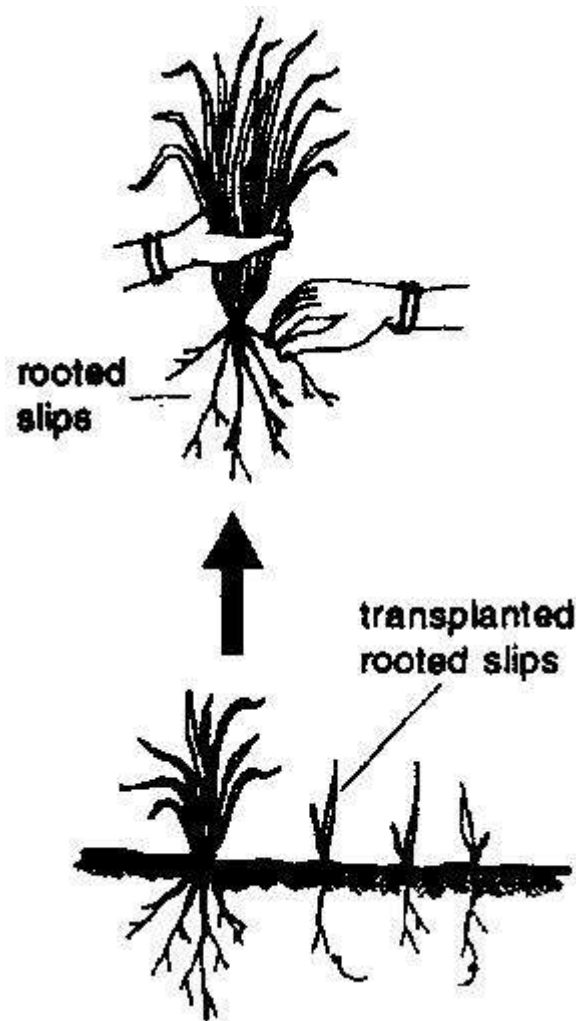
Fertilizer application. 50-60 kg nitrogen/ha and 20-30 kg phosphorus/ha can be applied to the pasture

during monsoon. Applying fertilizer increases forage yield **of** mixed pastures by 50-100 percent. The protein content **of** the forage is also increased.

Management **of** cutting. During the year **of** establishment, just one harvest is advised. **In** subsequent years, forage can be harvested every 50 or 60 days. Cut the forage 10-15 cm above ground level.

Conservation **of** surplus fodder. Surplus fodder can be conserved as hay or silage. Hay is made by drying harvested fodder under the sun. Silage is made by allowing harvested and chaffed material to ferment under anaerobic conditions (without oxygen) **in** pits.

Grazing. Graze animals according to a schedule which regulates the number **of** animals and where they graze. This is done to prevent overgrazing and to make good **use of** pasture growth.



Establishing pasture by rooted slips

Establishing pasture by rooted slips

Some grasses do not produce seeds. For these, rooted slips must be used (sprouts which grow from roots **of** some grasses during the monsoon). Transplantation **of** nursery-raised grass seedlings can also be very effective **in** establishing pasture.

Contributor Dr. Punjab Singh

Cattle feeding

Questions most often asked by farm women about feeding cattle

- What proportion **of** straw, green fodder, and concentrates should I feed my cattle?
- What can be done when green fodder is not available **in** the fields?
- Can green fodder be preserved for **use in** the lean months?
- Is there a way to make straw more nutritious?
- Are there less expensive substitutes for concentrates?

In the following pages, you will find answers to these important questions.

Generally, cattle are fed with dry straw mixed with some green fodder. Milch animals and draught bullocks need more nutrition; therefore, give them an additional ration **of** concentrates.

Green fodder

Green fodder is not only nutritious but also palatable and easily digestible. It is available **in** the form **of** green forages, such as berseem, lucerne, oats, maize, sorghum, pearl millet, cluster bean, cowpeas, grasses, and lappings **of** trees. Leguminous fodder crops, like berseem, lucerne, cowpea, and cluster bean, are more nutritious than non-legumes, such as oats, maize, and sorghum. Therefore, for better feed, mix legume fodder with nonlegume fodders. Do not feed animals only with legumes as this can cause bloat.

Cattle should be given about 30-35 kg **of** mixed green fodder daily. This should be chopped to avoid wastage.

Dry fodder

Dry fodder is available **in** the form **of** straw and stover. Though less nutritious, these are needed to meet the bulk or dry-matter requirement **of** cattle. Mix green fodder together with the dry fodder. Feed 3-4 kg **of** dry chaffed fodder daily. (See Improve dry fodder by adding urea.)

Concentrates

Oil cakes, rice and wheat bran, cereal grains, seeds, molasses, etc., make good concentrate mixtures. Concentrate is economically prepared by mixing cakes, wheat or rice bran, and grains or pulses **in** equal proportion. There is not much advantage **in** adding expensive items, like cotton seeds, to the mixture.

Concentrates containing proteins and minerals are the most nutritious part **of** cattle feeds. Concentrates are especially important for growing calves, first carvers, pregnant and milch animals, and working bullocks.

On average, 1 kg **of** concentrate mixture is given daily to first carvers, especially cross-bred cattle. Pregnant cows should be provided with 1 to 1.5 kg **of** concentrate mixture every day during the last 60 days **of** pregnancy.

Important tips

- Chaff the green and dry fodder to avoid wastage.

- Treat dry fodder with urea to increase its nutritive value. This will help reduce the quantity **of** concentrate required **in** the feed. (See improve dry fodder by adding urea.)
- When green fodder is scarce, supplement the diet with an increased quantity **of** concentrate mixture.
- You can reduce expenditure on concentrate mixtures by supplementing with ureamolasses liquid mixture. See Ureamolasses liquid mixture.)
- Mineral mixture and common salt should be fed at the rate **of** approximately 30 g per animal per day, if not otherwise supplemented **in** the feed.
- Store concentrates under dry conditions. High moisture content encourages mould growth.
- Reject all feed which has developed mould or fungus. This could lead to poisoning.
- Make sufficient clean drinking water available to your cattle. Contaminated water will result **in** diarrhoea and other disorders.

Mineral mixture

Mineral mixture contains major and trace minerals. Feed 30-35 g **of** good mineral mixture to milch cattle, 20-25 g to heifers and dry animals per day.

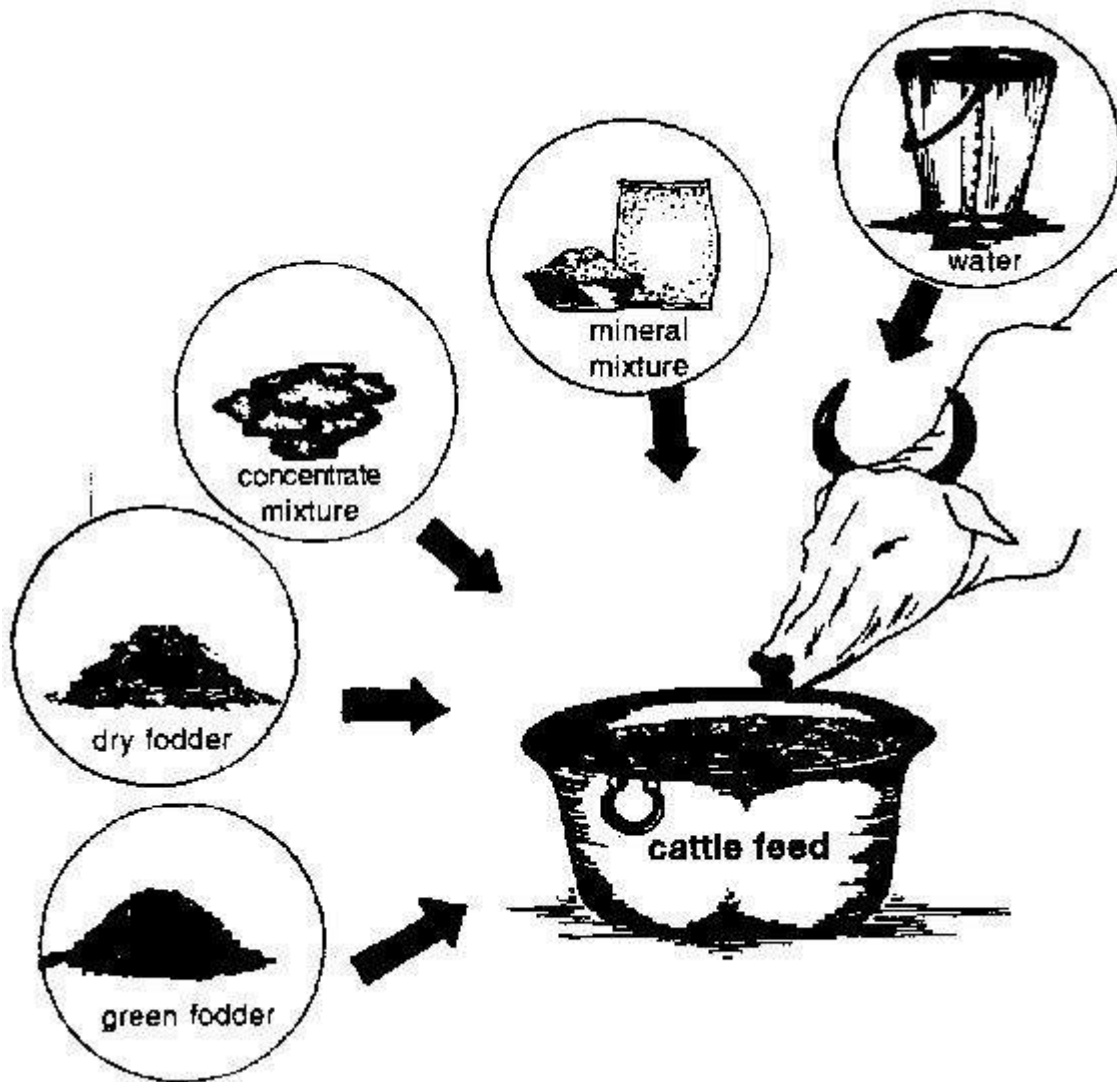
Common salt can be provided **in** the concentrate mixture at the rate **of** 20-25 g per day, or separately **in** the form **of** a rock-salt lick

Water

Cattle need 30-40 litres **of** water daily. Clean water should be available to your cattle at all times. If this is not possible, offer water to your cattle at least three times a day. Allow them to drink as much as they want

Balanced feed Requirements for green fodder, dry fodder, concentrates, and minerals depend on:

- Size and age **of** the animal
- Growth stage and pregnancy status
- Climatic conditions
- Milk yield
- Nature and amount **of** work



Cattle feed

Balanced feed for cattle Cattle feed generally consists **of** the following:

- Green fodder
- Dry fodder
- Concentrate mixture
- Mineral mixture
- Water

A good feed is palatable, nutritious, balanced, easily digestible, non-toxic, and economical.

A balanced feed is one which provides different components **of** feed **in** proper proportion to meet the needs **of** each animal- calves, milch cattle, dry-cattle, draught cattle, etc. More feed might be required **in** extreme hot or cold weather. As such, a balanced feed is different for different animals under different conditions.

Economical feeding

Cattle feed should also be economical. Feeding green fodder is more economical than providing concentrate mixture. You can reduce expenditure on feed by substituting green fodder for concentrate mixture.

A cow yielding up to 8 litres **of** milk need not be given concentrate mixture if it is fed 40-45 kg **of** mixed green fodder (such as oats + berseem, cluster bean + sorghum, or cowpeas + maize), 3-4 kg **of** dry fodder, and mineral mixture each day.

Higher yielding animals will require additional concentrate, perhaps 1 kg **of** concentrate mixture a day for each additional 3 litres **of** cow milk or 2.5 litres **of** buffalo milk.

Feeding during lean months

Provide good quality dry fodder during lean months when green fodder is not available. The amount **of** concentrate fed should also be increased to make up for the lack **of** green fodder. As such, 9 kg **of** wheat straw mixed with 4 kg **of** concentrate mixture can be given to a cow yielding 10 litres **of** milk during the lean months. (See Make silage to preserve green fodder and Make hay to preserve fodder.)

Do not forget to add mineral mixture and common salt to the feed **in** all seasons.

Contributors: Dr. Ram Chand, Ms. Parvinder Sharma, and Dr. Jagdish Singh

Make hay to preserve fodder

Handle with care

Be gentle when raking ~ moving dry fodder. Rough handling will shake off nutrition legume leaves.

Green fodder is especially scarce during the summer and early winter. Try preserving surplus green fodder as hay for these times **of** scarcity.

What is hay?

Hay is any forage crop cut before it is mature and dried for storage. It is more nutritious and palatable than straw because hay preserves the entire plant.

Crops suitable for hay

All fodder crops (including most grass species) can be used to make hay, but clovers and oats are especially suited.

How to make hay

Harvest berseem and lucerne just before flowering. They are most nutritious at this stage. Cereal fodder crops, such as oats and sorghum, should be harvested at flowering stage. Young sorghum plants before flowering stage can be poisonous to livestock.

- **Use** the last few cuttings **of** berseem, lucerne, and oats. (The first cuttings are best fed as fresh fodder.)

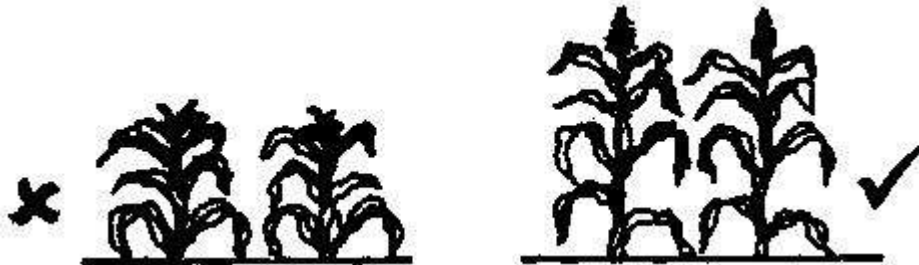
- Leave the material **in** the field to dry **in** the sun. Rake it frequently for uniform drying. **In** case the field is to be used immediately, move the material to a suitable place to dry. Try drying it on a fence.

- Overdrying will result **in** loss **of** nutrients, such as Vitamin A. On the other hand, underdrying will

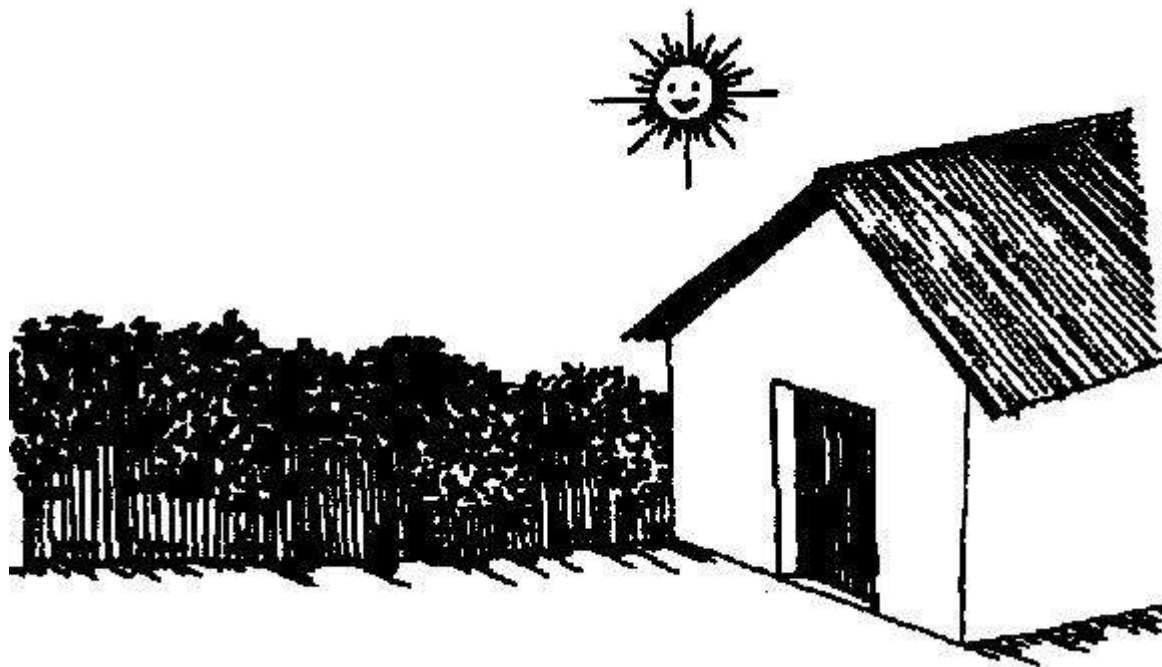
result **in** growth **of** fungus during storage. Ideally, the moisture content should be reduced to 15 percent. To tell if fodder is dry enough to make hay, rub the material between your hands. The material should not feel wet. Hay should retain its green color.

- After drying, the material should be collected and stored under shade **in** dry conditions.

Contributor: Dr. Jagadish Singh



Young sorghum plants can be poisonous to livestock.



Hay drying on a fence.

Make silage to preserve green fodder

One method at preserving green fodder is to turn it into silage.

What is silage?

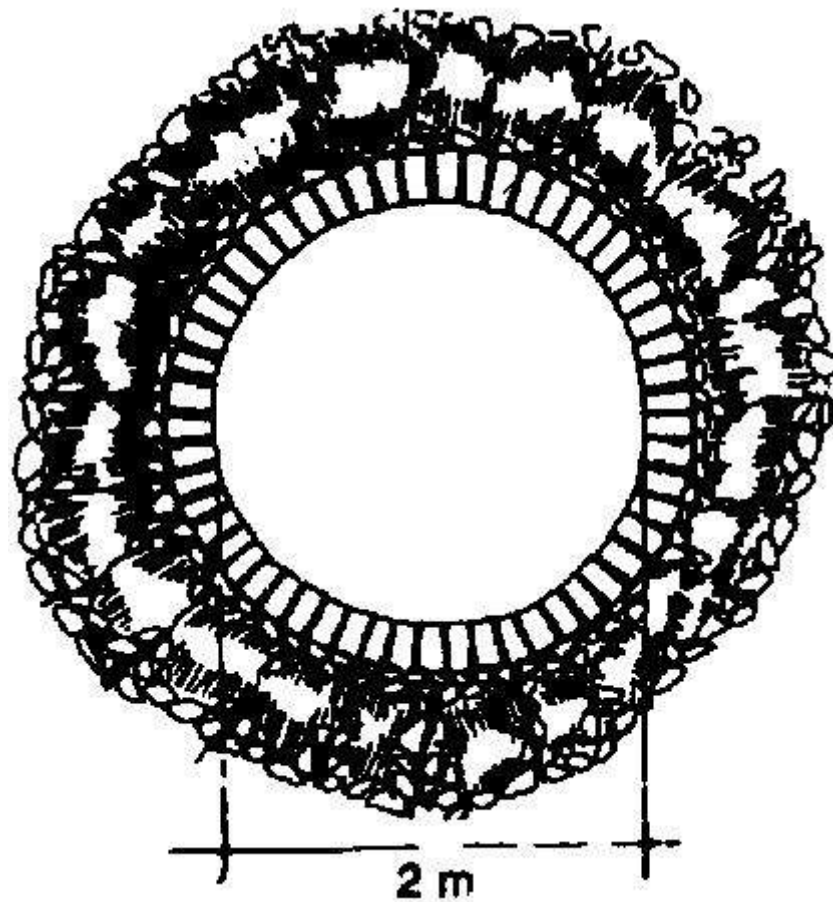
Silage is preserved green fodder that contains moisture. It is made **in** an airtight structure called a silo. Well-made silage is greenish yellow **in** colour, and has a pleasant vinegar-sweet smell.

Crops suitable for silage

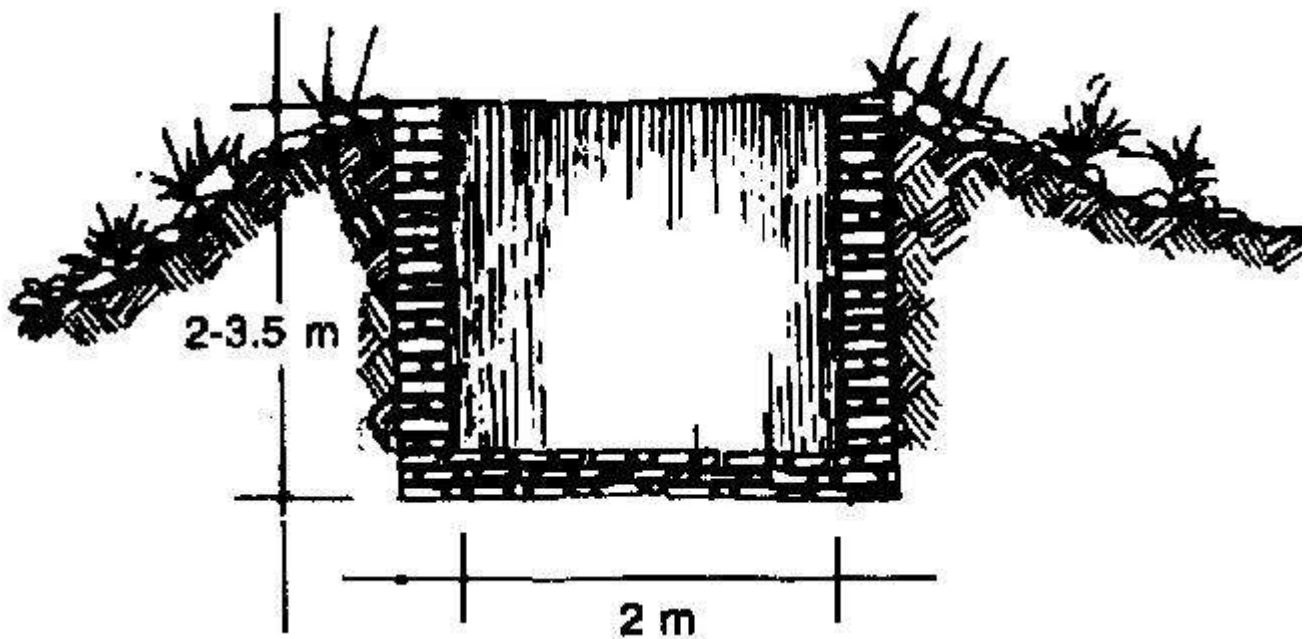
Cereal fodder crops, such as oats, maize, and sorghum, are most suitable for making silage because their high carbohydrate content results **in** good fermentation.

Method of preparing silage

- Construct a concrete or brick silo above the ground, or a pit silo. The latter is more economical and easy to handle for a small farm family.

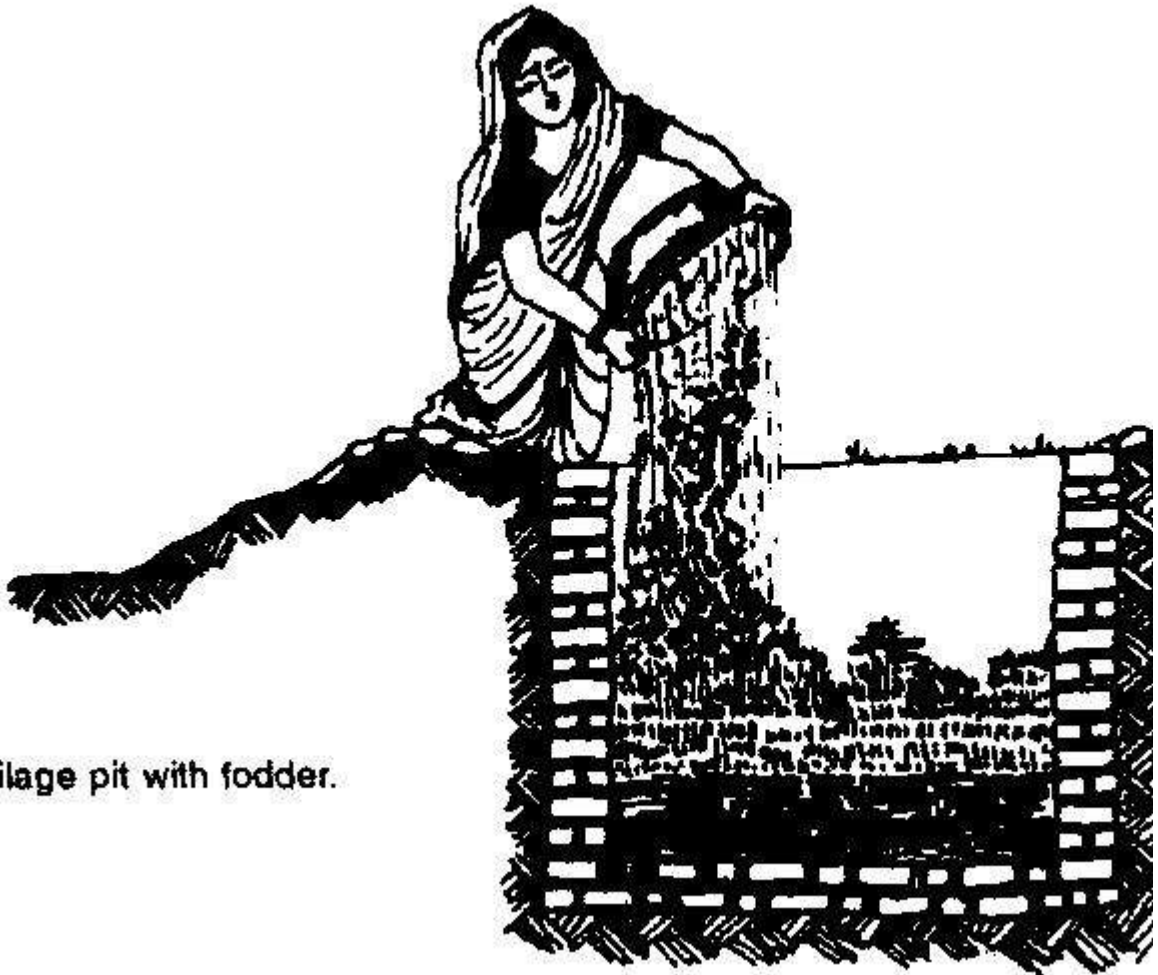


Silage pit-view from above



Silage pit cross-section view

- Select a piece **of** land at a higher level to prevent stagnation **of** rainwater.
- Construct a circular concrete or brick pit-silo about 3.5 m deep and 1.5 to 2 m **in** diameter. This pit is sufficient to provide: silage to feed four animals for three months at the rate **of** 20 kg per animal per day. Instead **of** a pit, a rectangular trench silo can be built. The trench should slope to 2 m depth at its deepest end. The rest **of** the structure is same as the cylindrical silo. See illustration on the next page.



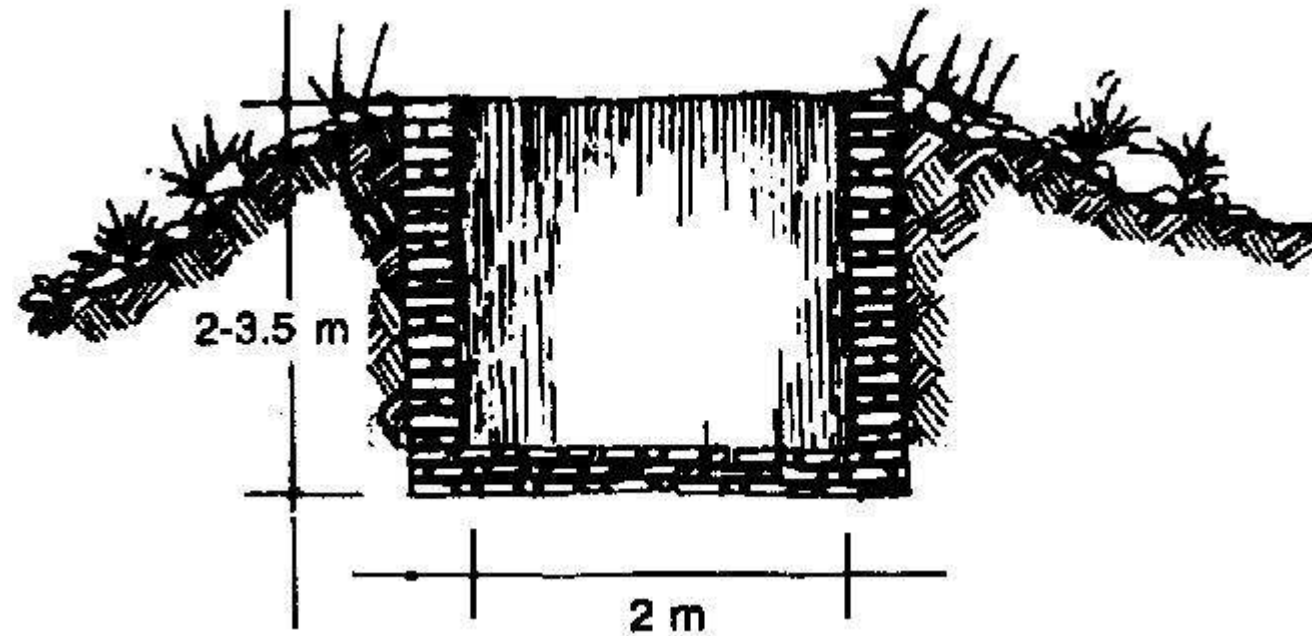
Filling silage pit with fodder.

Cross-section view

- Harvest cereal fodder crops, such as sorghum, maize, and oats, at the flowering to milk stage.
- Legumes should be harvested just at flowering stage.
- Chaff the green fodder.
- Spread the chaffed material evenly **in** layers **in** the silo and pack thoroughly to remove all air.



Silage pit-view from above



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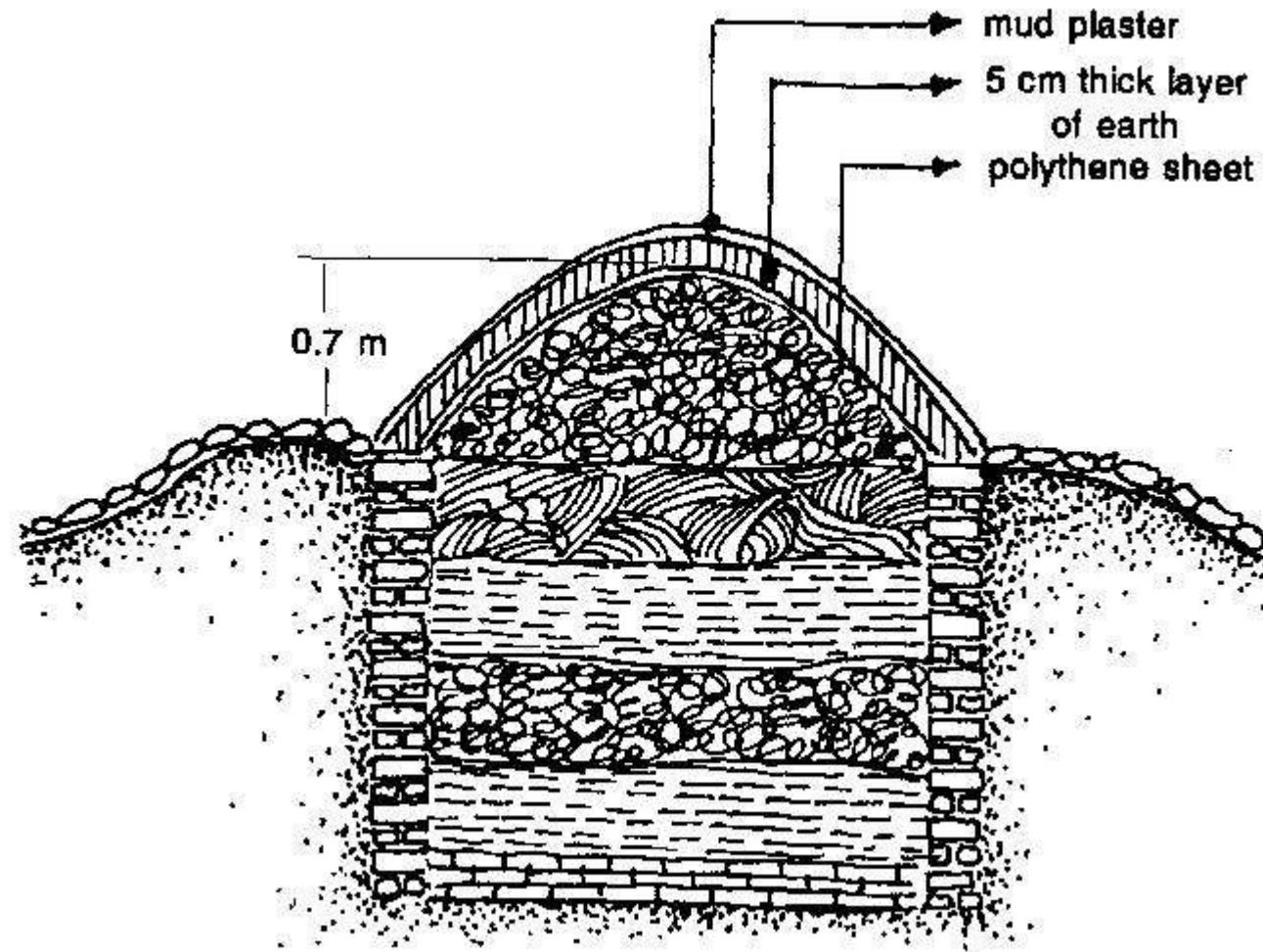
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- Spread the chaffed material evenly in layers in the silo and pack thoroughly to remove all air.



Cross-section view

- In the case of legume-only fodders, mix straw with the green fodder to reduce the moisture content.
- Fill the chaffed fodder 0.7 to 1 m above the soil surface.
- Cover the silo pit with polythene sheet. Spread a 5 cm layer of earth over it, and finally, plaster it with mud to make the structure airtight.



Packing rectangular trench silo - side view



Packing rectangular trench silo.

Silage is ready for feeding after 30-45 days.

Silage is nutritious and palatable. About 25 kg of silage is equivalent to 3 5 kg of green fodder. It can be used as cattle feed during the dry lean months.

Contributor: Dr. Jagdish Singh

Improve dry fodder by adding urea

When green fodder is unavailable, farm women are forced to feed their cattle poor-quality dry fodder, such as wheat and paddy straw, local grasses, and dry stalks of maize, sorghum pearl millet, and sugarcane tops.

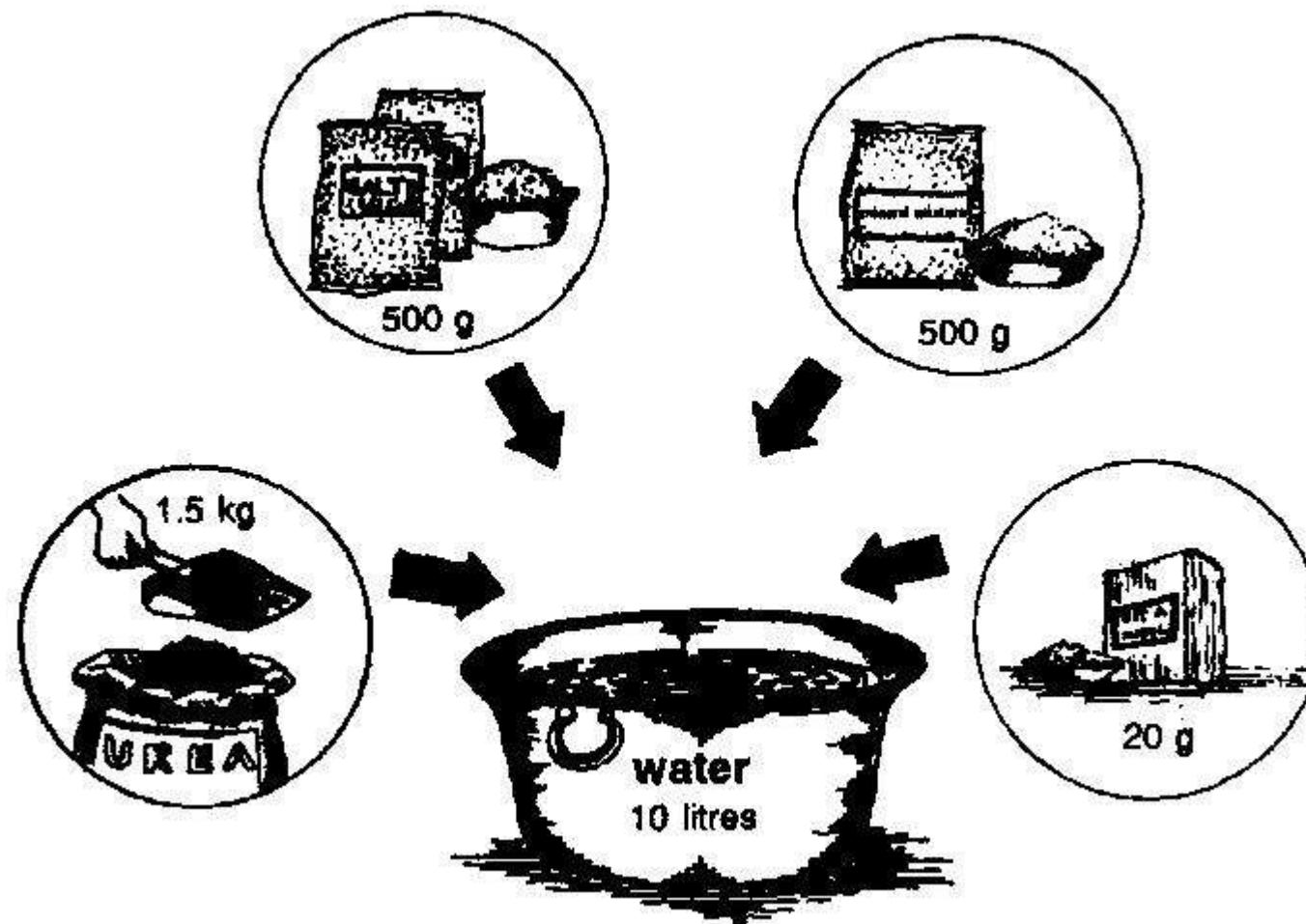
Increasing the cattle's concentrate ration to make up for this shortfall is costly. There is a low-cost alternative. You can improve the quality of dry fodder by treating it with urea, a common fertilizer. Urea treatment is easy.

Materials required (for every 100 kg of dry fodder)

Urea	1.5 kg
Common salt	500.0 g
Mineral mixture	500.0 g
Vitablend	20.0 g
Water	10.0 litres

Method of treatment

Dissolve urea, common salt, mineral mixture, and Vitablend thoroughly in water by stirring it with a wooden stirrer.



Method of treatment

Spread the dry fodder evenly under the sun in a 5 m x 10 m area.

Spray half the quantity of urea solution on the dry fodder, using a sprayer or garden watering can.

After about 30 minutes, turn the dry fodder upside down, and apply the remaining quantity of urea solution. The treated fodder can be fed immediately after it dries. If stored in a sealed plastic container, the material will ferment. Fermented fodder is more palatable. Use within 2-3 weeks.

Contributor: Dr. Jagdish Singh

Urea-molasses liquid mixture

Nutritious concentrates account for a large part of feed costs for ruminants. Depending on the cost of molasses, this expenditure can be reduced by replacing concentrates with a nutritive ureamolasses liquid mixture.

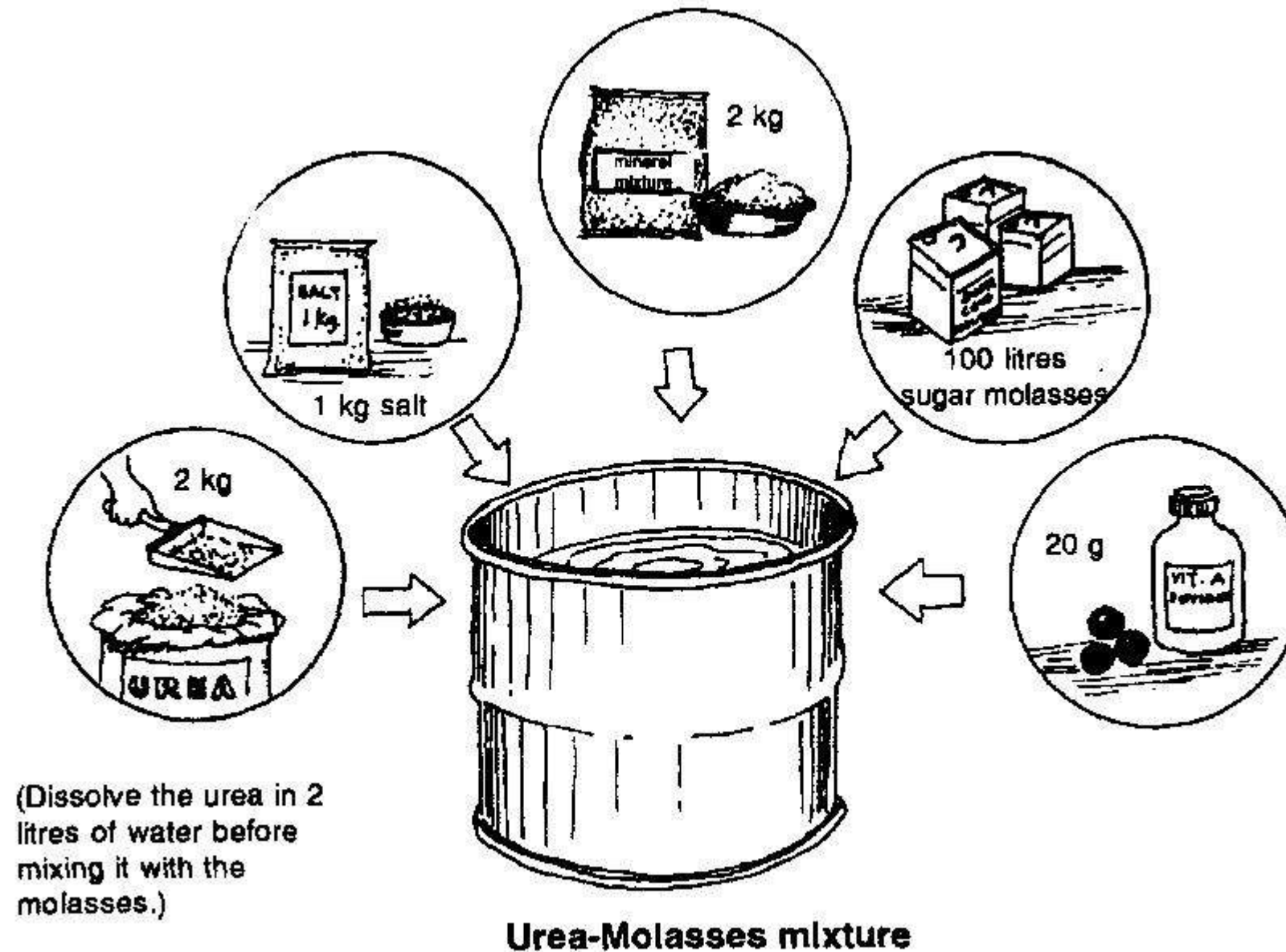
Materials

Urea		2 kg
Sugarcane	molasses	100 litres
Water		2 litres
Mineral mixture		2 kg
Common salt		1 kg
Vitamin A supplement		20 g

(if green fodder is not available)

Method of preparation

- 1 Take 2 litres of drinking water in a pot.
- 2 Dissolve 2 kg of urea thoroughly in the water by stirring it with a wooden stirrer.
- 3 Put 100 litres of sugarcane molasses in a trough of galvanized iron sheet or some other metal.
- 4 Mix the urea solution slowly in the molasses, stirring it continuously.
- 5 Make a mixture of 2 kg of powdered mineral mixture and 1 kg of powdered common salt.
- 6 Mix the mineral mixture and salt in the urea-molasses mixture.
- 7 Mix in 20 g of vitamin A supplement. 8 Heat the mixture to boiling point. Continue stirring during heating to avoid charring and to facilitate uniform mixture 9 Allow it to cool.



Urea-Molasses mixture

Schedule of feeding

Introduce the urea-molasses mixture gradually over 2-3 weeks.

During the initial three days, give 500 g of the urea-molasses mixture daily; reduce the quantity of concentrate mixture by 25 percent.

During the next four days, offer 1-2 kg of the urea-molasses mixture; cut the concentrate to half the original amount, and reduce roughage by 25 percent.

In the second week, give 2-3 kg of the urea-molasses mixture daily and withdraw the concentrate mixture completely (for adult non-working animals as a maintenance diet). Roughage can also be reduced by 75 percent of the original amount.

From the third week onwards, you can increase the ureamolasses mixture to as much as 1 kg per 100 kg of animal body weight.

What animals can be fed ureamolasses liquid mixture?

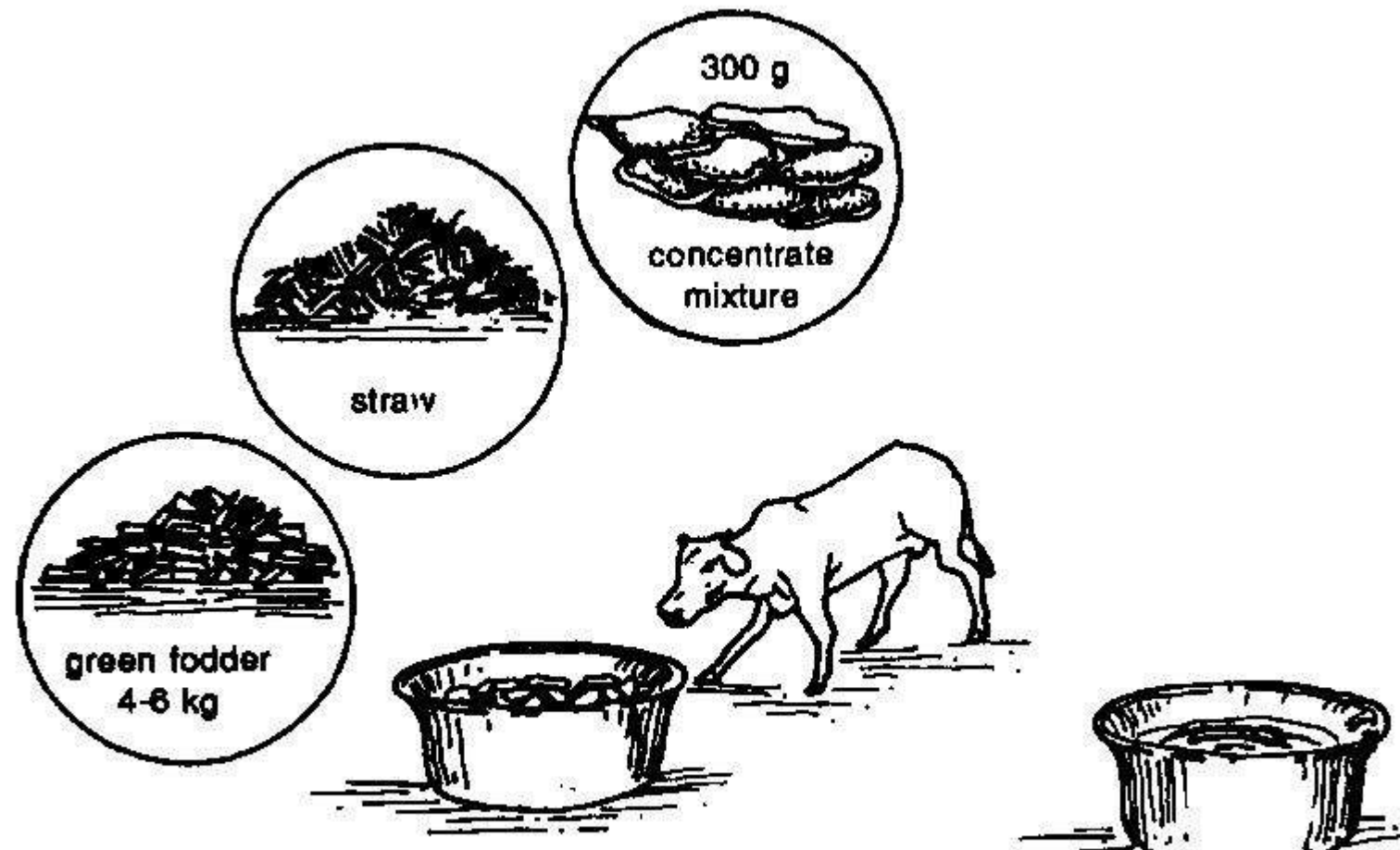
Cattle and buffaloes over six months of age, and sheep and goats over four months of age can be fed urea-molasses liquid mixture. Avoid feeding it to young calves, as their stomachs are still developing.

How much to feed

Growing calves (older than 6 months)

Green fodder, mixed straw, and 300 g of concentrate mixture.

In addition, 1-2 kg of the urea-molasses mixture for free-choice consumption.



For 6-month-old calf

Dry buffaloes and cows

Feed dry buffaloes and cows urea-molasses (5-6 kg) and dry fodder (5-6 kg) daily.

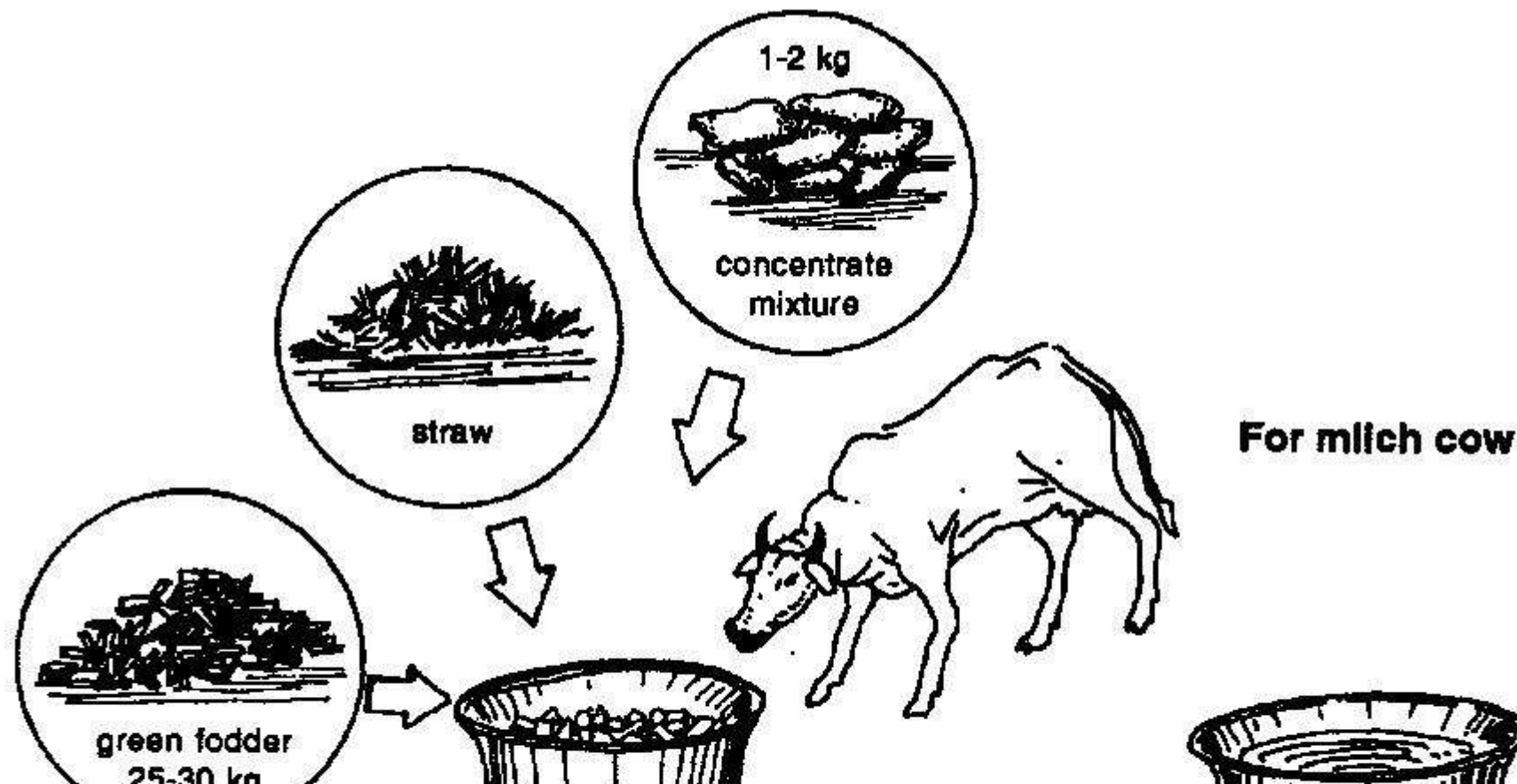
In addition, give green fodder at the rate of 1 to 2 kg or vitamin

A supplement in the diet.

Milch animals (producing about 10 litres of milk)

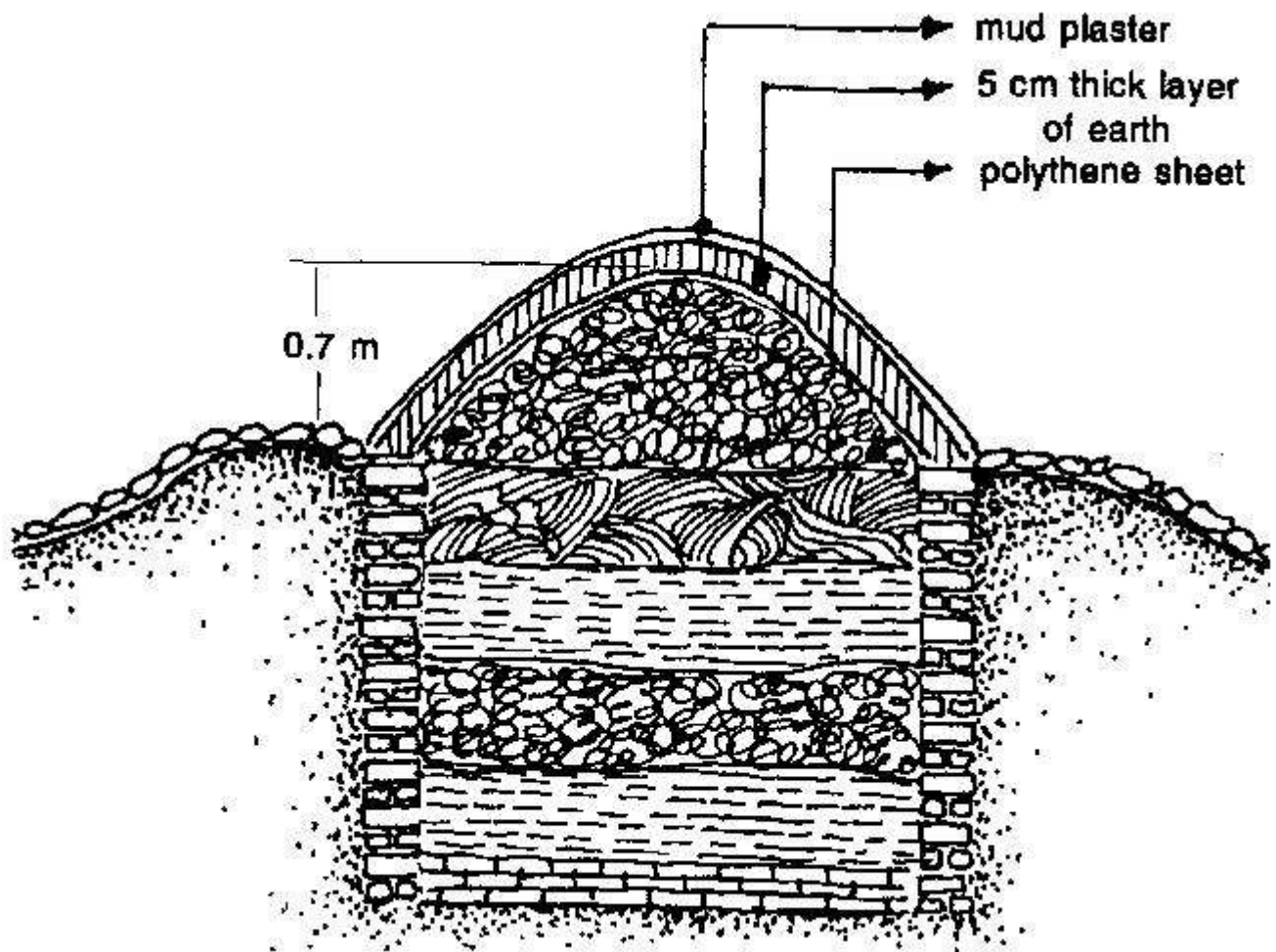
Feed green fodder (25-30 kg and straw mixed with 1-2 kg of concentrate mixture.

In addition, provide urea-molasses mixture for free-choice consumption.



Cross-section view

- **In** the case **of** legume-only fodders, mix straw with the green fodder to reduce the moisture content.
- Fill the chaffed fodder 0.7 to 1 m above the soil surface.
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Packing rectangular trench silo - side view



Packing rectangular trench silo.

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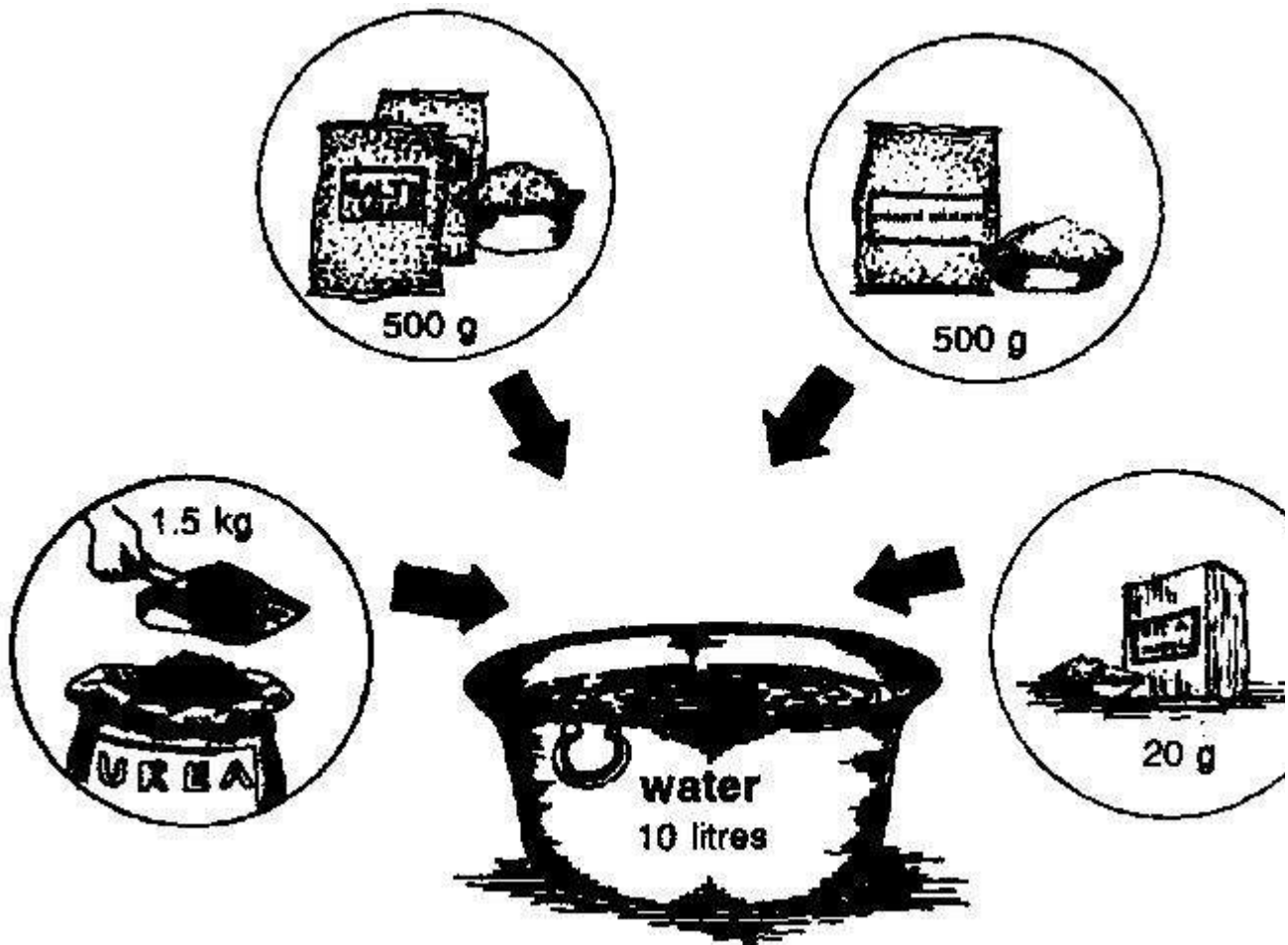
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Materials required (for every 100 kg **of** dry fodder)

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Method **of** treatment

Dissolve urea, common salt, mineral mixture, and Vitablend thoroughly **in** water by stirring it with a wooden stirrer.



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Spread the dry fodder evenly under the sun in a 5 m x 10 m area.

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Contributor: Dr. Jagdish Singh

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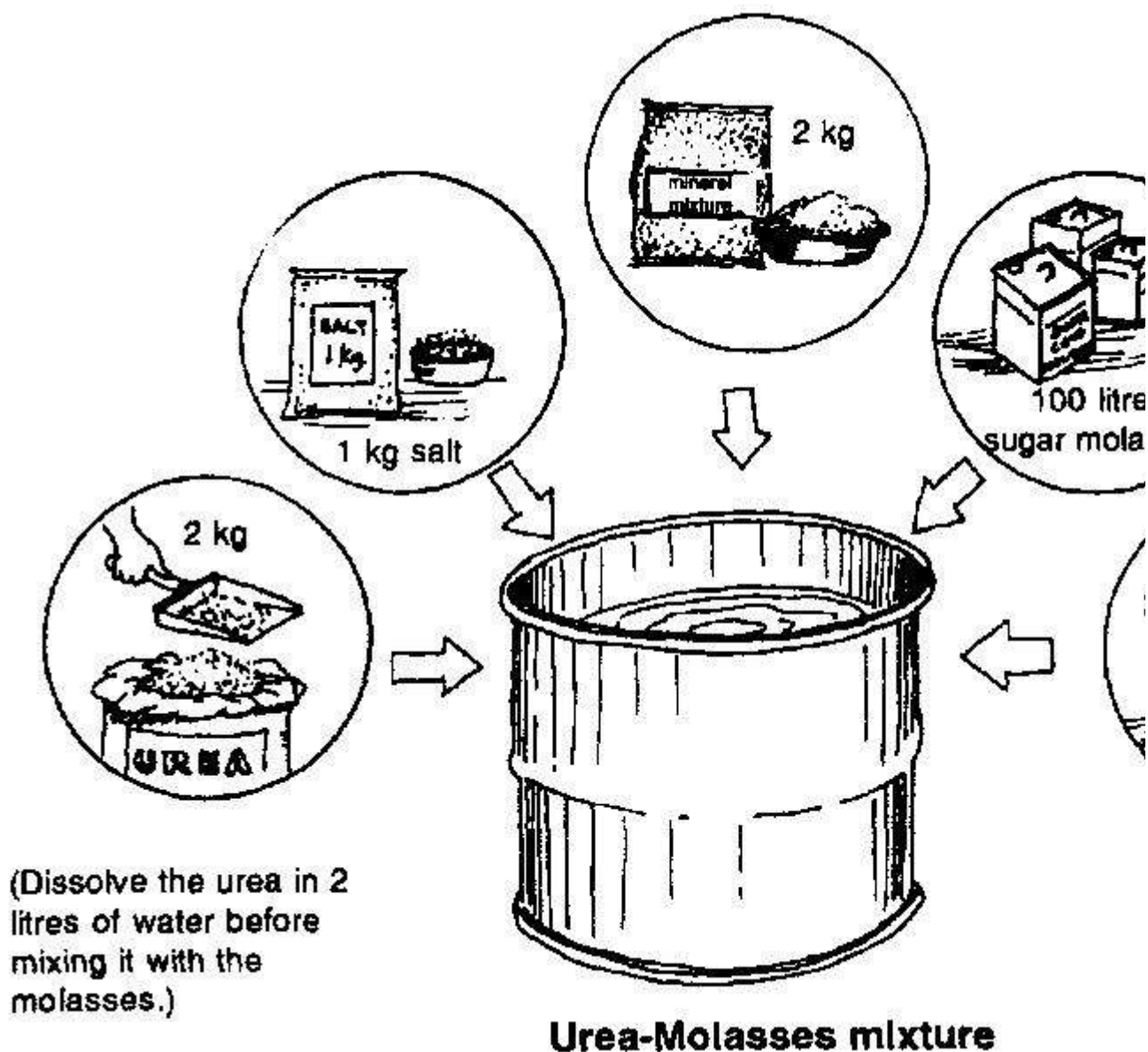
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Water		2 litres
Mineral mixture		2 kg
Common salt		1 kg
Vitamin A supplement		20 g

(if green fodder is not available)

Method **of** preparation

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Urea-Molasses mixture

Schedule of feeding

Introduce the urea-molasses mixture gradually over 2-3 weeks.

During the initial three days, give 500 g of the urea-molasses mixture daily; reduce the quantity of concentrate mixture by 25 percent.

During the next four days, offer 1-2 kg of the urea-molasses mixture; cut the concentrate to half the original amount, and reduce roughage by 25 percent.

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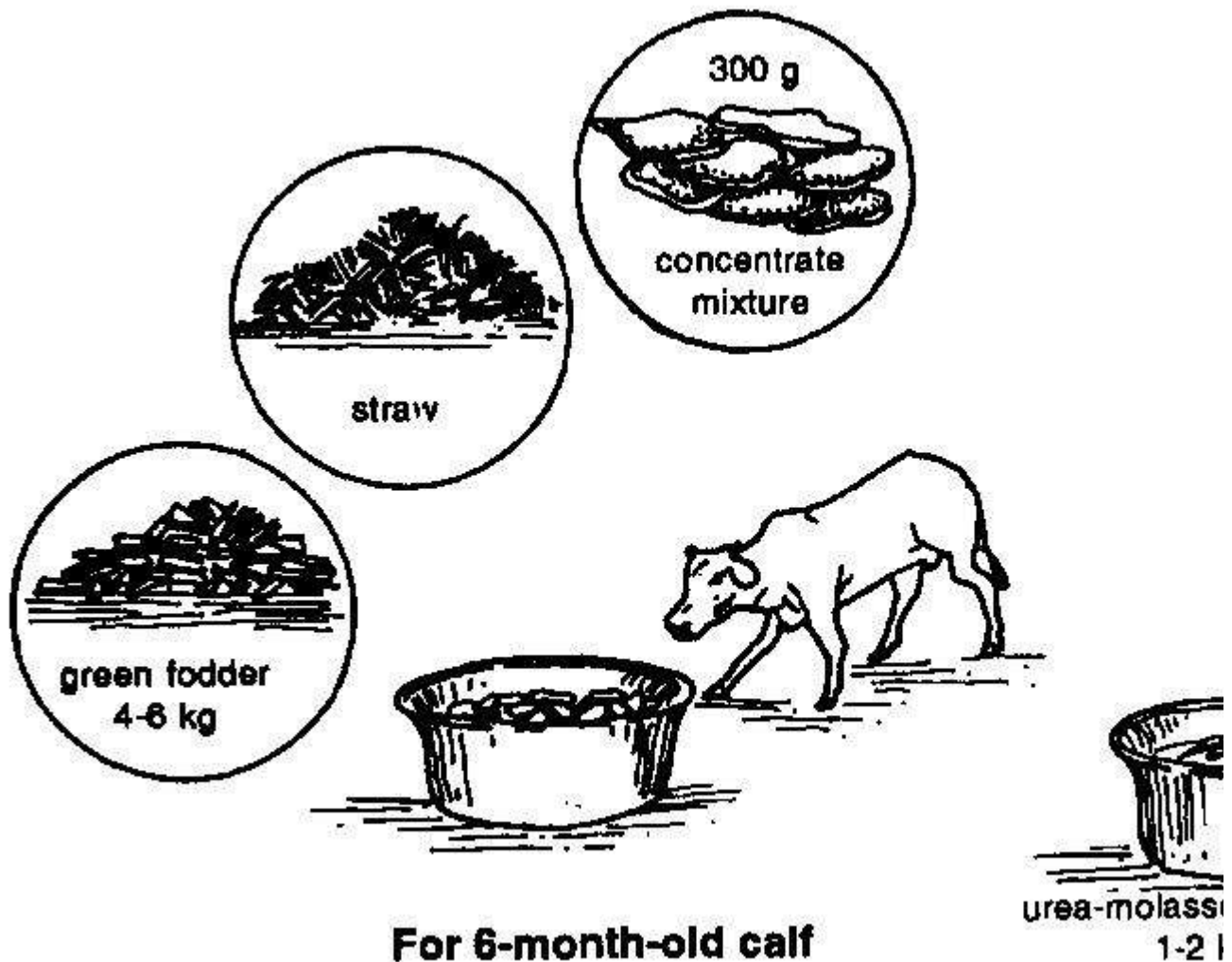
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How much to feed

Growing calves (older than 6 months)

Green fodder, mixed straw, and 300 g **of** concentrate mixture.

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For 6-month-old calf

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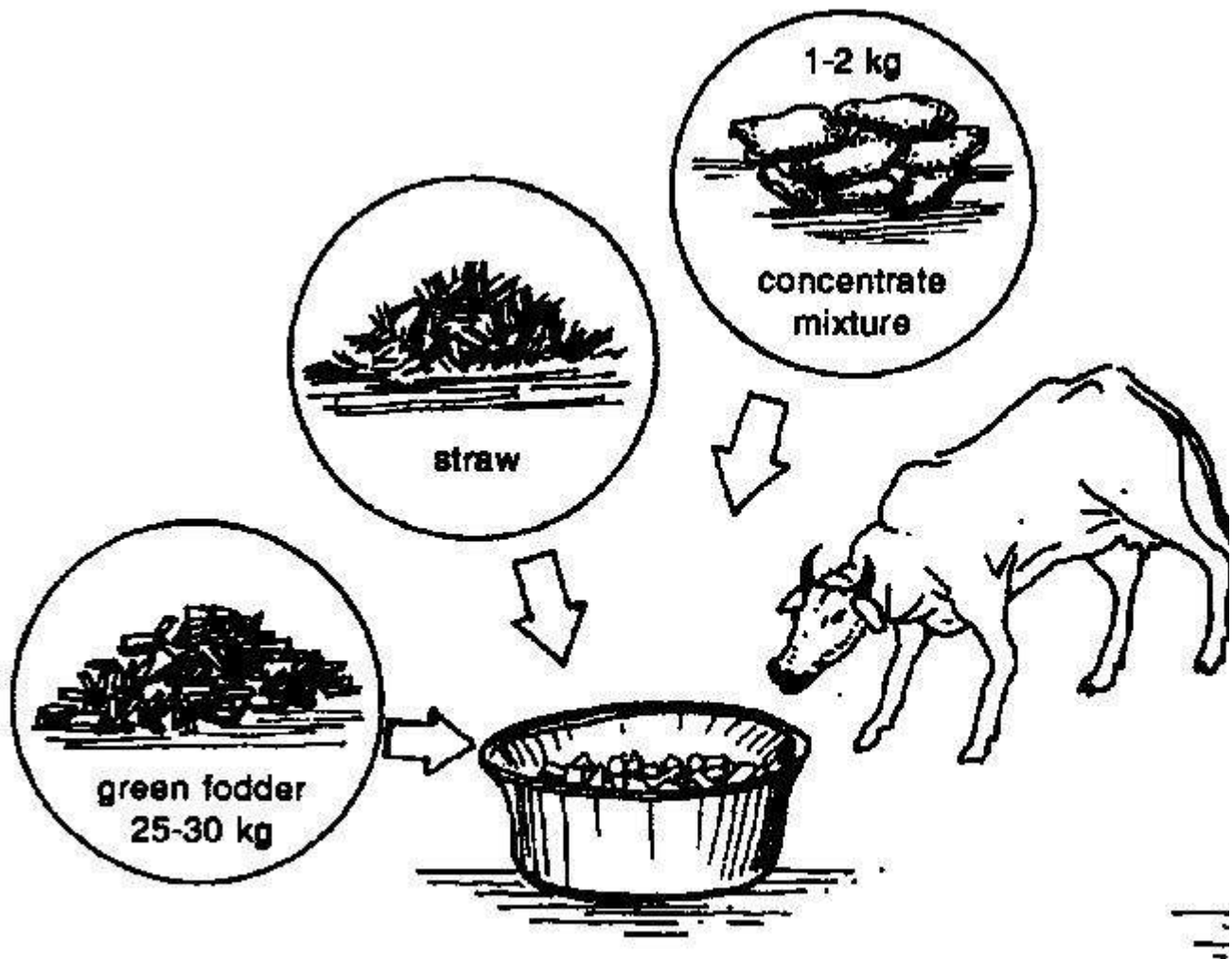
In addition, give green fodder at the rate **of** 1 to 2 kg or vitamin

A supplement **in** the diet.

Milch animals (producing about 10 litres **of** milk)

Feed green fodder (25-30 kg and straw mixed with 1-2 kg **of** concentrate mixture.

In addition, provide urea-molasses mixture for free-choice consumption.



For milch cow

Working bullocks

Feed dry fodder (5-6 kg) and urea-molasses mixture (5-6 kg) daily.

In addition, feed green fodder at the rate **of** 1-5 kg and concentrate mixture at the rate **of** 1-3 kg, depending on whether the work is light, medium, or heavy.

When not to feed ureamolasses liquid diet

Discontinue the urea-molasses mixture if the animal salivates excessively or appears sick, or is unusually slow to move.

Contributor: Dr. M. Y. Khan

Urea-molasses-mineral lick

Composition

Molasses	40 %
Urea	12 %
Salt	5 %
Mineral mixture	6 %
Bentonite	4 %
Groundnut cake	15 %
Cottonseed cake	10 %
Calcium oxide	8 %

Groundnut cake and cotton seed meal can be replaced with cheaper, locally available cakes and meals.

Ruminant animals, such as cattle, goats, and sheep, are able to convert nitrogen and fibrous feeds into protein and energy. Actually, the job **of** producing this protein and energy is done by bacteria which live **in** the rumen-one **of** the three stomachs **of** ruminant animals-**in** a process called microbial fermentation. Fibrous crop **residues** alone, a major feed for ruminant animals, are actually a very poor source **of** nitrogen, energy, and minerals. A urea-molasses-mineral (UMM) lick is an effective way to supplement nitrogen (necessary for making protein) and other essential nutrients lacking **in** fibrous feeds.

Advantages

- UMM licks contain all the nutrients essential for growth and production.
- Adult cattle and buffalo can be maintained by licking 300500 g **of** UMM lick and consuming whatever crop **residues** are available.
- For growing animals, 20-30 percent **of** concentrate can be replaced with UMM lick.
- UMM licks are good for underfed, growing animals. The licks provide all essential nutrients and minerals, especially those required by rumen microbes for fermentation **of** fibrous material.
- **In** low-producing and underfed lactating animals, UMM supplementation can increase milk production by 30-50 percent depending on the production level.
- The essential minerals provided from UMM licks help **in** reproductive development, reducing the age to first calving.

Preparation

With a little instruction, UMM licks can be prepared by farmers, on-farm, without special equipment. See the amounts **of** ingredients **in** the box above labelled "Composition".

Safe

UMM licks are safe. The chance **of** urea toxicity is virtually eliminated.

Note

Do not leave the UMM lick exposed to the rain.

1 Pour molasses into a tub.

2 Mix the urea and common salt with a wooden stick on a sheet **of** plastic or a clean floor.

3 Stir the urea and salt mixture into the molasses.

4 Mix, one after the other, on a plastic sheet or on a clean floor, the mineral mixture, calcium oxide, bentonite, powdered groundnut cake, and powdered cotton seed cake.

5 Slowly and thoroughly stir this powdered mixture into the tub with the molasses, urea, and salt.

6 Pour this semisolid mixture into a wooden, cardboard, or metal mould lined with polythene.

7 The lick will set **in** about 24 hours.

Cost

UMM licks can be made on-farm for between Rs 3.20 and 3.85 per kg, depending on the filler ingredients. One kilo is enough for 2-3 days for one animal. The cost can be reduced by using cheaper, locally available filler ingredients. All ingredients are readily available **in** the market.

Contributor: Dr. G. P. Singh

Clean milk production

Most farm families like to keep milch cattle. However, keeping milch cattle is one thing, and producing clean milk is quite another. Women are often responsible for milking cows and storing and handling the milk.

Why clean' milk?

Milk and milk products are good for the health **of** every member **of** the family- young and old. But milk should be clean. Unclean milk causes illness and poor health. Also, milk is a perishable commodity. Unclean milk gets spoiled quickly; it fetches a low price **in** the market, or may be unsalable.

What is clean milk?

Milk is clean when it does not contain any harmful bacteria and/or foreign matter, such as dust, cow dung, hair, flies, etc.

A number **of** things are required to produce clean milk. These include clean environment and premises, clean containers, clean and healthy animals, clean milking habits, and finally, clean and healthy milkers.

Clean environment and premises

- The cow shed should be well-lit and ventilated. The floor should be made **of** smooth concrete or brick and should have a drain. Smooth ceilings and walls help keep the shed clean.

- Clean and disinfect the floor and the drains with water, using 2 percent phenyl after milking.
- Periodically, whitewash the ceilings and walls. Keep them free from cobwebs, dust, and dirt.
- Avoid feeding the animal fodder, straw, etc., immediately before milking as these can raise dust. Concentrates prepared beforehand can be given.

Clean vessels

Use only clean utensils for collecting milk. Dirty utensils are the main source **of** harmful bacteria **in** milk.

Clean all milk utensils promptly after **use**. Do not keep them unattended for long.

Clean the utensils with warm water using an alkali washing powder (such as sodium hypochlorite) and a stiff brush. When ash is used, rinse the utensils thoroughly. Avoid using clay to clean utensils. Dry utensils thoroughly after washing by stacking them upside down, preferably **in** direct sun for three hours.

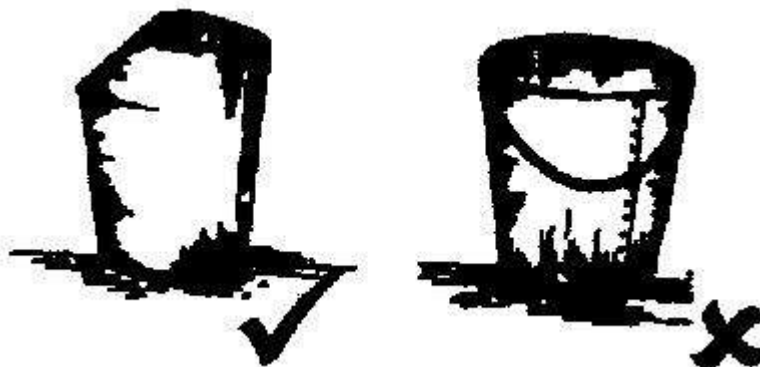
Use clean water for washing milk utensils.

Milk containers

- **Use** a narrow-mouthed pail for milking. An open-top pail allows easy access to dirt, cow dung, etc., **in** the milk.
- **Use** a seamless pail, if possible, or the seams **of** the pail should be smooth and easily washable.

Clean animals

- Before milking, wipe the animal's udder, flanks, and tail with a clean, damp cloth.
- Clean the udder and teats with lukewarm water. Add potassium permanganate to the water (one pinch **in** a bucket **of** water).
- Wipe the udder and the teats dry with a clean rough cloth after washing.
- Preferably, keep the tail **of** the animal tied to its hind legs during milking, to keep it from flicking dirt into the milk.



Use a narrow-mouthed, seamless pail.



Tie the animal's tail to its hind legs while milking.



Wipe the udder with a clean cloth before milking.

Healthy animals

- Ensure that the milch animal is healthy and free from diseases communicable to people. Tuberculosis and other diseases can spread through milk.

- Examine the animal's udder every day for cracks. Treat these with an antiseptic ointment. Swelling **of** the udder, or pus or blood **in** the milk are signs **of** mastitis. If you see these signs, call a veterinarian.

Clean milking

Wash your hands and arms with soap thoroughly before milking.

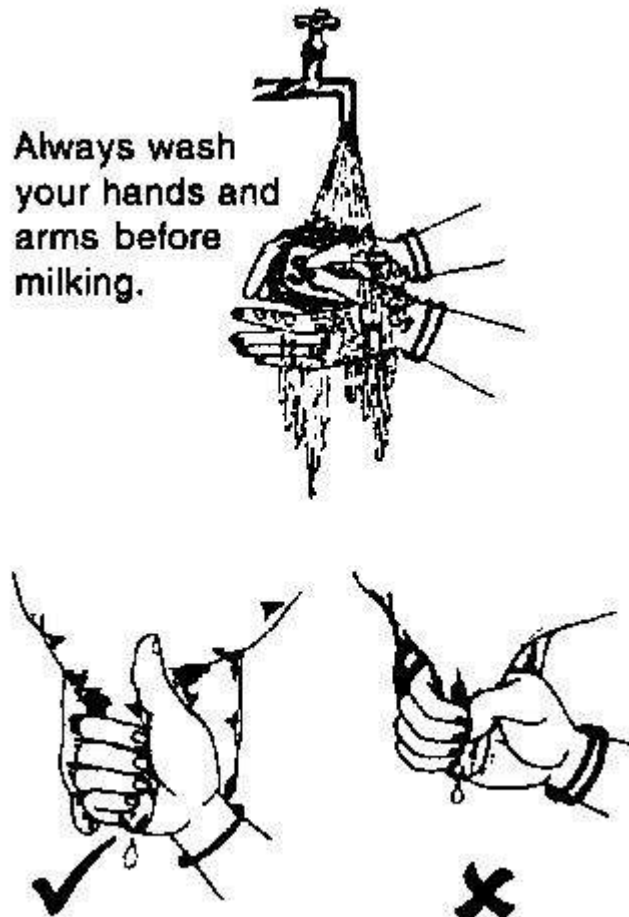
Trim your fingernails short.

Cover your head to prevent your hair from falling **in** the milk.

Wear clean clothes.

Your hands should be dry when you milk the animal. The udder and teats should also be dry, as moisture on teats can lead to cracks. Wipe the teats dry after every milking.

Milk the animal using the full-hand method. The thumb should not be pressed inward; the thumb knuckle should not press against the teat.



Use the full-hand method.

Healthy milkers

- The person milking the animal should be healthy. Diseases, such as cholera, typhoid, and scarlet fever can be carried from infected persons into the milk.

Clean milk storage

- Aluminum or stainless steel cans with tight lids are good for storing and transporting milk. When tin or chrome-plated iron cans are used, see that there are no rust spots.

- Cover the milk with a cloth to keep out dust and flies.

- Don't keep the milk **in** direct sunlight as the taste **of** the milk changes and some vitamins are destroyed.

- To keep milk cool, place milk cans **in** a tub containing cold water.

- Don't mix fresh milk with old milk.

- Empty milk vessels should be washed and cleaned immediately.

Clean milk production will help you avoid unnecessary financial losses through spoilage **of** milk. It will also guard the members **of** your family against diseases carried **in** unclean milk.

Contributors: Mrs. Ritu Chakravarty, Dr. Ram Chant, Mr. B. S. Mitra, Mrs. Parvinder Sharma, and Dr. Jaddish Singh

Livestock diseases

Women are often responsible for taking care **of** farm animals. They are, therefore, most likely to notice any disease symptoms. Take care to look for the following problems.

Anthrax

Symptoms

- High fever

- Difficulty **in** breathing

- Bleeding from ears, mouth, nose, anus, and vagina

- Blood does not clot

- Trembling and convulsive movements

- Animal collapses and dies quickly

Animals susceptible

Cattle, buffaloes, horses, pigs, camels, dogs, and humans.

Source **of** infection

Soil contaminated with bacillus anthracis spores or fodder grown on infected soil, contaminated drinking water, excrete, blood.

Prevention and control

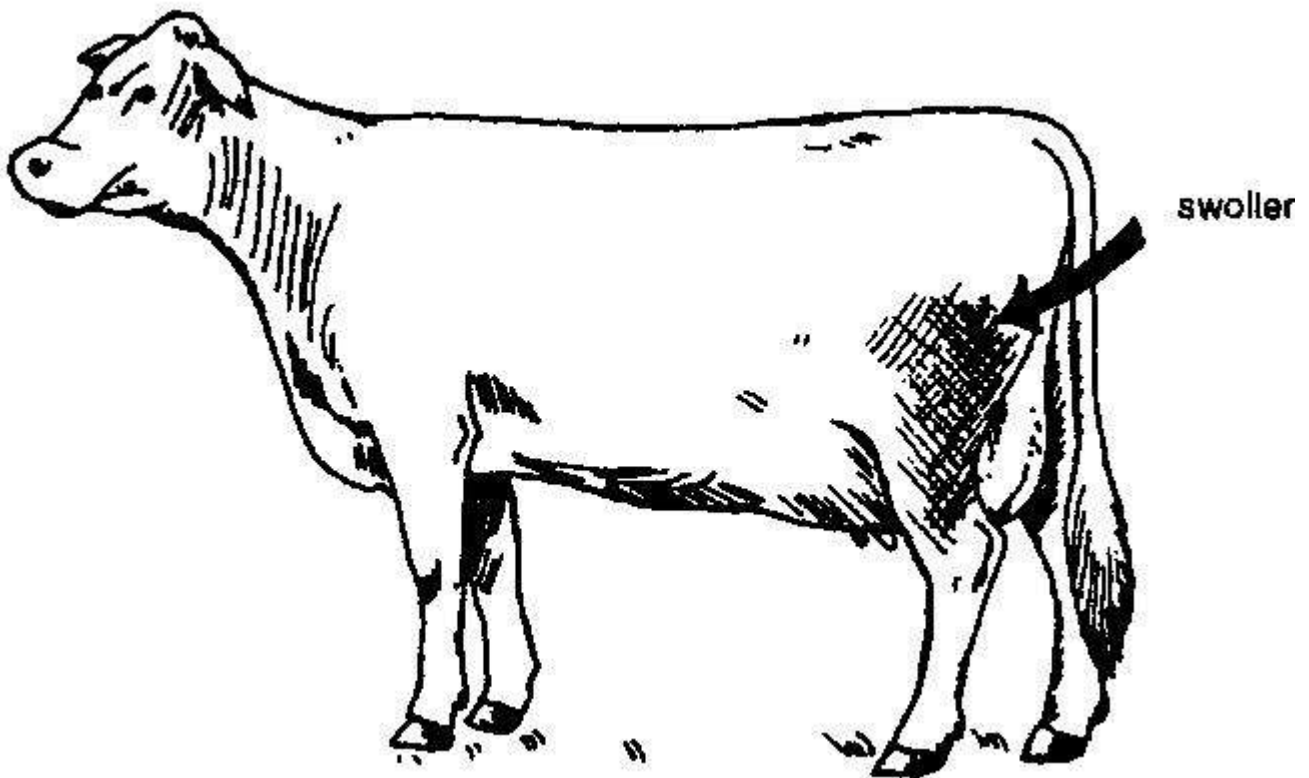
- Improve hygiene.
- Do not open the carcass for post mortem, if anthrax is suspected.
- Burn or bury the infected carcass immediately, together with bedding and contaminated soil.
- Bury the animal 2 m deep. Cover with quicklime on all sides and the top.
- Never drag an anthrax carcass along the road **Use** a cart or ambulance which should later be thoroughly disinfected.
- Annual vaccination with Anthrax Spore Vaccine is a must for all animals **in** endemic areas.

Black quarter

(Blackleg)

Symptoms

- Fever
- Lameness
- Swollen muscles **in** affected area-bubbles can be felt under the skin **in** the swollen area



Black quarter

Animals susceptible

Cattle, buffaloes

Source **of** infection Soil contaminated with infected faeces or decomposed carcasses, contaminated foodstuffs, water, and open wounds.

Prevention and control

Vaccinate all animals every year before the monsoon season. swollen muscles

Brucellosis

(Contagious abortion)

Symptoms

- Abortion or retained placenta
- Cloven-hoofed animals

Animals susceptible

Cattle, buffaloes, sheep, goats, and pigs

Source **of** infection

Aborted foetus, foetal membrane, vaginal discharge. Milk and faeces **of** infected animals contain the disease organisms which contaminate the environment, feed, water, and grazing ground.

Prevention and control

- Identify and isolate affected animals.
- Dispose **of** aborted foetus, placental and uterine discharges, contaminated litter, and soil by burning or burying after covering with quicklime.
- Vaccinate 3-6-month-old calves.
- Make sure that fresh stock is free from the disease.

Foot-and-mouth disease

Symptoms

- Blister-like sores and ulcers on udder, teats, feet, and inside the mouth, nose, and muzzle
- Excessive salivation
- Fever
- Lack **of** appetite
- Refusal to eat

The disease usually lasts about a week but can last longer. It is often fatal to young animals.

Animals susceptible

Cloven-hoofed animals: cattle, buffaloes, sheep, goats, and pigs

Source **of** infection

Virus **of** the disease remains alive **in** dried saliva and can contaminate the feed. Infected animals spread enormous amounts **of** virus from their mouths and noses into the air. The disease can also spread through contaminated water, hay, and pastures.

Prevention and control

- Dispose **of** contaminated feed and dung **in** a compost pit.
- Isolate affected animals.
- Bury dead animals **in** a pit 2 m deep after covering the carcass with quicklime.
- Get first vaccination done at the age **of** 6-8 weeks, followed by a booster dose 4-6 weeks later. Repeat the vaccination as advised by a veterinarian.

Haemorrhagic septicemia

(Galahotu)

Symptoms

- Fever
- Discharge from the nose
- Cough
- Lack **of** activity
- Lack **of** appetite
- Bloat
- Swelling **of** the neck
- Laboured breathing
- Tongue sticks out (**in** last stage **of** disease)

Animals susceptible

All animals **in** low lying areas during periods **of** high humidity.

Source **of** infection

The disease organism multiplies rapidly **in** lungs, and infected droplets are exhaled **in** the air. Disease is spread either by droplet inhalation or by ingestion. Sick animals also contaminate the atmosphere and grass by excreting a large number **of** bacteria from the nose or mouth or **in** the faeces. Environmental stress, starvation, chilling, or change **in** diet can bring on the disease.

Prevention and control

- **In** endemic areas, carry out preventive vaccination every year, one month before the onset **of** rains.
- Vaccinate promptly if there is an outbreak **of** haemorrhagic septicemia **in** your area.
- Segregate healthy animals from sick animals and from others that have come into contact with the sick animals.

Rables

Symptoms

- Animal becomes aggressive
- Bellowing
- Frequent urination
- Salivation
- Constipation
- Animal becomes vicious-runs at and tries to bite anything that moves

- Convulsions

- Death

Animals affected

All domestic animals: cattle, buffaloes, horses, mules and camels, hilt is most common **in** dogs and cats. Can also infect humans.

Source **of** infection

Dogs and cats are the main source **of** infection. Foxes act as carriers and are the most important reservoirs **of** the disease. The disease is communicated from animal to animal and to people chiefly by bites from rabid animals. The virus is excreted **in** saliva. Infection can also occur when handling infected animals. The virus can enter through scratches or wounds. Infection can also occur through licking by dogs and cats. Saliva **of** rabid animals infects pastures, utensils, and housing. Infected saliva remains virulent for many days. The virus can survive **in** water for 20-30 days. Contaminated water can transmit the disease to healthy animals.

Prevention and control

- Keep animals away from rabid dogs and cats.

- Promptly wash wounds **of** bitten animals with water. Allow the wounds to bleed for some time. This helps to wash out the virus.

- Apply tincture **of** iodine on the wounds.

- If a dog or cat bites your livestock, keep both the livestock and the dog or cat confined and under observation for 10 days. If rabies symptoms are observed, have the livestock vaccinated.

Rinderpest

Symptoms

- Very high fever

- Discharge from the nose

- Foul-smelling, shooting diarrhoea which contains blood and mucus

- Difficulty **in** breathing

- Watery eyes

- Dehydration

- Lesions on mouth and tongue

- Animal cannot eat

Animals susceptible

Cattle and buffaloes.

Source **of** infection

The virus is found **in** saliva, discharge from eyes and nostrils, and **in** urine and faeces. It contaminates pastures and grasslands, and spreads by ingestion **of** contaminated feed and water.

Prevention and control

- Isolate infected animals.
- All adult cattle and calves older than 3 months should be vaccinated.
- Revaccinate exotic and cross-bred animals every 3 years.
- Plug all natural openings **of** the carcass **of** dead animals with cotton to prevent spilling infected blood and discharge.

Tuberculosis (TB)

Symptoms

- Low, recurrent fever
- Weakness
- Lack **of** appetite
- Progressive loss **of** weight despite good nutrition and care
- Enlarged superficial lymph nodes. You can feel them as swellings behind the ears and **in** front **of** the shoulders

Animals susceptible

All species

Source **of** infection

Contaminated environment, contact with infected animals, food contaminated with infected discharge, faeces, urine or milk. **In** damp, contaminated environments, such as watering troughs, stagnant ponds and accumulated manure, the bacteria survive for many months.

Prevention and control

- Have a tuberculin test done. (Consult a veterinarian.)
- Clean and disinfect troughs for feed and water.
- Isolate infected mothers and their calves from the herd immediately at birth.

Contributors: Dr. Ram Chand, Dr. A. C. Mathur, and Dr. S. K. Verma

Common maladies in cattle

The most important factor adversely affecting animal production and reproduction is disease. This leads to economic losses and setbacks. Timely recognition and prevention **of** disease is, therefore, necessary. For this, a greater knowledge **of** different types **of** diseases is required. Many animal diseases are environmentally induced. Here are some **of** the important environmentally induced diseases, and how to recognize and prevent them.

Diseases caused by unfavourable weather

Heat stroke

This happens when the external temperature is very high (over 40° C), and animals are kept outside either working or grazing. It can also be caused by overcrowding **in** badly ventilated shelters. This is especially true for poultry. Asbestos sheet and tin roofs tend to get overheated **in** very hot weather.

Symptoms

Initially, animals pant and search for water; their body temperature goes up very high; then they have trouble breathing, stop urinating, collapse, and **in** severe cases, die.

Prevention

Do not allow animals to work or graze during the day **in** summer when it is very hot. Work and graze animals during early mornings or late evenings. Allow animals access to plenty **of** water, salt, and shade. Avoid overcrowding **of** animals **in** shelters. Design animal houses so ventilation is adequate **in** hot weather. Insulate roofs with straw or other agricultural residue to prevent overheating. Allow buffaloes to wallow.

Treatment

When the animal's temperature goes very high, cool the animal with packs made by soaking strips **of** cloth **in** cold water. Give the animal plenty **of** fluids to drink, such as tamarind juice, sugar cane juice and coconut water. Or, make oral rehydration drink by mixing 4-5 teaspoons **of** sugar and 1/4 teaspoon **of** salt **in** each litre **of** water. Move the animal to comfortable surroundings with plenty **of** shade and ventilation.

Treat heat stroke by cooling the animal.

Make oral rehydration drink **of** sugar, salt, sad water.



Treat heat stroke by cooling the animal.

Threat heat stroke by cooling animal



**Make oral
rehydration drink
of sugar, salt,
and water.**

Make oral rehydration drink

Coughs and colds

Extremely cold weather or a combination **of** cold and wet weather can lead to various disease conditions, the simplest **of** which are coughs and colds. This lowers the resistance **of** animals and makes them susceptible to more serious conditions such as haemorrhagic septicemia and ephemeral fever (or threeday sickness).



Avoid exposing animals to cold wind and rain.



Cover chilled animals.



Rub the animal's chest with turpentine liniment, eucalyptus oil or camphorated oil. Allow it to inhale vapors from a bucket **of** hot water, to which a little eucalyptus oil has been added.

Symptoms

Shivering, discharge from nose and eyes, coughing, possibly accompanied by high fever. The animals huddle together, and are very slow to move.

Prevention

Avoid exposing animals to cold wind and rain. Provide adequate and comfortable animal houses, and dry bedding **in** wet and cold weather.

Treatment

Make surroundings comfortable. Rub wet animals dry. Rub chest with turpentine liniment, camphorated oil, or eucalyptus oil. Give animals nourishing, warm food-like gruel made **of** wheat, finger millet, or pearl millet flour with lots **of** brown sugar. If animals do not show signs **of** improvement **in** 12 hours, seek professional help.

Diseases caused by unhygienic surroundings

Unclean surroundings with dirt, spoiling and rotting garbage, polluted water sources, and overcrowding can lead to many disease conditions. Most **of** these conditions are infectious, i.e., they can spread rapidly from one animal to another and cause many animals to be sick at the same time. Some common examples:

- Unclean milking habits lead to mastitis.
- Unclean wounds, cuts, and sores can lead to tetanus, black leg, and even anthrax.
- Unclean food can lead to flukes and worms **in** the digestive tract, as well as many other digestive

problems, such as diarrhoea and vomiting.

- Unhygienic surroundings also make conditions favourable for the breeding **of** ticks and mites. These external parasites transmit many diseases, such as filariasis, babesiosis, and anaplasmosis which infect the blood and can eventually lead to death **of** the animal.

Prevention

- Animal houses must be kept clean. They must be cleared **of** dung and urine twice a day and washed well at least once a day. Dung and urine transmit many diseases. Efficient and quick utilization **of** dung and urine prevents germs, worms, and other organisms from infecting other animals.



Keep animal housing clean.

Similarly, discharges from animals like nasal discharge, placenta and vaginal discharges can carry infection. These should be washed out **of** animal houses and buried. Bedding and straw on which sick animals sit can spread infection. These should be burned so they cannot contaminate the food supply **of** other animals.

Animal houses should be regularly inspected for ticks, lice, and fleas. These parasites usually lay eggs **in** corners, nooks, and crevices. It is a good practice to fumigate animal houses with neem or tobacco leaves once **in** two or four weeks, depending on the severity **of** infection. Remove animals

from the shelter when fumigating.

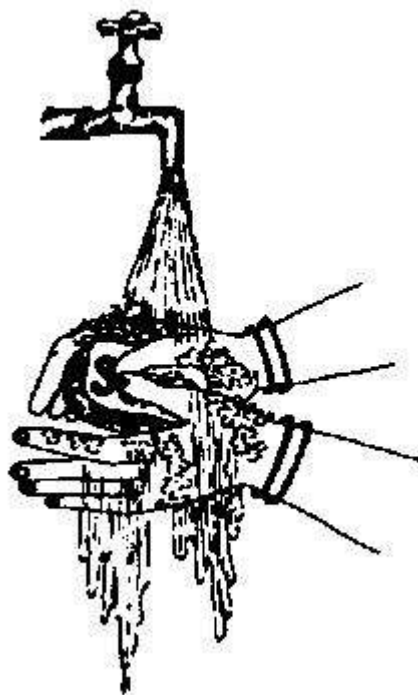
Mosquitoes and flies breed **in** stagnant pools **of** water or accumulated garbage heaps. Avoid unnecessary accumulation **of** water and garbage; make a soak pit for water and a manure heap for **organic** waste.

Humans often carry infection from one animal to another. Always wash your hands after attending to animals which are sick. It is also a good practice to wash your hands after milking one cow, before milking the next.

In some areas, people and animals live **in** the same room. This can cause diseases to be transmitted from humans to animals and from animals to humans. As far as possible, keep rooms for animals and humans separate.

Unclean cuts, wounds, and sores can lead to very dangerous conditions, such as tetanus. When animals get hurt, wash the wound well and cover with a clean, dry cloth. Prevent flies from sitting on wounds by applying locally available fly repellents, such as neem oil or camphor.

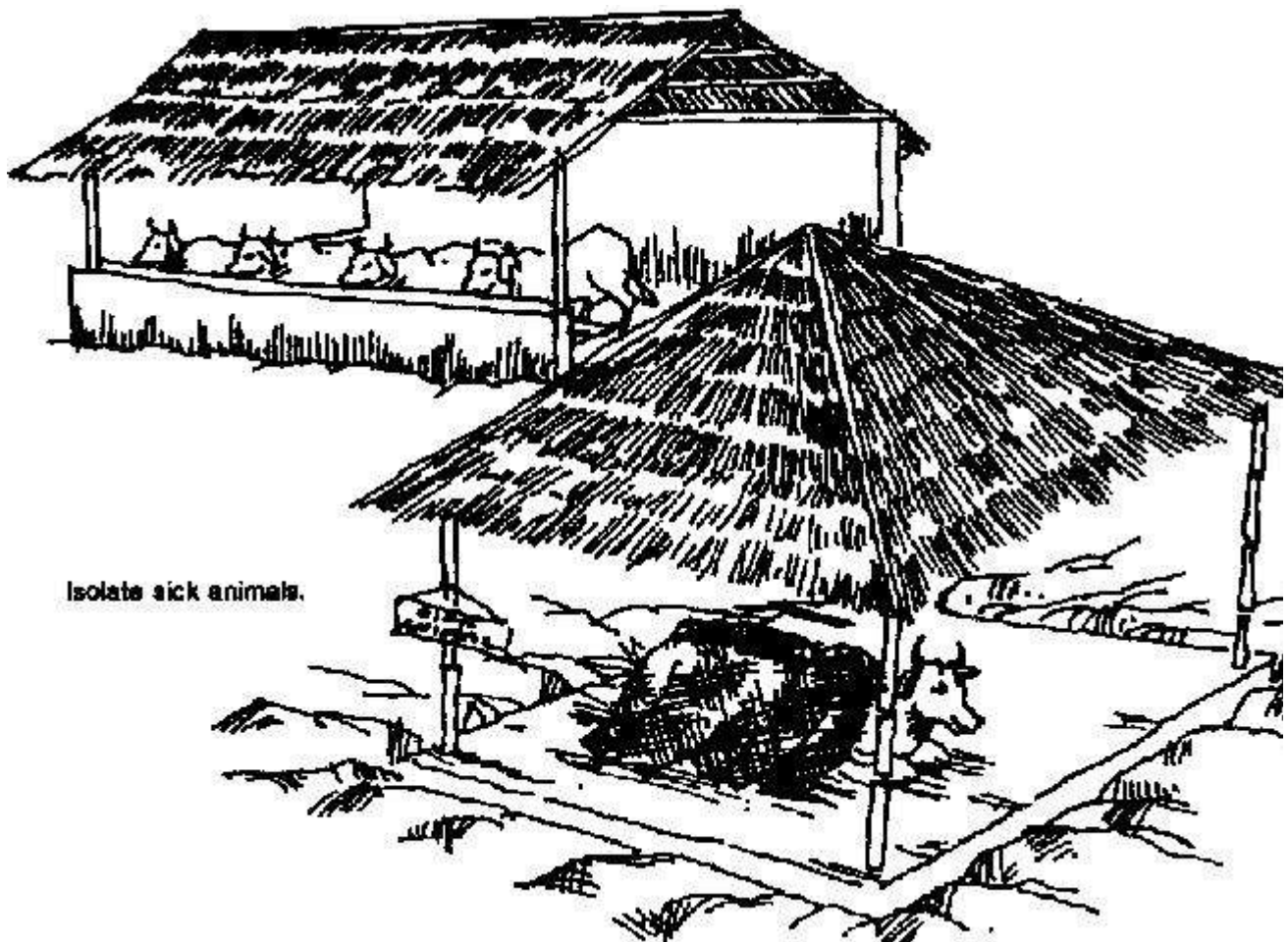
Make sure all food and water fed to animals are clean. Food meant for animal consumption must be fresh and should not have fungus. As far as possible, ensure a clean source **of** drinking water for your animals. Many diseases are spread through unclean drinking water.



Washing hands

If animals go out to graze every day, deworm them regularly, at least twice a year. Calves up to the age **of** six months should be dewormed once a month. There are many commercial deworming preparations as well as many local remedies, including decoctions **of** neem leaves, areca nut powder, papaya seeds, and custard apple seeds. A decoction is prepared by soaking some **of** the dewormer **in** hot water.

If possible, isolate your sick animals from other animals **in** order to prevent the spread **of** disease.



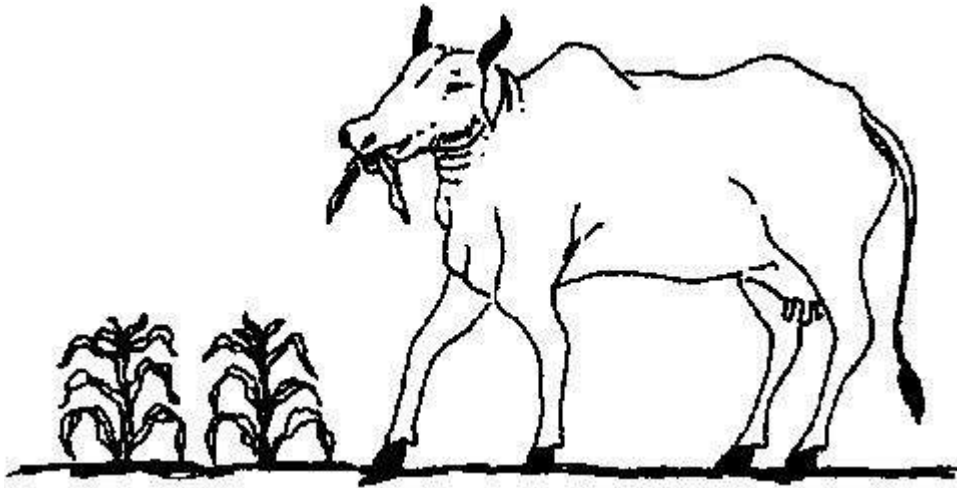
Isolate sick animals.

Protect your cattle from poisoning

Poisoning

Causes Chemicals, such as arsenic, mercury, and salt

- Poisonous plants, such as lantana, young sorghum, and other plants **in** the flowering stages
- Pesticides and medicines used **in** fields
- Snake bites



Poisoning

Symptoms

The symptoms vary but poisoning can be suspected when:

- animals suddenly fall sick or die.
- animals show signs **of** illness abdominal pain groaning kicking at the abdomen diarrhoea constipation convulsions

Treatment

When poisoning is suspected:

- Drench animal with 1 litre **of** paraffin oil or vegetable oil.
- Drench animal with milk, water with powdered charcoal, or coconut water; or mix together 10-12 egg whites, 1/4 kg sugar and 1 litre water. Drench once a day for one or two days.
- Seek professional help immediately if you suspect poisoning.

Important

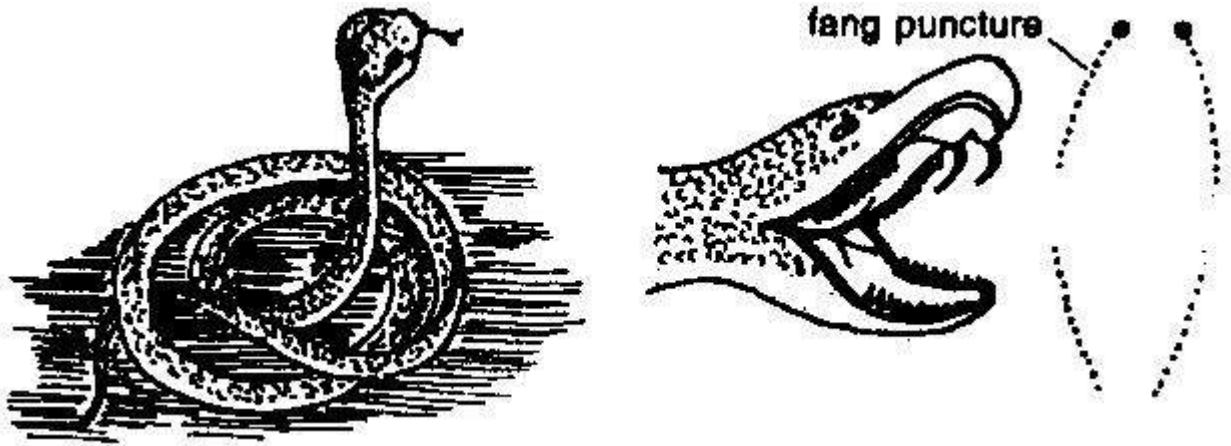
Cases **of** poisoning difficult and expensive to cure. It is better to prevent poisoning by being careful when using poisonous substances.

Poisons	Source	Symptoms	Emergency treatment
Arsenic	Rat poison, insecticidal dips and sprays mischievous poisoning.	Dark, blackish diarrhoea, red mucous membrane, loss of hair, leathery skin.	None
Lead	By licking lead-painted objects Some insecticidal sprays also have lead.	Strong-smelling diarrhoea, bellowing, blindness.	Epsom salts, 100 g in 50 ml wafer given as drench.
Nitrate	Insecticidal sprays, young plants grown in nitrate rich soils. Accidental ingestion of nitrate fertilizers.	Blue colouring inside the mouth and eyelids, rapid and laboured breathing.	Drench with milk with egg white.
Salt poisoning	Excessive consumption of salt and dryness inside	Loss of appetite, hypersensitivity, redness slightly for smaller animals. mouth and eyelids.	Drench 500 ml oil, followed by 500 ml of water. Reduce
Selenium	Plants growing in selenium-rich soil.	Loss of hair from mane and tail, rough hooves, deformed hooves. Occurs over a period of time due to slow accumulation of selenium in the body.	No emergency treatment.
Sorghum, Sudan grass	Young immature plants. and eyelids might turn blue, death.	Convulsions, inside mouth feeding on the plants.	Drench. Stop animals from
Lantana	Shrubs and plants of lantana.	Skin becomes sensitive and red. Animal shuns light. Suffers diarrhoea or constipation.	Drench. Remove lantana from pasture.
Fungus	Food which is stale and mouldy.	Diarrhoea. Animals do poorly.	Drench. Remove stale and mouldy food.
Malathion and other term chemicals	(Grazing on recently sprayed fields, or accidental contamination of food and water.	Convulsions, twitching of muscles, loss of control over urination.	Seek professional help.

Snake bites

Symptoms

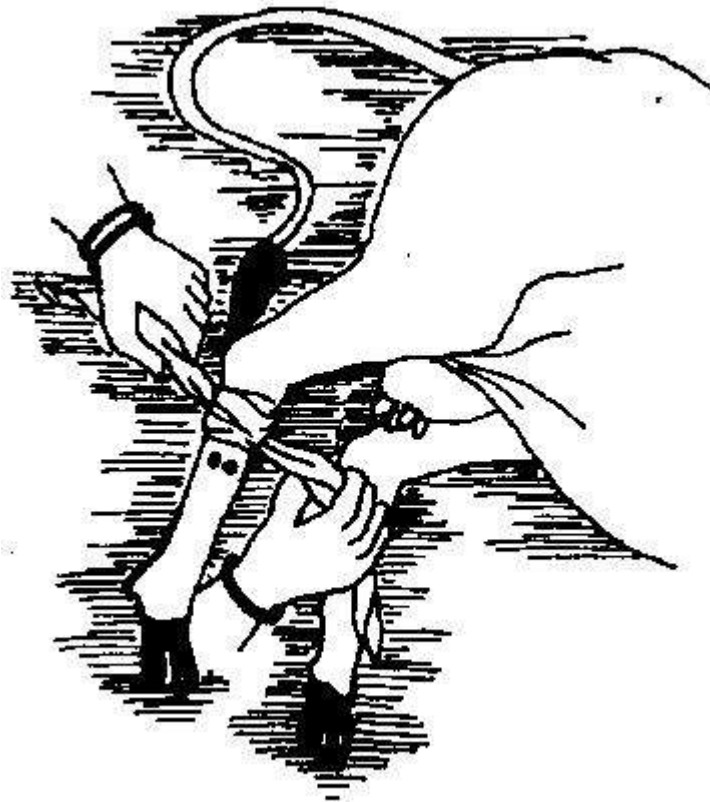
- Bitten animal might appear anxious.
- There may be a wound or swollen area and fang marks on the leg or face.



Poisonous snake bite-look for tang punctures and swelling.

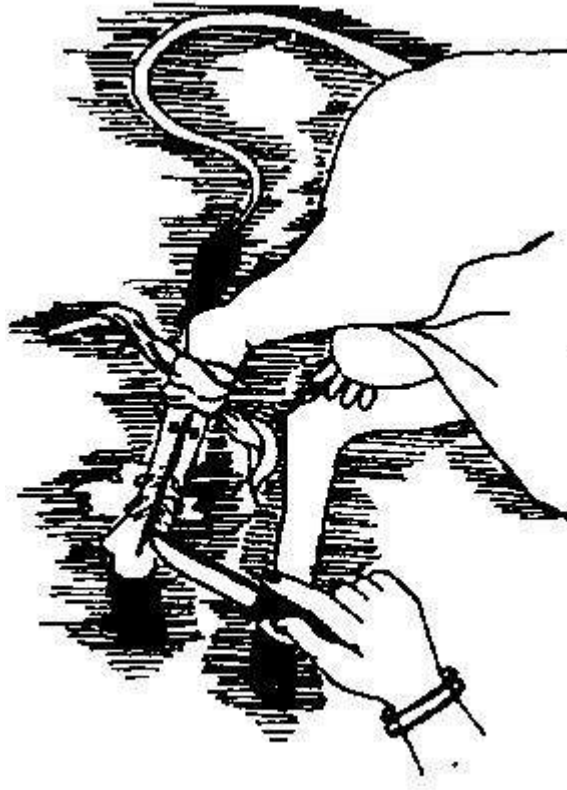
Emergency treatment

- Locate bite.

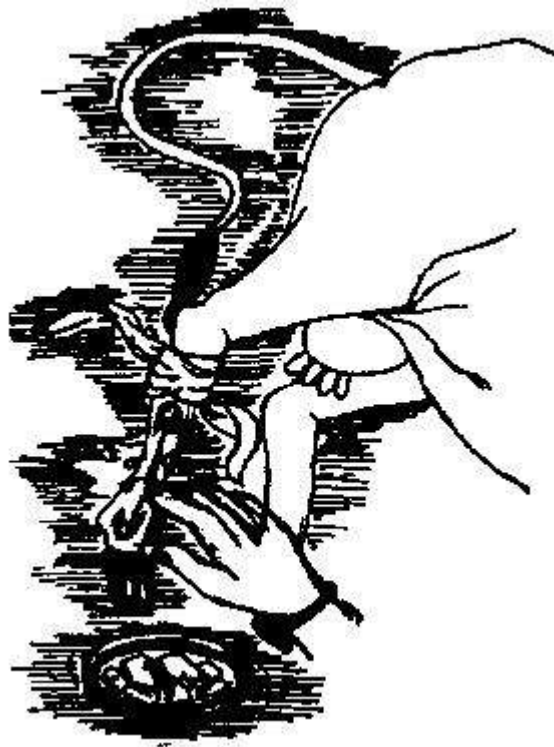


Tie a bandage above bite to reduce flow of blood to the heart.

- Make a deep cut over the wound and allow wound to bleed freely.



Make a deep cut over the wound and allow wound to bleed freely.



Seek professional help

Adaptation of livestock

Differences

- Graded murrah buttaloes need more green fodder and dry fodder than local buffalo breeds **in** order to perform to their potential.
- Compared to cattle, buffaloes are able to produce more milk grazing on low-quality dry fodder and crop residue.
- Goats can survive and produce on a diet **of** fodder trees and shrub leaves, a diet unsuitable for cattle.

Many environmental factors influence the health and productivity **of** domestic animals. If you know how animals react to different environmental conditions, you can select and breed animals that are suited to your location and have fewer health and production problems.

Nutrition

The quality and quantity **of** natural grasses vary from place to place, season to season. Different livestock species and breeds require different amounts and types **of** fodder for optimum production and health. Select the livestock types and adjust stocking numbers according to

- the quantity and quality **of** natural grasses, cultivated fodder, and **residues** available from your land.
- the quantity, quality, and productivity **of** fodder, fodder trees, and grasses available from common lands.
- your ability to purchase concentrates, fodder, and **residues**.

Access to water

Different species and breeds have different requirements for water:

- Goats, sheep, camels, and donkeys can survive on little water for long periods.
- Buffaloes need plenty **of** water for wallowing **in** order to keep cool (this also improves milk production).
- Lactating and working animals need more water.

Soil acidity

The acidity **of** soil affects how much nitrogen, calcium, and phosphorus is available to the plants and thus indirectly to animals.

Neutral to alkaline soils (pH 6.5 - 7.5)

Plants assimilate large amounts **of** nitrogen, so are rich **in** protein. Large animals can be maintained on alkaline soils due to greater availability **of** protein, calcium, and phosphorus.

Water sources

Choose your species and breeds according to the availability **of** water through out the year from:

- Private borewells

- Open wells
- Hand pumps
- Public common property canals
- Ponds
- Tanks
- Water holes
- Streams
- Rivers
- Open wells
- Borewells

Acidic soils (pH less than 5.5)

Natural grasses are low **in** protein, calcium, and phosphorus, but high **in** crude fibre. Small animals are more suitable to acidic soils due to lower availability **of** protein, calcium, and phosphorus. This leads to smaller muscles and bones.

Test the soil pH **in** your area and choose animals with body sizes suited to the availability **of** protein, calcium, and phosphorus **in** the natural herbage.

Temperature

Select animals which are adapted to the temperatures **in** your area.

- **In** hot areas, animals with short hair coats and thin skin, well-covered with sweat glands, are best suited.
- **In** cold, windy areas, animals with heavy coats for the cold season and smooth coats for the warmer periods are best suited.

For example, buffaloes have thicker hides than cattle and a lower density **of** sweat glands. Hence, they need to wallow **in** water **in** order to keep cool. They should not be grazed under the midday sun.

Terrain

Consider the following points:

- Large, heavy animals are at greater risk **of** injury when grazed on hilly terrain. Smaller-framed, nimble animals are useful here.
- Small bullocks can plough soils that are sandy and light. Heavy and larger animals are required to plough black cotton soil and clay or loam soils.

Ectoparasites

- Animals indigenous to an area often possess natural immunity to tick-borne and flea-borne diseases.
- **In** areas where insect-borne diseases are a particular problem, smooth-coated, short-haired animals, with large numbers **of** sweat glands and rich skin blood supplies, are preferred. These animals repel mosquitoes, flies, and ticks.
- Cross-bred, exotic cattle are more prone to tick-borne diseases, such as theileriosis and babesiosis.

Note

Many other factors should be considered when selecting and breeding animals, including land ownership, access to labour, access to capital, technical know-how and markets. You must also consider why you are raising the animal-for dung, meat, draught, milk, mixed purpose investment?

When selecting animals, consider:

Technical factors

- What health support facilities are available veterinarians, clinics, local animal healers, paraveterinarians?

Financial factors

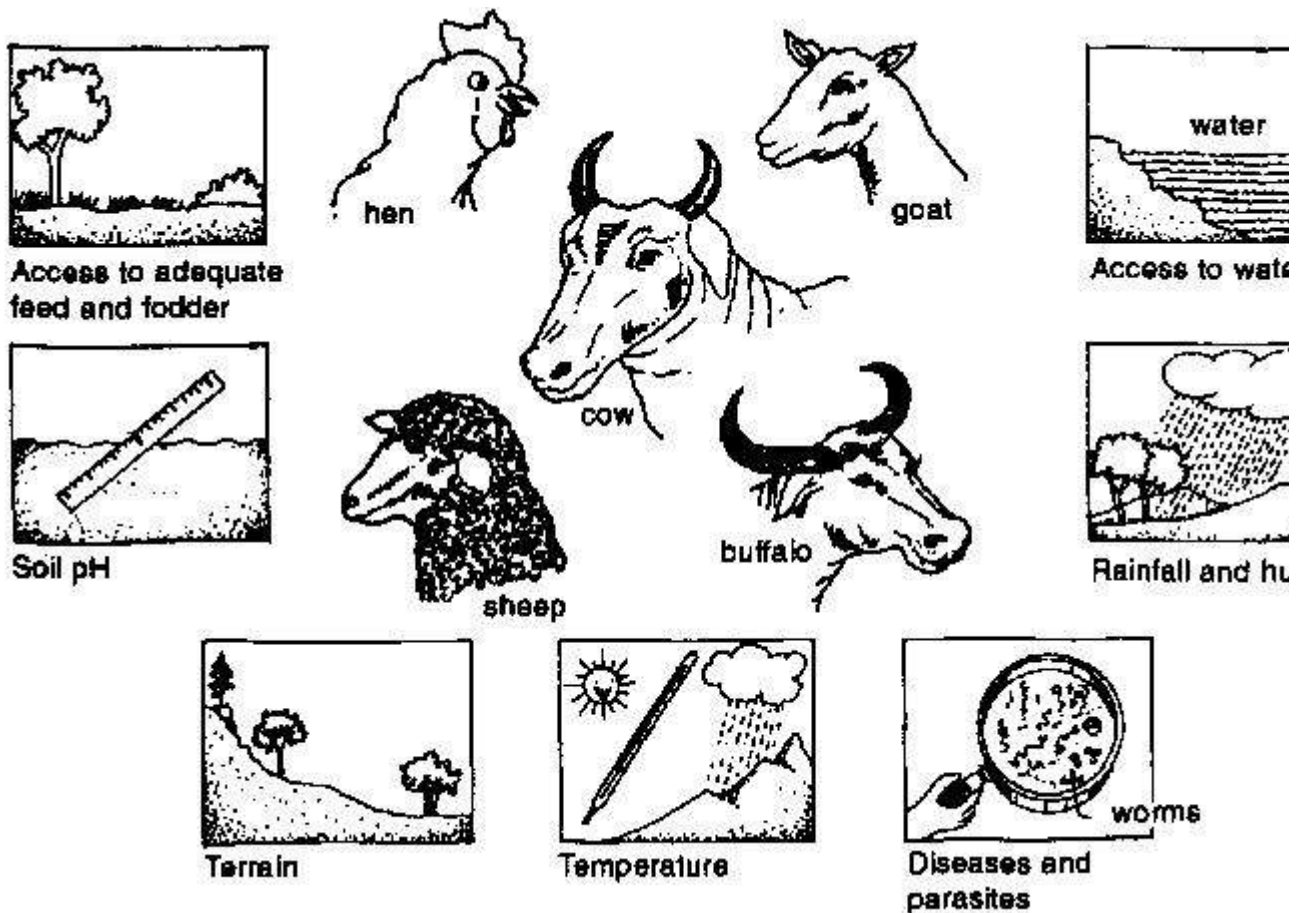
- Can you afford animal health services, or would it be more economical to rear animals that are naturally disease-resistant?

Endoparasites

- Internal parasites (worms, liver flukes, etc.) are a serious problem **in** some areas. While this is often a result **of** poor management, some indigenous breeds have developed resistance to endemic endoparasites.

Rainfall and humidity

Rainfall and humidity affect pasture production, groundwater availability and the population **of** ticks, mosquitoes, flies, and other insects and parasites **in** an area. They also influence the availability **of** minerals **in** the soil and the soil pH.



Adaptation **of** livestock to different agroecological conditions

Contributors: Ms Sagari R. Ramdas and Ms. Nitya Ghotge

Vegetables and post-harvest technologies

Nutrition garden

Every family, even landless labourers, can grow nutritious vegetables. It is easy and very rewarding: you will save money, improve your diet, and avoid eating pesticide-tainted vegetables often sold **in** the market.

Types **of** home gardens

Large gardens (at least 500 sq m)

Almost all types **of** vegetables can be grown **in** a large garden, including one or two large fruit plants, such as papaya, guava, lemon, grape, or dwarf mango.

Medium-size gardens (150 to 200 sq m)

Choose from tomato, eggplant, fenugreek, chill, French bean, bitter gourd, cucumber, spinach, amaranth, radish, turnip, carrot, lettuce, cauliflower, cabbage, summer squash, okra, cowpea, or cluster bean.

Small gardens (less than 100 sq m)

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Financial factors

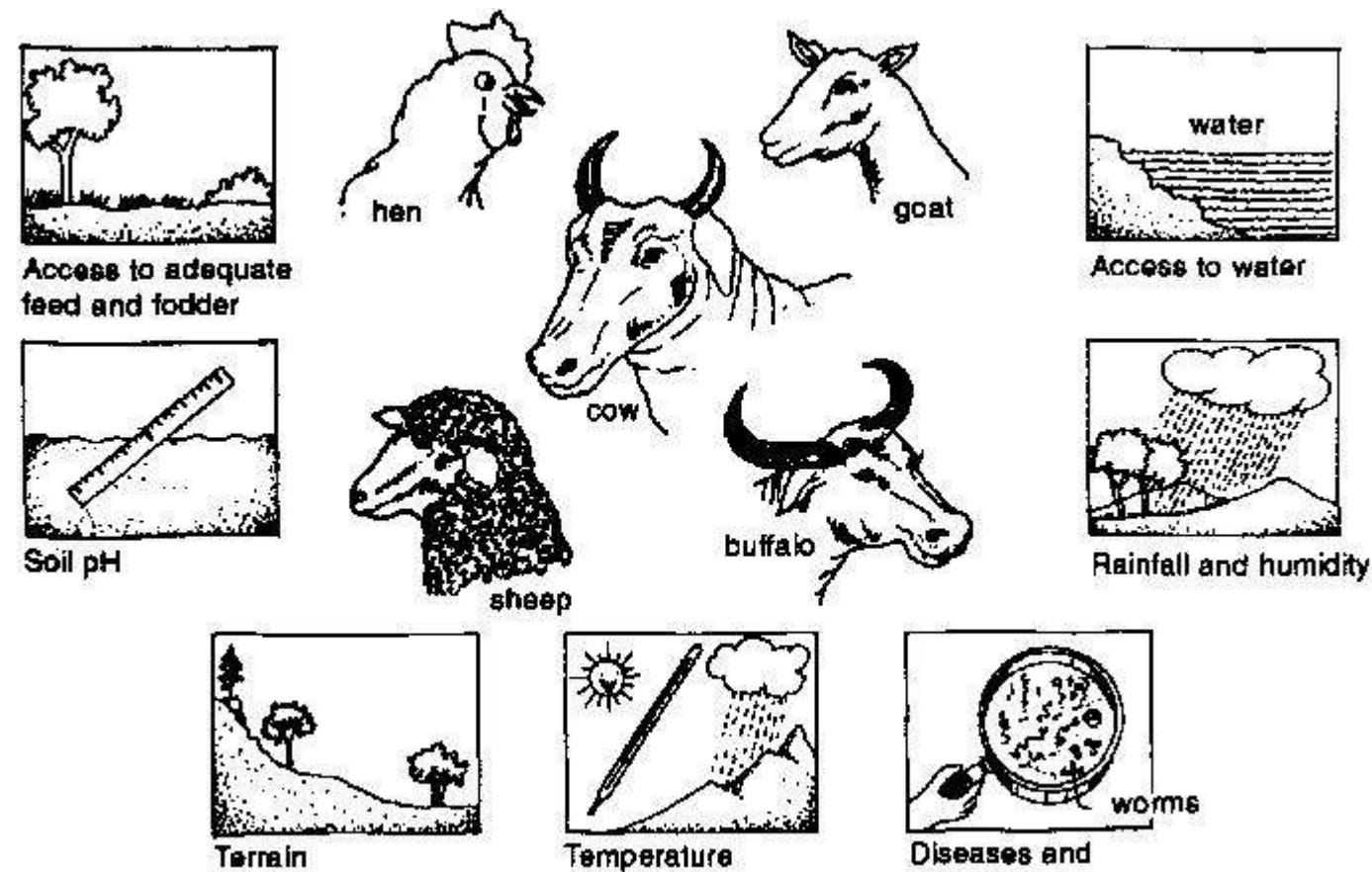
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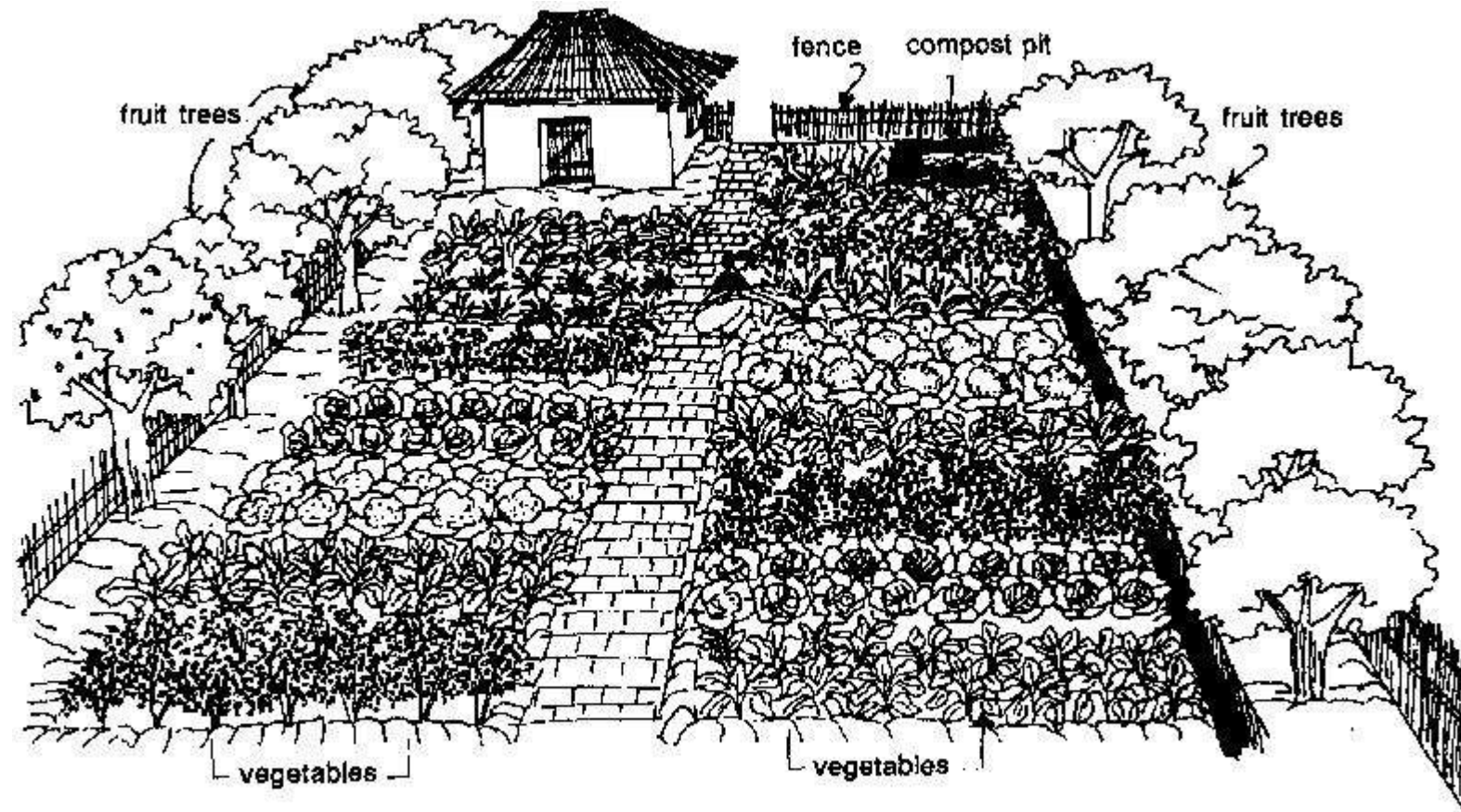
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Small gardens (less than 100 sq m)

Choose from amaranth, spinach, fenugreek, radish, turnip, tomato, eggplant, chill), lettuce, mint, or coriander.



Nutrition garden

Note

If frost threatens, irrigate frequently until the danger has passed.

Pest control

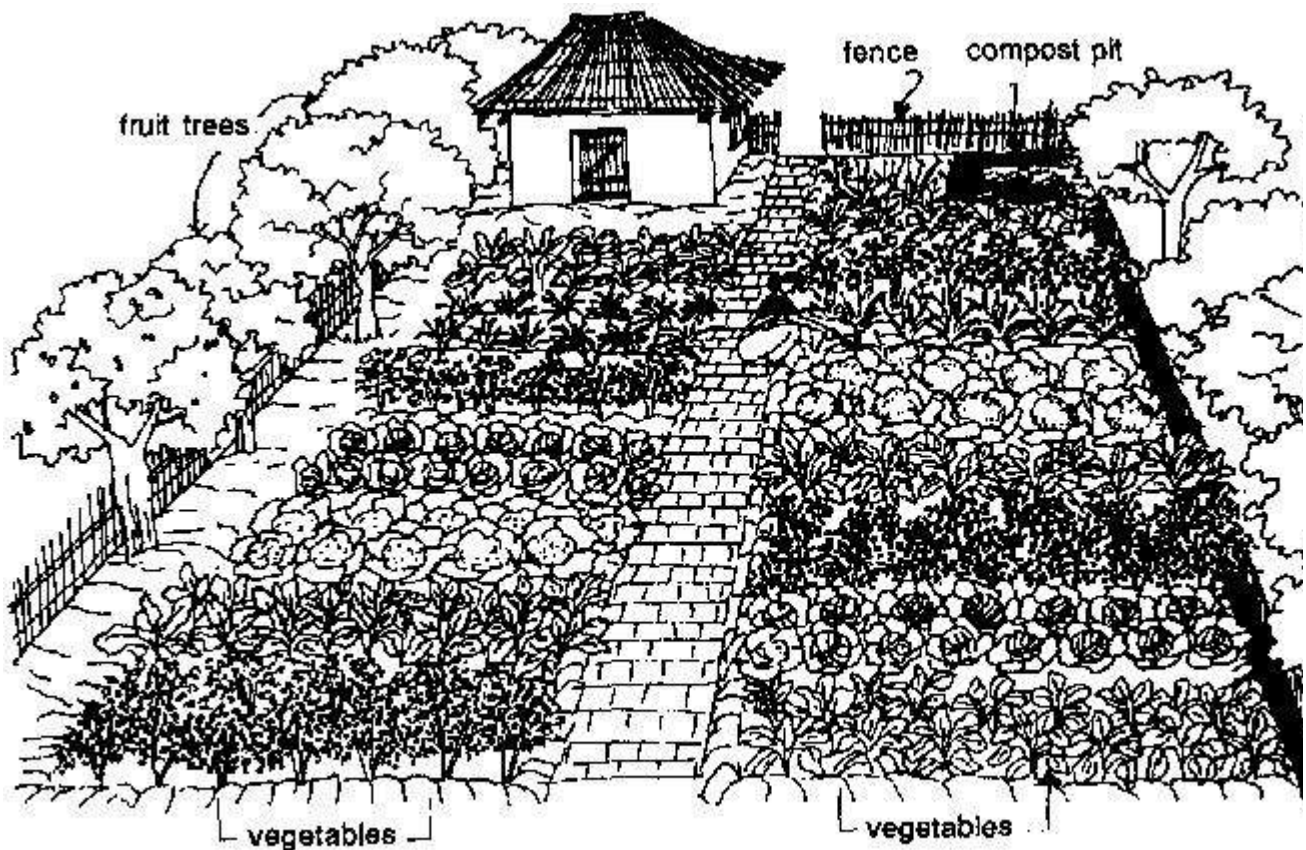
Pests can be a serious problem. Avoid costly damage by practicing the effective and safe techniques described in the section Integrate pest management. Using these simple techniques, you can also avoid costly and dangerous pesticides. See also Neem for plant protection and list of Banned and nonapproved pesticides in the glossary.

Market-bought fertilizers

Nitrogenous fertilizers, such as urea or ammonium sulphate, and phosphoric fertilizers, such as single superphosphate, and potassium fertilizers, such as murate of potash, are required for good vegetable and fruit crops. Single superphosphate and murate of potash should be mixed in the soil before sowing or planting. Nitrogenous fertilizers, such as urea, should be top-dressed once or twice in the standing crops.

Tools

Choose from amaranth, spinach, fenugreek, radish, turnip, tomato, eggplant, chill), lettuce, mint, or coriander.



Nutrition garden

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Tools

A few tools can be very useful: spade, hand hoe, watering can, sickle, knife, basket, small hand sprayer, twine, and bamboo stakes.

Container gardens

Some vegetables grow well **in** pots or containers placed on sunny terraces, window ledges, balconies, verandahs, or on the roof. Fill containers with a mix **of** sand, soil, and manure.

Choose from chilli, tomato, coriander, mint, amaranth, spinach, table radish, kulfa, lettuce, knol-khol, French bean, okra, fenugreek, cluster bean, green onion, garlic, leek, parsley, broccoli, and tomato.

Nutrition garden management

- Sow or transplant seedlings **in** rows or lines with proper spacing.
- Remove some seedlings if plants are crowded.
- If many seedlings die, plant more to take their place.
- Irrigate after transplanting.
- Remove weeds between the rows and between plants.
- Vegetables need regular watering for good growth and yield.
- On larger plots, irrigate lightly every third or fourth day during summer and once every one or two weeks **in** winter.
- Farm yard manure and compost are great fertilizers for vegetable gardens. Mix them **in** the soil about a week before sowing or transplanting. (See Vermi-composting and **Organic** farming)
- Apply a nitrogenous fertilizer, such as urea, **in** small quantities **in** standing crops for higher plant growth and yield. Apply urea only when the soil is moist; otherwise, give a light irrigation after application.

Garden layout

Important points for laying out and planning your nutrition garden:

- Your garden will need plenty **of** sunlight.
- Rectangular gardens are better than square gardens, but any shape will do.
- Avoid the shade **of** big trees.
- Locate near a water source if possible.
- Vegetables which lose their quality and freshness rapidly after harvest, such as spinach, amaranth, fenugreek, mint, and radish, should be given priority **in** the garden.
- Plant root crops along the ridges which separate plant beds.
- Climbing vegetables make good **use of** space. Train them up fences, walls, or grow them on terraces.
- Dig one or two compost pits **in** a shady, unused corner **of** your plot.

Nutritious vegetables

Vegetables supply vitamins, essential amino acids, carbohydrates, and proteins for good health. Dieticians say that adults require about 300 g **of** vegetables: 125 g **of** green leafy vegetables, 100 g **of** roots and tubers, and 75 g **of** some other vegetables. But most people eat less than these amounts. The following matches important nutrients with their vegetable sources: carbohydrates potato, sweet potato, colocasia, beetroot

Protein peas, carpet legume, French bean, cowpea, clusterbean, amaranth, broadbean

Vitamin Carrot (yellow type), spinach, turnip, amaranth, sweet potato (yellow-fleshed), pumpkin (yellowfleshed), cabbage, fenugreek, tomato, coriander, broccoli, parsley

Vitamin B peas, carpet legume, garlic, colocasia

Vitamin C- tomato, turnip, green chillies, cauliflower, knol-khol, bitter gourd, radish leaves, amaranth, Brussels-sprouts, parsley

Calcium beetroot, amaranth, fenugreek, turnip leaves, coriander, pumpkin, onion, tomato

Potassium-sweet potato, potato, bitter gourd, radish, carpet legume

Phosphorus garlic, peas, bitter gourd

Iron-bitter gourd, amaranth, fenugreek, mint, Indian spinach, spinach

Harvesting

- Vegetables harvested at the peak **of** their maturity and used promptly are always superior **in** nutrition, flavour, taste, and appearance.
- Harvest root vegetables while they are still tender-delay can make them pithy, tough, and unfit for consumption.
- Harvest all fruit and pod vegetables when they attain their proper size, while they are still tender.
- Melons, tomatoes, and ash gourd can be allowed to ripen on the vine.
- Clip leafy vegetables frequently at their most succulent and tender stage.
- Pumpkin, chill), colocasia tubes, and onion bulbs can be harvested as immature or mature produce.

Vegetable crops for different seasons

In northern parts **of** India, there are three distinct seasons for growing vegetables. The following lists the vegetables suited to each season.

Winter (October-February)

Potato, cauliflower, cabbage, knol-khol, broccoli, carrots, Brussels sprouts, kale, radish, turnip, carrot, beetroot, onion, garlic, leek, broad bean, lettuce, parsley, celery, peas, spinach, fenugreek, mustard, coriander, fennel.

Summer (March-June)

Okra, cowpea, cluster bean, tomato, eggplant, chill), capsicum, garden bean, pumpkin, bitter gourd, bottle gourd, luffa, cucumber, melons, amaranth, colocasia, asparagus.

Rainy season (July-October)

Okra, cowpea, clusterbean, chill), eggplant, tomato, capsicum, cucurbit vegetables (except melons), radish, tumip, carrots, sweet potato. colocasia.

Preserving nutrients

Many people destroy valuable nutrients when they cook their food. The following points will help you choose and prepare nutritious meals.

Eat food fiber

Dietary fiber, or roughage, aids **in** digestion. It is available **in** whole grains, fresh fruits, and vegetables. Whole wheat bread, bran cereals, crunchy raw carrots, and other root crops are especially valuable sources **of** fiber.

Eat unpolished rice

Eat unpolished rice. And remember, the water left after cooking your rice is very nutritious.

Eat plenty **of** salad

Salad improves your appetite and aids digestion.

Eat fresh seasonal fruits and vegetables

Fruits and vegetables are very nutritious, and very tasty. Eat them **in** season and preserve them to have all year round.

Preserving nutrients

Follow these tips to reduce nutrient loss during cooking and processing:

- Eat the leaves **of** root vegetables, such as turnips, radish, beets, and knolkhol. Their leaves contain more nutrients than the root. Cook them with potatoes or a leafy vegetable.
- Cook vegetables **in** a pressure cooker. This saves time and retains more **of** the vitamins B and C.
- Salads, fruits, and vegetables should be washed first and then cut to prevent washing away water soluble vitamins B and C and minerals.
- Cook, preserve, or process cut fruits and vegetables immediately after cutting. Long soaking **of** cut fruits and vegetables washes away valuable nutrients.
- Select fresh and sound fruits and vegetables for cooking.
- Avoid deep-frying.
- Cook leafy vegetables on a low flame. Carrots and pumpkin can be cooked on a high flame.

Preservation **of** vegetables and fruits

- 1 Select raw vegetables, such as cauliflower, ginger, lotus stem, carrot, radish, and raw mango slices.
- 2 Peel, cut, and wash the raw material.
- 3 Place the prepared material **in** glass jars.
- 4 Prepare a chemical solution **in** preboiled tap water using 3 percent salt, 0.8 percent glacial acetic acid, and 0.2 percent potassium metabisulphite.
- 5 Pour the chemical solution into the glass jars containing the fruit and vegetables. Fill to the brim. (There should be about 1 1/2 as much solution as fruit and vegetable mix.)
- 6 Close the jars tightly and store them **in** a cool and dry place.
- 7 Wash the vegetables and fruit thoroughly before cooking. For pickles, pakora, and chutney, the preserved mix can be used immediately after straining.

Preservation **of** whole tomato pulp

- 1 Select fully ripe, red, and undamaged tomatoes.
- 2 Wash them and cut them into pieces. Remove any green portions.
- 3 Boil them **in** a stainless steel or aluminium vessel and crush the pieces with a ladle or **in** a blender.
- 4 Boil on mild heat until the weight **of** the whole mass is reduced to one third, i.e., into a thick paste.
- 5 Towards the end **of** the cooking, add a teaspoon (5 ml) **of** glacial acetic acid for every kg **of** the paste and boil for 5-8 minutes.
- 6 For every kg **of** finished product, add 0.4 g potassium metabisulphite and 0.2 g sodium benzoate dissolved **in** a small amount **of** water. Mix thoroughly.
- 7 Fill the hot crushed tomato pulp **in** clean dry glass jars up to the brim. Seal the jars tightly and store **in** a cool, dry place.

Lactic fermentation **of** vegetables

- 1 Select good cabbage heads and carrot roots.
- 2 Remove outer leaves **of** the cabbage and cut them into narrow shreds. Peel carrots, wash, and shred. Mix cabbage and carrot shreds **in** the ratio **of** 1:1.
- 3 To the mixed vegetables, add 2.5 percent salt and 1.5 percent mustard powder (rai).
- 4 Shake the whole mass daily for up to two weeks.
- 5 The fermented product is ready to eat.

Contributor: Dr. Vijay Sethi

Preservation

Consider preserving your fruits and vegetables so you can enjoy them **in** the off season. They can be bottled, pickled, turned into chutneys, preserved as pulp or juice, fermented, or dried **in** the sun. There are various preservation techniques using sugar, salt, spices, chemical preservatives, or **organic** acids. Consult your local government nutritionist or look for someone **in** your community who can teach you food preservation techniques.

Preservation by fermentation

Do you grow vegetables? If so, try this simple, low-cost preservation technique. By preserving vegetables **in** the peak season, you can enjoy nutritious vegetables all year round.

Fermentation

Fermentation is a great way to preserve several types **of** vegetables together at one time. One **of** the vegetables **in** the mix should be cabbage. Cabbage contains substances which help **in** fermentation. When cabbage is not available, radish or cucumber will serve the purpose.

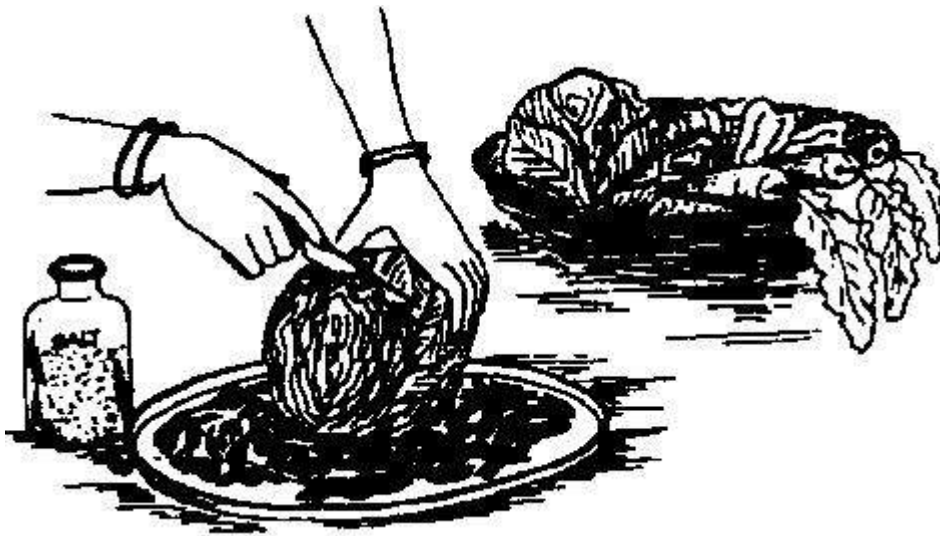
Procedure

1 Select any type **of** vegetable except potato, sweet potato, or other vegetables which are rich **in** carbohydrates. Wash the vegetables thoroughly **in** clean water, and wipe them dry with a clean, rough cloth.



Procedure

2 Shred the vegetables, preferably with a stainless steel knife or shredder.



Shred the vegetables

3 Cabbage (or radish or cucumber) should comprise at least half the total weight **of** the vegetable mix.

4 Add 22 g (4-5 tsp) **of** common salt per kg **of** shredded vegetables and mix it thoroughly. Allow it to stand for an hour or two.

5 Put the mixture **in** a glass or plastic container, such as a bucket. The size **of** the container depends on your requirement. If you are using a wood or earthen container, coat the inside with wax.

6 Press down on the shredded vegetable mix until the brine solution is squeezed to the surface.



Press down on the shredded vegetable

7 Take a plastic sheet (200 gauge) twice the size **of** the mouth **of** the container and cover the mix.

8 Press down on the plastic sheet to expel all the air.



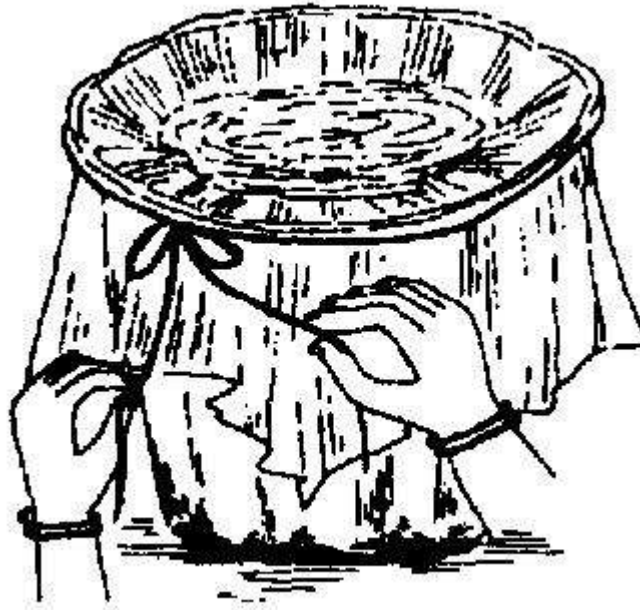
Press down on the plastic sheet to expel all the air

9 Pour water on the plastic sheet so that the sheet will be forced down on top of the vegetable mix.



Pour water on the plastic sheet so that the sheet will be forced down on top of the vegetable mix.

10 Fasten the hanging edges **of** the plastic sheet with a thick thread around the neck **of** the container to make it airtight.



Fasten the hanging edges **of** the plastic sheet with a thick thread around the neck **of** the container to make it airtight.

11 Keep the container **in** a cool place.

Note

Vegetables can be preserved by fermentation for about three months. But, once the container is opened, the vegetables **in** it should be used the same day. If this is not possible, preserve the leftover vegetables by bottling, refrigeration, or the **use of** preservatives.

Soft drink

To make a refreshing soft drink, add sugar and spices to the fermented juice, heat, and serve.

Preparation

Fermented vegetables are sour. So, wash the mixture thoroughly with water. This will remove the acid and salt. Cook the mixture to your taste.

Fermented juice

Instead **of** washing off the fermented juice, you might like to collect it and serve it as a nutritious drink. Fermented vegetable juice is rich **in** vitamins B and C. It is a good appetizer served before meals, and can be used as a stock for curries.

Contributor: Dr. Suneet Mukerjee

Zero-energy cool chamber

Spoilage **of** fresh fruits and vegetables is a serious problem **in** tropical countries. Cool storage can prolong the life **of** fresh produce, but refrigeration equipment is expensive to buy, expensive to run,

and expensive to maintain. There is, however, a practical, low-cost alternative for on-farm fruit and vegetable storage which employs the cooling power of evaporation. Zero energy cool chambers stay 10- 15° C cooler than the outside temperature and maintain about 90 percent relative humidity. And they are easy to build out of locally available materials, such as brick, sand, bamboo, straw, and gunny bags.

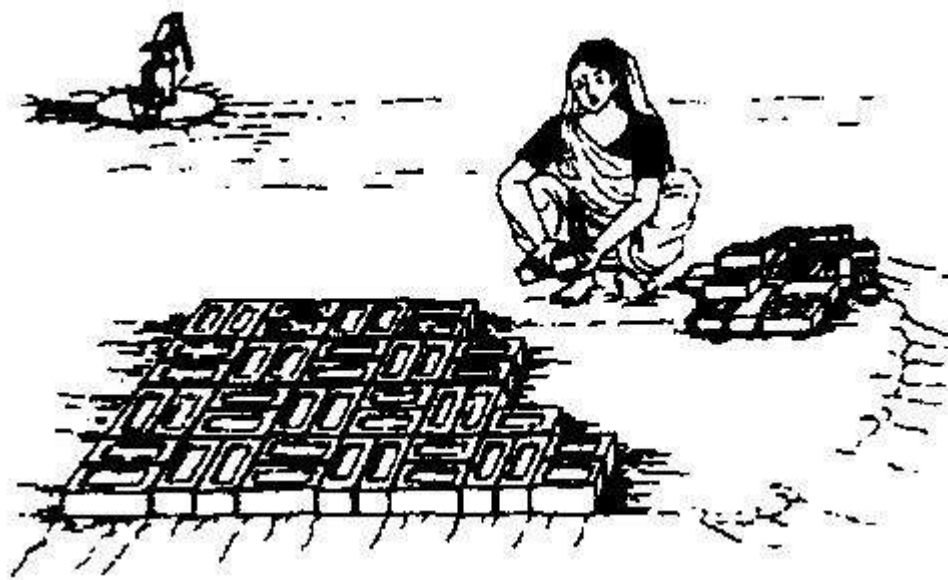
Living and breathing

Fresh fruits and vegetables are alive. They breath and ripen even after harvest. Cool temperatures stew this process, allowing you to keep your fresh produce longer and avoid spoilage.

Construction

1 Select a raised site close to a source of water.

2 Make a floor with bricks.



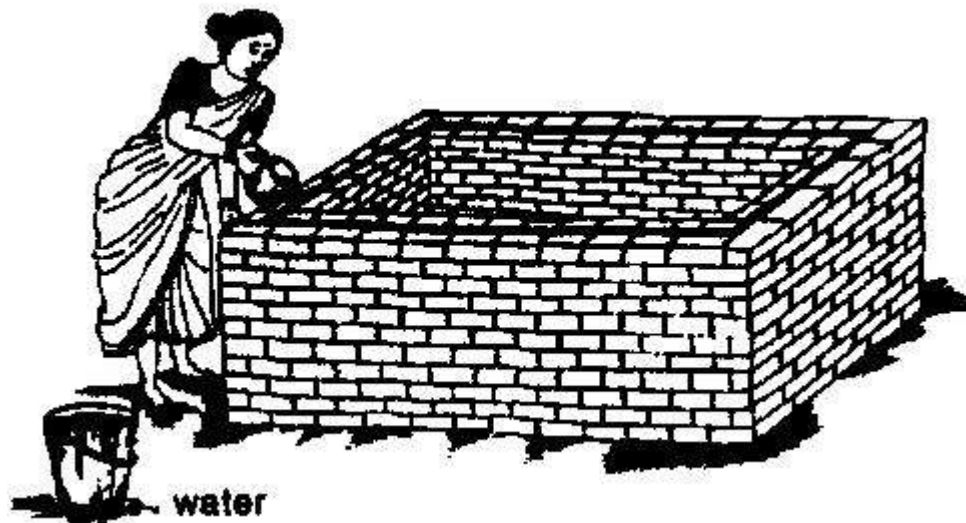
Make a floor with bricks.

3 Erect a double wall 70 cm high, leaving a cavity 7.5 cm wide between the two walls.



Erect a double wall 70 cm high, leaving a cavity 7.5 cm wide between the two walls.

4 Drench the chamber with water.



Drench the chamber with water.

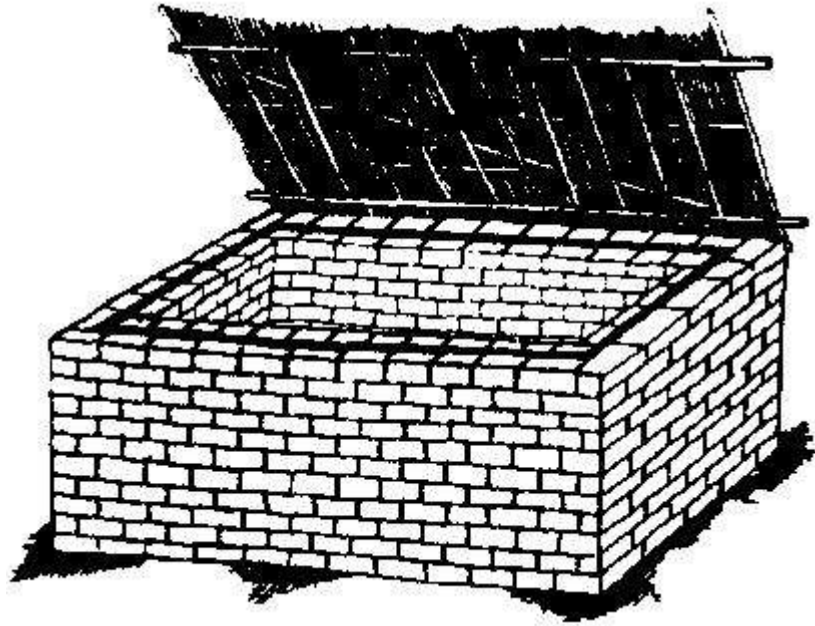
5 Soak fine, river-bed sand with water.

6 Fill the cavity between the double wall with this wet sand.



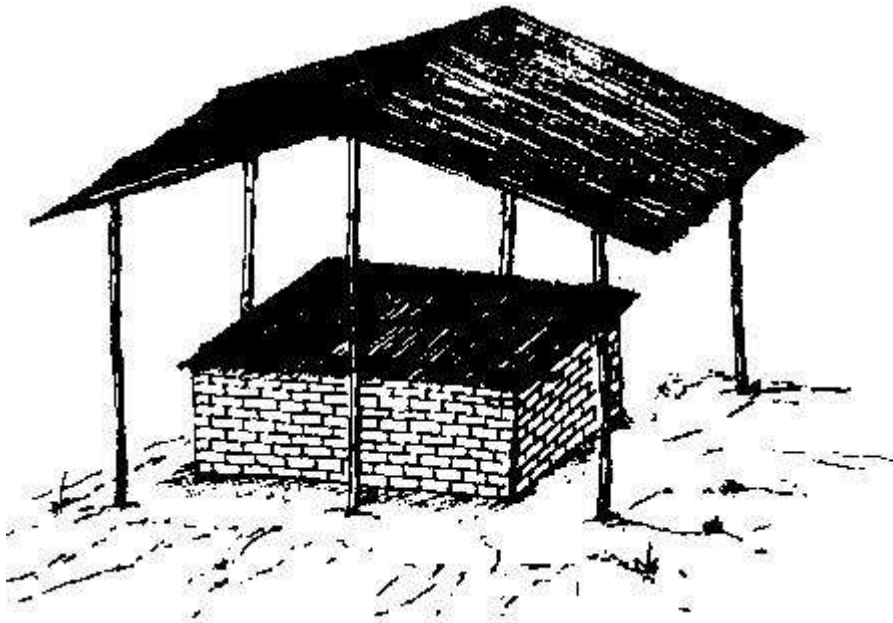
Fill the cavity between the double wall with this wet sand.

7 Make a cover frame **of** bamboo, sirki, straw, or dry grass.



Make a cover frame of bamboo

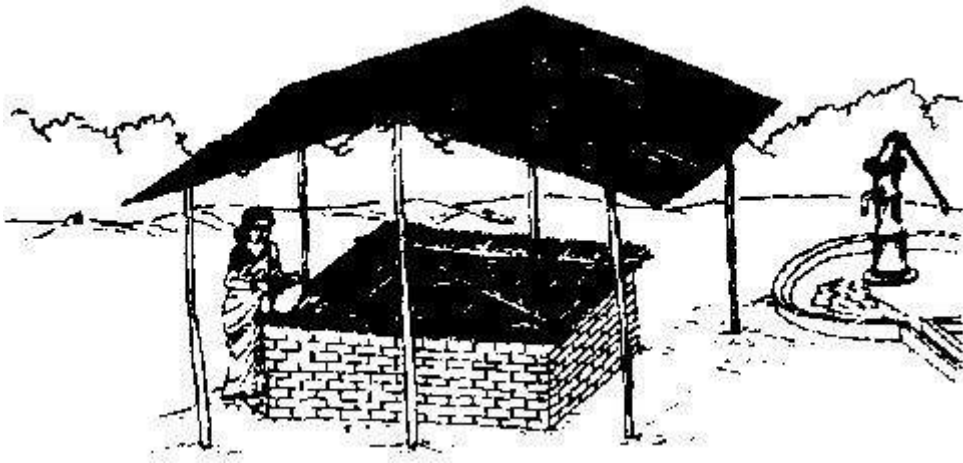
8 Build a thatched-roof shed over the chamber to shield the chamber from direct sun and rain.



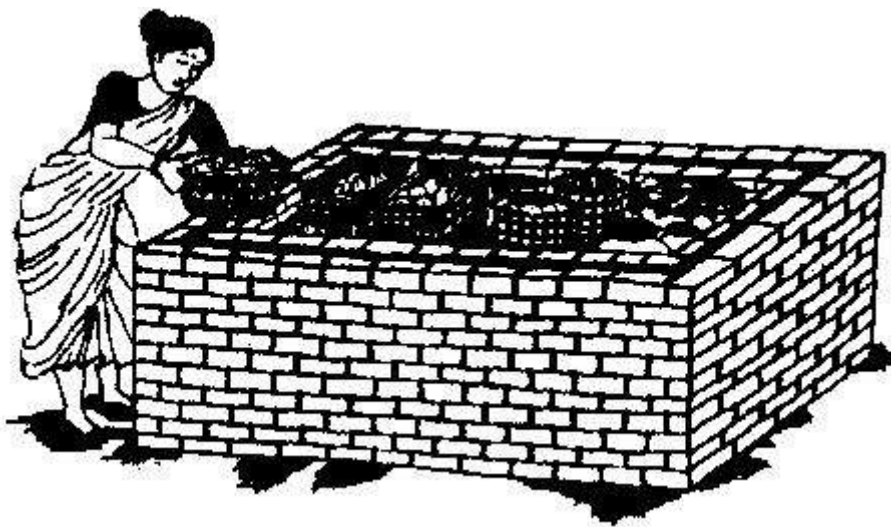
Build a thatched-roof shed over the chamber to shield the chamber from direct sun and rain.

Operation

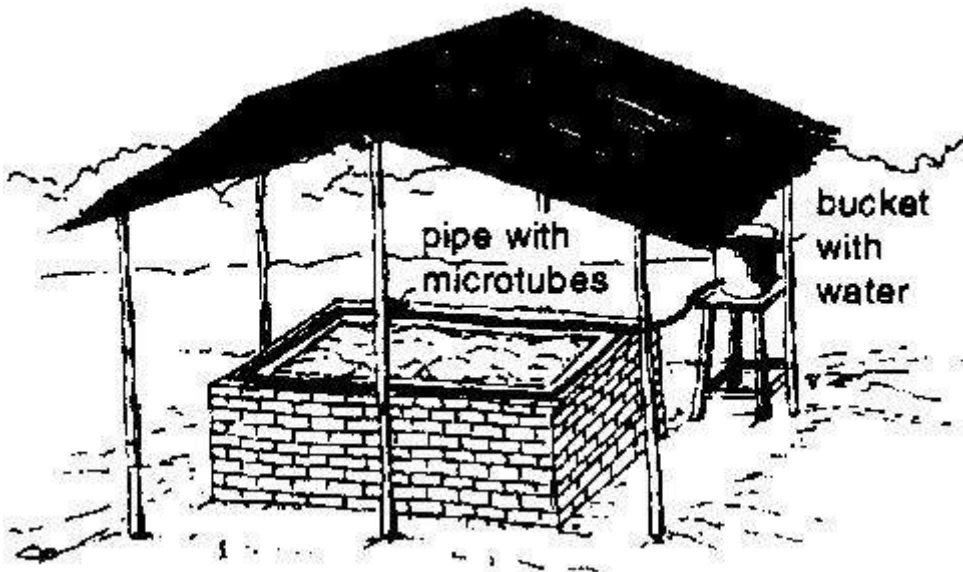
- Keep the sand, bricks, and top cover of the chamber wet.
- Water twice daily, in the morning and evening. A drip system can be built with plastic pipes, microtubes connected to an overhead water source.
- Store your fruits and vegetables in perforated plastic crates. Do not use bamboo, wood, or fibreboard boxes because these will be damaged by moisture.



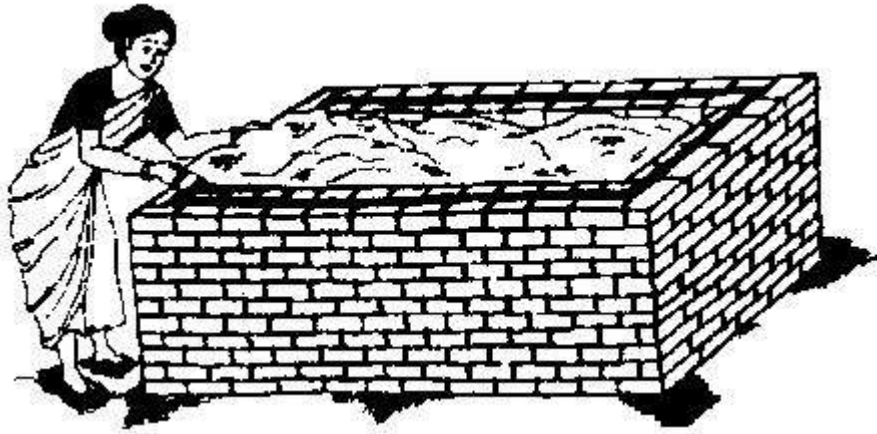
Water twice daily.



Watering with drip system



Cover these crates with a thin polyethylene sheet.



Rebuild the chamber with new bricks after 3 years. (The bricks' pores become blocked over time and this reduces the chamber's effectiveness.)

Advantages

- Can be constructed by an unskilled person No mechanical or electrical energy is needed.
- Allows small farmers to store produce for a few days and thus avoid costly rush selling.
- Ideal for household storage.
- Reduces losses and thus pays for itself **in** a short time.
- Useful for temporary storage **of** curd, milk, and cooked food.
- Can also be used for mushroom cultivation, raising silk - worms, and storage **of** biofertilisers.

Disadvantages

- Requires a significant capital investment
- Operation relies on a reliable source **of** water throughout the year.

Shelf life **of** fruits and vegetables **in** zero- energy cool chamber

Produce	Time <u>of</u> storage	Outside(days)	Cool chamber(days)
Leafy vegetables	Summer	< 1	3
	Winter	3	8-10
Other vegetables	Summer	1-2	5-6
	Winter	4-5	10-12
Potato	Spring/Summer	40	97
Mango	Summer	4	8
Orange	Winter	8-10	50-60

Notes

Build your chamber on a site where breezes blow.

Build on an elevated site to avoid waterlogging.

Use clean, unbroken bricks with good porosity.

Sand should be clean and free **of organic** matter, clay, etc.

Keep the bricks and sand saturated with water.

Prevent water drops from contacting stored produce.

Keep the chamber clean.

The empty chamber should be treated with an approved fungicide and insecticide.

Caution

Remove all produce before treating the chamber with insecticide or fungicide.

Cost **of** cool chamber

Bricks (400)	Rs 400
Sand	Rs 50
Bamboo	Rs 30
Other accessories	Rs 120
Outside shed	Rs 400
Total	Rs 1000

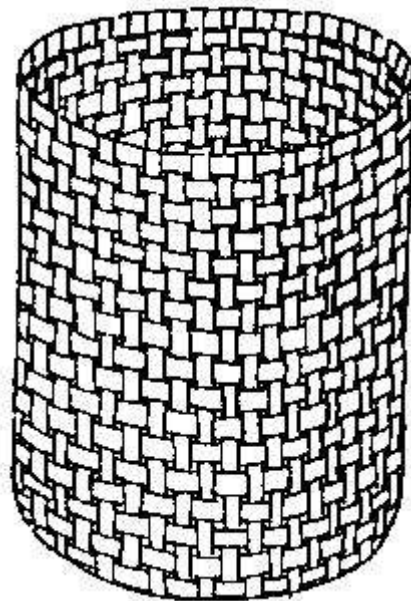
Contributor: Dr. S. K. Roy

Bamboo iceless refrigerator

In rural areas, storage **of** vegetables, milk, and other perishable food items is a problem, especially **in** the hot summer months. The bamboo iceless refrigerator is a low-cost device for storing food. It can be made easily by **rural** women out **of** commonly available materials.

Materials needed:

- A cylindrical basket made **of** bamboo or slender sticks **of** wood with an open weave
- A loose-fitting lid
- Jute cloth
- Metal or clay tray (circular or square)
- Stones or bricks.



Basket



Loose-fitting lid

Build the iceless refrigerator large enough to meet your family's requirements.

Construction

1 Cover the basket loosely with the jute cloth. Sew the jute cloth around the rim **of** the basket. The lower end **of** the cloth must hang loosely around the bottom, exceeding the length **of** the basket.

2 Arrange four or five bricks or stones **in** a circle. Place the metal or clay tray on top.

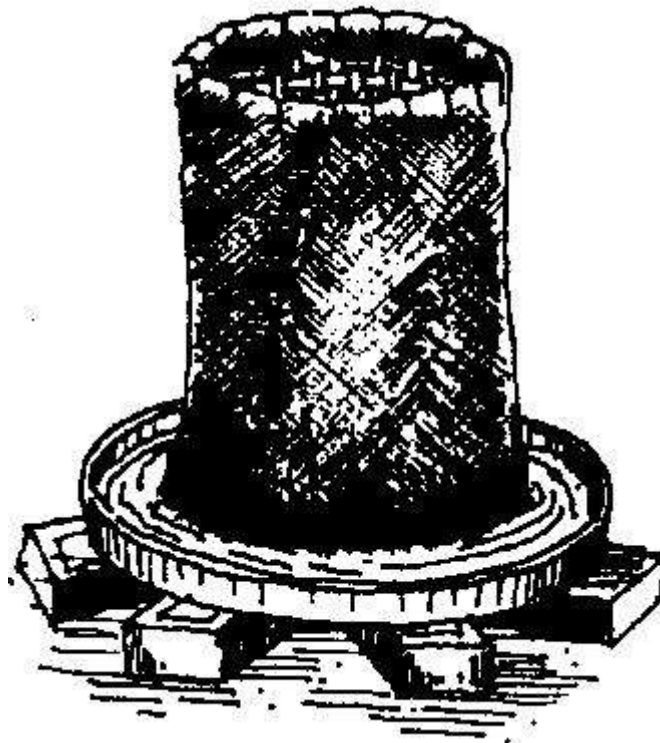
3 Place three to five stones (or bricks broken **in** half) **in** a circle inside the tray.

4 Place the jute-covered basket on top **of** the stones **in** the tray. basket loose-fitting lid

5 Fill the tray with water. Make sure that the loose ends **of** the jute cloth dip into the water.

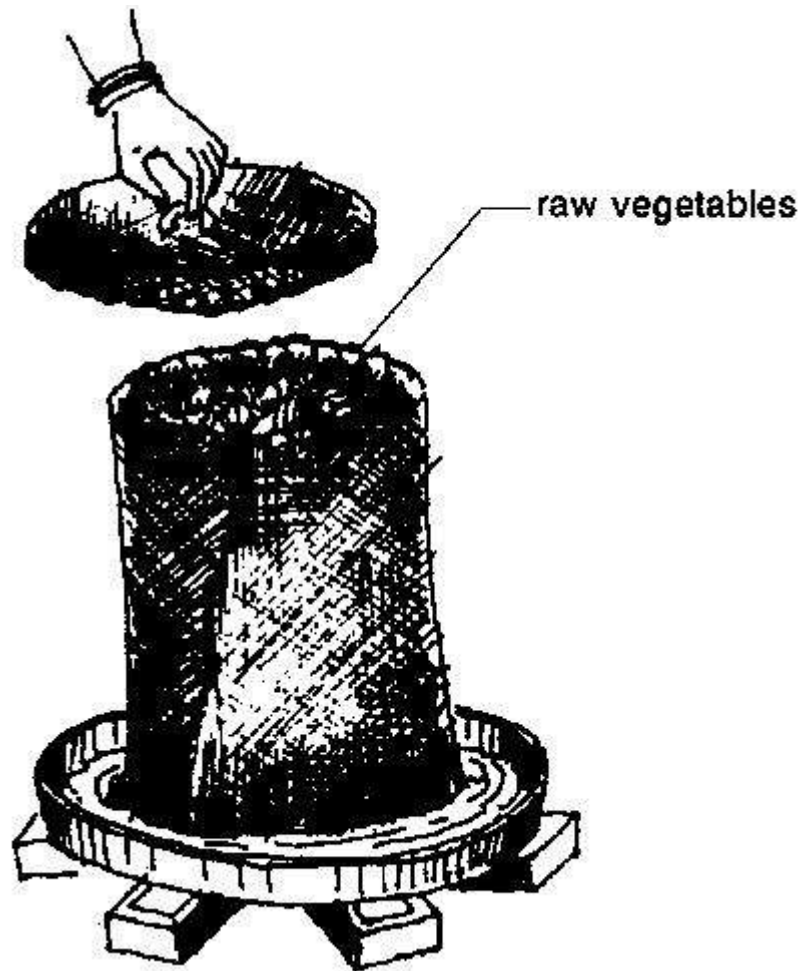
Using the iceless refrigerator

6 Place your perishable food **in** the basket.



Place your perishable food **in** the basket

7 Cover the basket with the loose-fitting woven lid. Cover the lid with a loose fitting, wet jute cloth.



Cover the basket with the loose-fitting woven lid. Cover the lid with a loose fitting, wet jute cloth.

8 The water will evaporate from the cloth, keeping the contents **of** the basket cool and fresh. Dampen the jute material-top and sides periodically with clean water.



The water will evaporate from the cloth, keeping the contents **of** the basket cool and fresh. Dampen the jute material-top and sides periodically with clean water.

Source: Consortium **of Rural** Technology, New Delhi

Organic farming

Organic farming

Deadly

Pesticides are dangerous to human health: 22,000 people die **in** developing countries each year from pesticide poisoning.

High dosages **of** fertilizers and liberal **use of** synthetic pesticides can pollute water, air, and soil. Pests can develop resistance to pesticides and previously unimportant pests can emerge

The health **of** the soil is also adversely affected. Certain micronutrients such as zinc, copper, and iron can become deficient **in** the soil over a period **of** time. As a result, it becomes increasingly difficult for farmers to sustain high yields year after year.

How can we face this critical dilemma **of** consistently obtaining high crop yields without polluting soil, air, and water, and without depleting soil fertility? The answer perhaps lies

In organic farming.

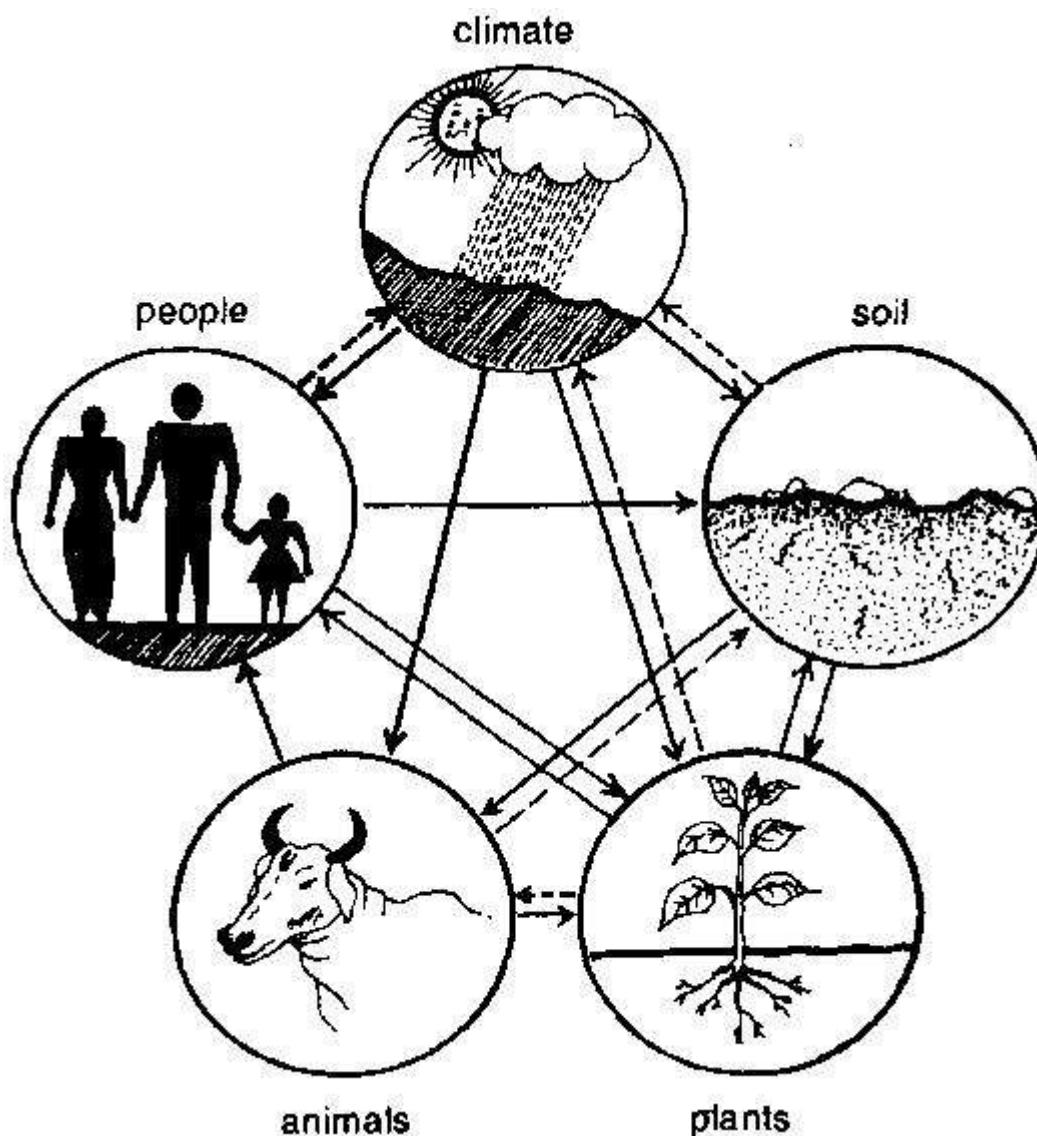
What is **organic** farming?

The aim **of organic** farming is to increase productivity with minimum reliance on chemicals, while at the same time conserving resources. It is a rediscovery **of** the practices **of** our ancestors, but with a modern and scientific outlook. It nurtures the soil rather than just a particular crop.

The **use of** synthetic chemicals is minimized (to the level **of** bare necessity). There is a greater reliance on conservation and **use of** all resources available on the farm, including animal, human, and plant wastes.

The goal **of organic** farming is to achieve stability without sacrificing high production and without polluting water, soil, and air.

It requires a multidimensional approach involving many practices.



Ecosystem integrated complex

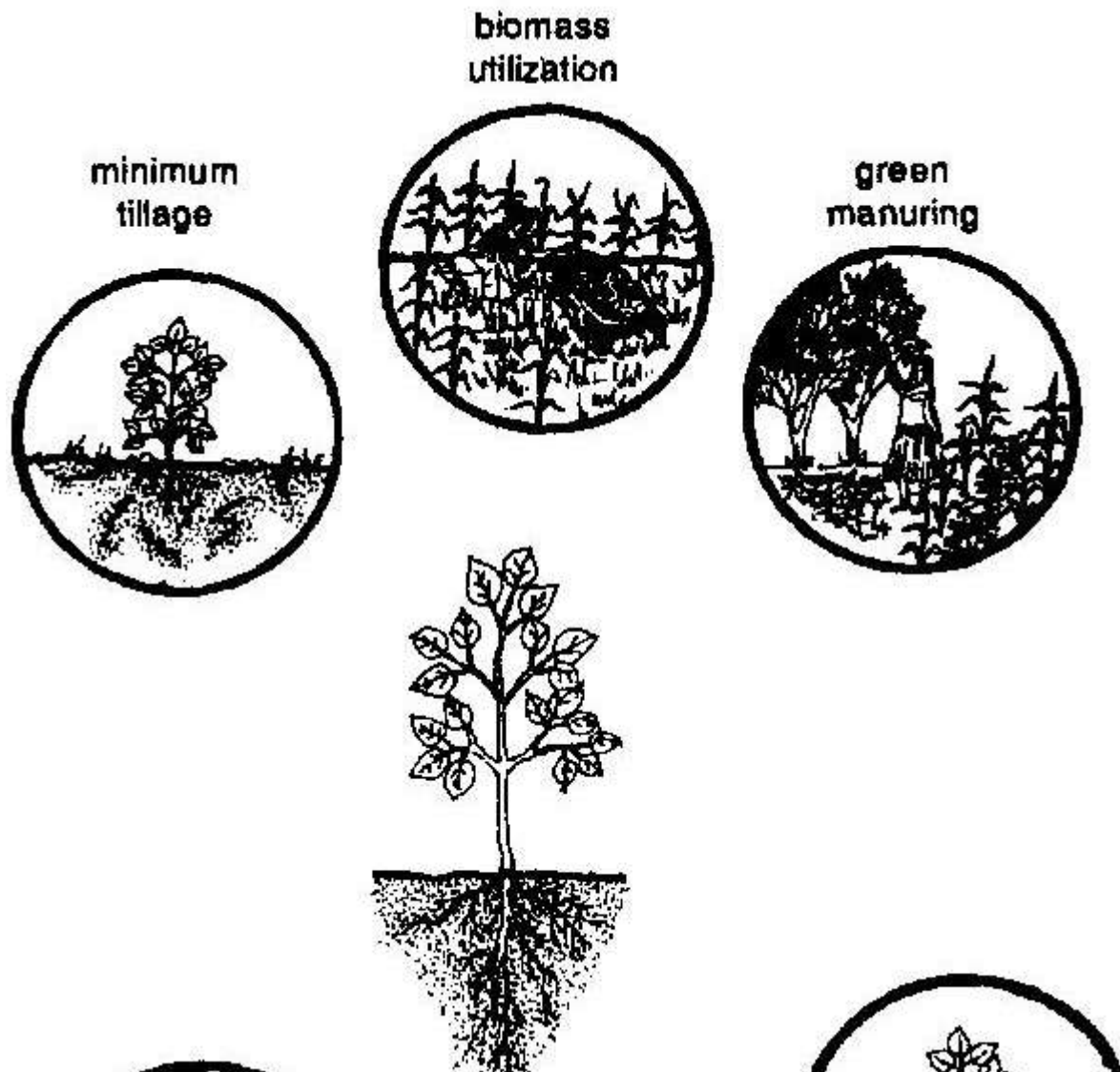
Integrated nutrient management

- **Use** minimum tillage practices to conserve soil **organic** matter and biotic life including earthworms.
- Convert all available biomass on the farm into compost rather than burning or otherwise wasting it. (See Compost-making and Vermicomposting.)

- Add at least 2-3 tonnes **of** compost per hectare annually. The ideal is 10 tonnes per hectare.
- Apply green manure to the fields after every second or third year. For instance, prunings from gliricidia or other leguminous trees planted on bunds can be incorporated **in** the rice fields at the time **of** puddling. This can reduce or eliminate the need for artificial fertilizers.

Incorporate leguminous plant material into the soil.

- Make up soil deficiencies, if any, (on a soil test basis) by applying minerals such as rock phosphate, gypsum, and pyrites.
- Manage weeds using nonchemical methods, rather than trying to eradicate weeds. (See Nonchemical methods **of** weed control.)
- Leave the weeds taken out **of** the fields to form a mulch and to decompose **in** the soil itself Or **use** them for making compost.
- Adopt suitable crop rotations, mixed cropping and intercropping, instead **of** growing one and the same crop year after year. This uses soil layers, space, and sunlight differently..
- Include legumes **in** the rotation; inoculate them with rhizobium culture.



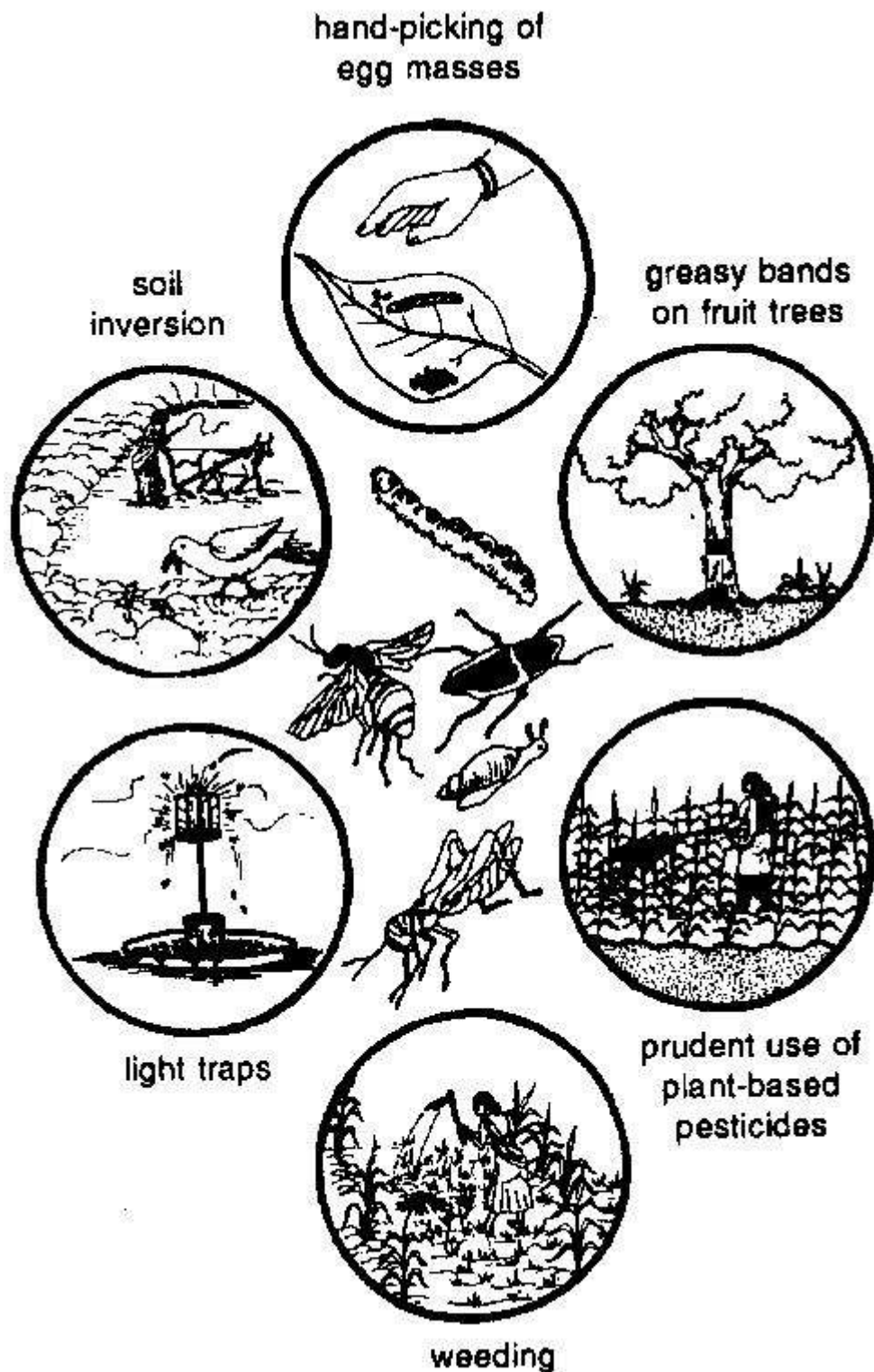
Incorporate leguminous plant material into the soil

Integrated pest and disease management

Organic farming uses various practices to manage the pest population at a safe level (one that does not cause economic injury) rather than completely destroying them using synthetic chemicals.

These practices include the following:

- Invert the soil after harvesting a crop to expose pests.
- Clean bunds and channels **of** grasses which harbour pests.
- Grow pest-tolerant varieties.
- Sow the crops at the right time.
- Sow healthy seeds.
- Increase the seed rate so that uprooting insect and disease-infected plants later does not affect optimum plant populations.
- Hand-pick and destroy egg masses, gregarious larvae, caterpillars, and adult beetles.
- **Use** light traps.
- Apply sticky grease bands on fruit trees to stop insects from crawling up the trunk.
- Release insect parasites and predators, and apply biological control agents such as *Bacillus thuringiensis*.
- When pesticides are used, restrict these to a few mainly plant-based pesticides: neem, karanj products, derris (also known as rotenone), and pyrethrum



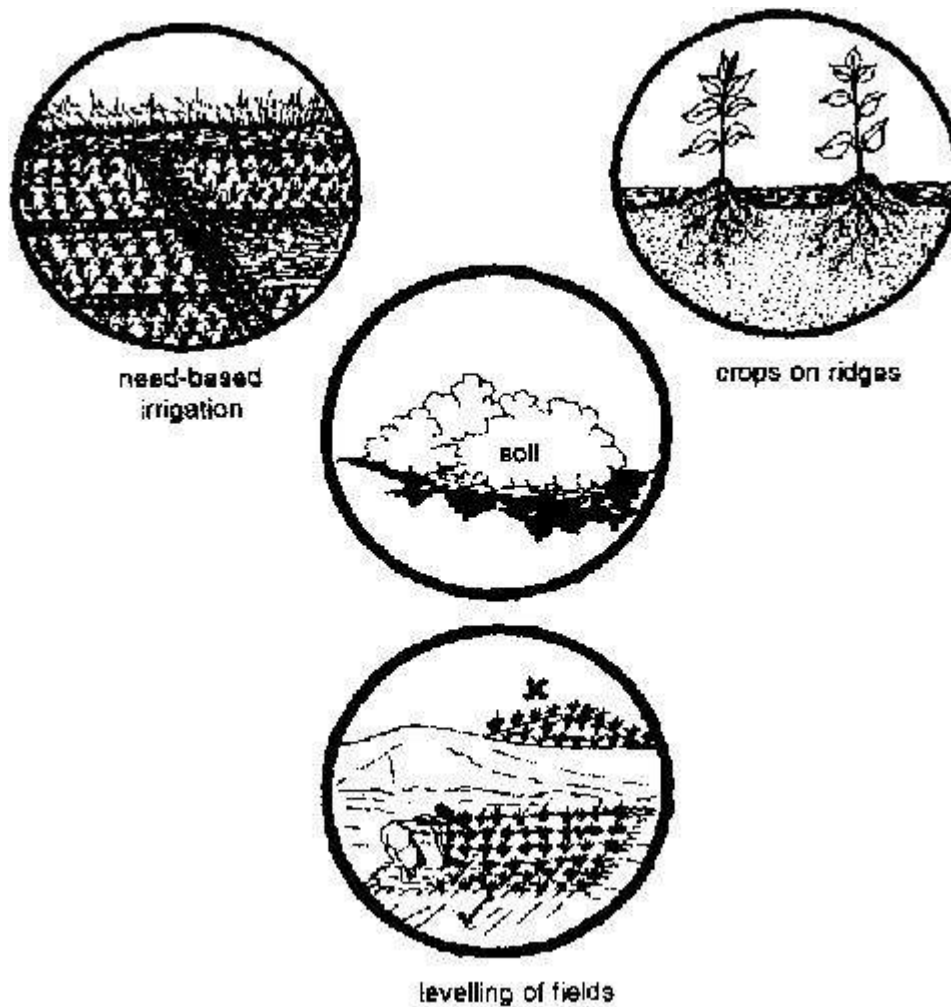
Integrated pest and disease management

Integrated soil and water management

Apply irrigation water efficiently to avoid wasting water and controlling soil erosion and loss **of** nutrients through runoff and leaching. For this:

- Irrigate your crops only when needed, **use** only the required amount **of** water. For instance, fields can be divided into small sections which can be irrigated separately.
- Do not apply excess water at any one time. Avoid leaching soil nutrients beyond the root zone.

- Keep your fields levelled.
- Consider constructing prefabricated concrete channels to avoid water seepage and leaching **of** nutrients.
- Harvest water by constructing bunds, channels, and tanks to store water for future **use**.
- Conserve water **in** the soil by using mulch, cultivating along the contour, and breaking the soil crust to slow the evaporation **of** water from the surface.



Integrated soil and water management

Contributors/Sources: Dr. V. N. Shroff, Mr. C. V. Sheshadri, Ms. Chitra Gandhi, Dr. W. R. Deshpande, and Dr. Jagdish Singh

Compost making

Turn **organic** waste into compost for improved soil fertility and sustained crop production.

What is composting?

Composting is a big-chemical process **in** which micro-organisms decompose **organic** waste matter-crop residue, kitchen wastes, cowdung, urine-into a soil-improving product called compost.

The final product is a uniform, black mass **of** rotten, nutrient rich manure.

Advantages **of** adding compost to soil

Compost:

- supplies nutrients.
- improves microbial activity, which helps release soil nutrients for **use** by plants.
- checks pollution from manure heaps and leaching **of** urine into the soil.
- reduces the need for chemical fertilizers which are costly and potentially damaging to the environment.
- increases the amount **of organic** carbon and nitrogen, improving physical properties **of** soil and allowing higher response to chemical fertilizers and higher crop yields.
- improves soil structure, improving drainage and making tillage easier.
- increases the water-holding capacity **of** soil.
- helps check wind erosion by improving soil structure.

Selection **of** site for composting

Your compost pit should be:

- easy to inspect.
- built on higher ground to avoid waterlogging.
- near the cattle shed and a source **of** water.
- located away from the road to avoid contamination by lead and other toxic metals which, **in** turn, could contaminate food crops affecting the health **of** humans and livestock.

Caution

Compost and farmyard manure are major sources **of** weed seeds. Weed seeds withstand partial decomposition, therefore, put only fully decomposed compost and farmyard manure on your fields.

Three methods for making compost

Indore method

Raw materials for composting

Plant **residues**-Mix plant **residues**, weeds, sugarcane tops, leaves, grass, wood ash, bran, etc. Chop and crush hard woody material

Dung-Collect dung and bedding **of** farm animals, including the urine-soaked mud from animal sheds.

Wood ash-Wood ash reduces compost acidity and adds potassium.

Water and air-Both are necessary for bacterial and fungal activity.

Size **of** the compost pit

Width 2 to 2.75 m

Depth 0.75 to 1 m (not more than 1 m)

Length 3 m or more as required.

Method **of** filling the pit

1 Spread raw material evenly **in** the pit **in** layers 7 cm thick.

2 Add a layer **of** wood ash (if available) along with urine and mud.

3 Next spread a 5-cm layer **of** bedding with cattle dung and soil. Sprinkle with water until moist.

4 Continue adding layers until the material is 30 cm above ground level. Apply water. The heap will shrink as it decomposes.

5 Turn over the heap three times. Moisten with water each time.



To aerate, dig out the compost . . .



And then put it back **in** the pit.

Turning

Decomposition needs proper mixing as well as circulation **of** water and air. You can ensure this by turning over the material three times:

First turning 10-15 days after filling the pit.

Second turning 15 days later.

Third turning after 2 months.

At the third turning, you can take it out **of** the pit and put it back **in**. This helps the bacteria to take nitrogen out **of** the air. **In** regions **of** heavy rainfall, compost pits should be covered by a shed. Compost-making should be discontinued between June and September.

Bangalore method

Raw material Same as for the Indore method.

Size **of** the pit

Width 2 m

Depth 1 m

Length 6 m

Method **of** filling the pit

1 Spread a 1 5-cm layer **of** farm refuse on the bottom **of** the pit and moisten this with water.

2 Follow this with a 5-cm layer **of** cattle dung and urine soaked mud.

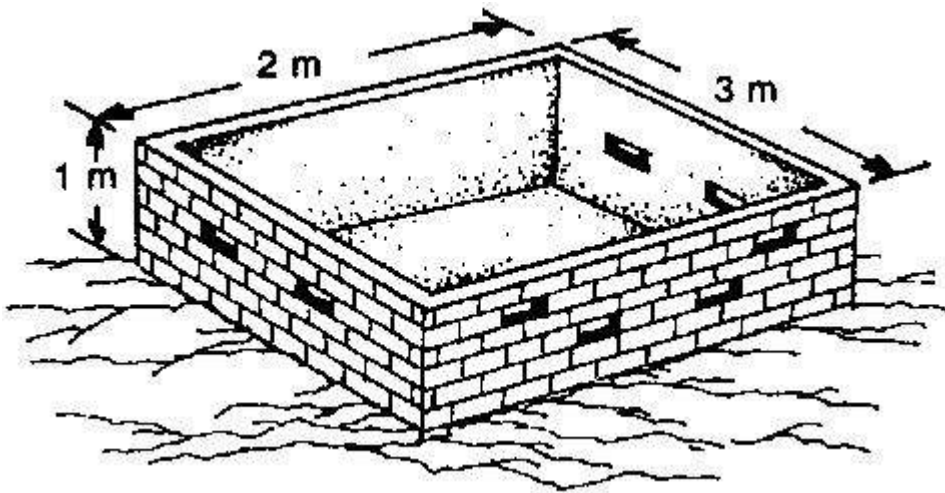
3 Next apply a 2.5- to 5-cm layer **of** soil.

4 Repeat the process until the heap is about 0.5 m above ground level.

The material decomposes within 8 to 9 months and the finished product is ready for **use**.

Nadep method (above ground)

Raw materials Waste **organic** material-about 1,500 kg. Cattle dung-90 to 100 kg (8-10 baskets) Dry-sieved soil-1,750 kg (120 baskets). Urine-soaked soil is most effective. Remove glass, stones, plastic, and other nondecomposable substances. Water-Enough to keep the pit moist.



Nadep method (above ground)

Tank construction

Build a rectangular tank (3 m long, 2 m wide and 1 m high) made **of** brick walls and floor with mud mortar. Leave holes **in** the tank walls for aeration (about four holes along each side wall and two holes **in** each end wall). Plaster the inner walls and the bottom **of** the tank with a mud and cow-dung mixture.

Method **of** filling

First layer-15-cm compact layer **of** plant waste material.

Second layer-Cow-dung slurry: about 4 kg **of** cow dung mixed with 10 buckets **of** water (drench thoroughly).

Third layer-Add a 2-cm layer **of** fine, sieved soil (60 to 65 kg).

Keep adding layers **in** this way until the material is heaped 15 cm above the lip **of** the tank. Add another 7-cm layer **of** fine soil on top **of** the heap. Seal the tank with cow-dung plaster.

For best results

- Build a temporary shed **of** thatch and bamboo to shield your compost tank from direct sunlight and rain.

- After three to four months, digestion (composting) is complete. Do not disturb the pit during this crucial period.
- Compost is dark and has a pleasant smell. Sieve this compost through a thick mesh and it is ready to **use**.

Contributor/Source: Dr. V. N. Shnoff and Dr. Jagdish Singh

Vermi-composting

What is vermi-composting?

Vermi-composting is the process by which earthworms convert **organic** waste into fertile manure. With a little knowledge **of** earthworms and an investment **of** time and some inexpensive materials, you can fertilize your garden with rich vermicompost.

Living composters

Earthworms live **in** the soil, mixing it, making it porous as they help decompose soil **organic** matter. Earthworm casts are the excrete **of** earthworms. These casts contain five times the nitrogen **of** ordinary soil, seven times the phosphorus, eleven times the potash, two times the calcium and magnesium, and eight times the actinomycetes (useful bacteria).

Earthworms:

- feed on soil and soil **organic** matter and convert it to compost, making the soil rich **in** nutrients.
- encourage growth **of** useful micro-organisms, which also make soil rich.
- aerate and pulverise soil.
- are natural tillers **of** the soil.
- make soil porous, improving drainage.
- increase the water-holding capacity **of** soil.
- produce enzymes, hormones, vitamins, and antibiotics, thereby increasing immunity **of** plants against some pests.

Advantages **of** vermi-compost over other fertilizers

- Low cost to produce
- Easy to **use**
- Not harmful to useful soil organisms
- Converts **organic** matter to useful plant food
- Source **of** income



Advantages **of** vermi-compost over other fertilizers

Earthworms suitable for vermi-composting There are two types **of** earthworm:

Surface feeders convert waste matter into humus. Surface feeders are needed for vermi-composting. Certain species introduced from Africa are very efficient humus producers. They can be bought from companies which produce vermicompost. Some important species: *Eisenia foetida*, *Eudrilus eugivae*, *Perionyx excavates*, *Lumbricus rubellus*.

Deep feeder move soil and humus around and aerate the soil. Most Indian earthworm species are deep-feeders and are not suitable for vermi-composting.

Materials required for vermi-composting For a 10-sq-m plot:

- Dry **organic** matter-200-300 kg
- Decomposed farmyard manure 300-400 kg
- **Organic** wastes-700-800 kg
- Earthworms-10,000
- Water-ready supply

Method **of** preparation

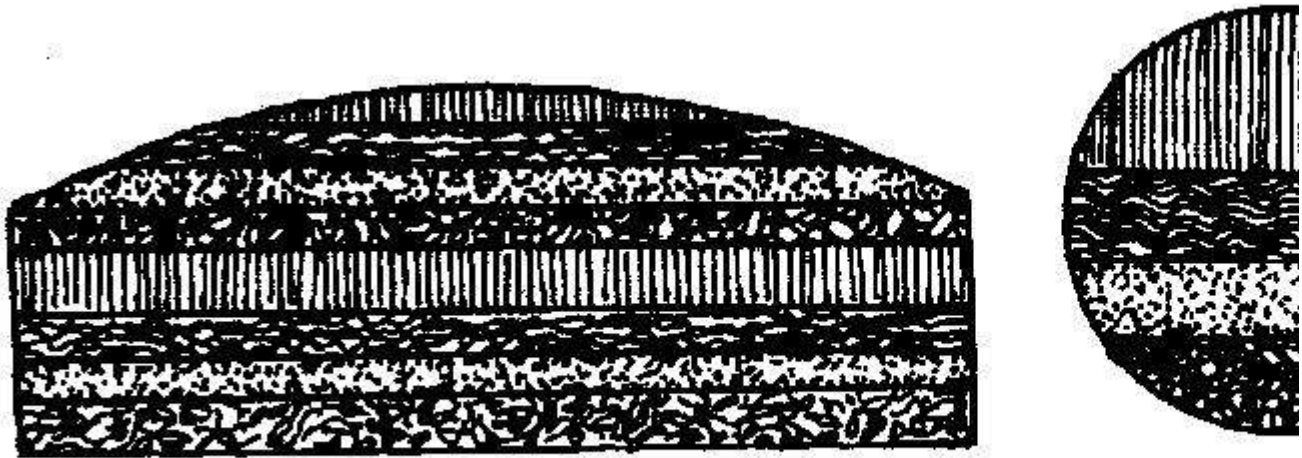
1 Erect a shed 5 m wide and 12 m long.

2 Under the roof **of** this shed, build a long, thin rectangular (1 m wide and 10 m long) bed **of organic** matter 15 cm deep.

3 On top **of** this, spread a layer **of** decomposed manure or biogas slurry 15 cm deep.

4 Moisten the bed with water and leave it for 48 hours.

5 Place earthworms uniformly at the rate **of** 1,000 per sq m on the top layer.



raised bed

Raised bed

6 Spread a 20-cm layer **of organic** wastes, litter, etc., over the earthworms.

7 Cover with gunny cloth and sprinkle water regularly to keep the plot wet. During summer months, you might have to sprinkle water twice a day.

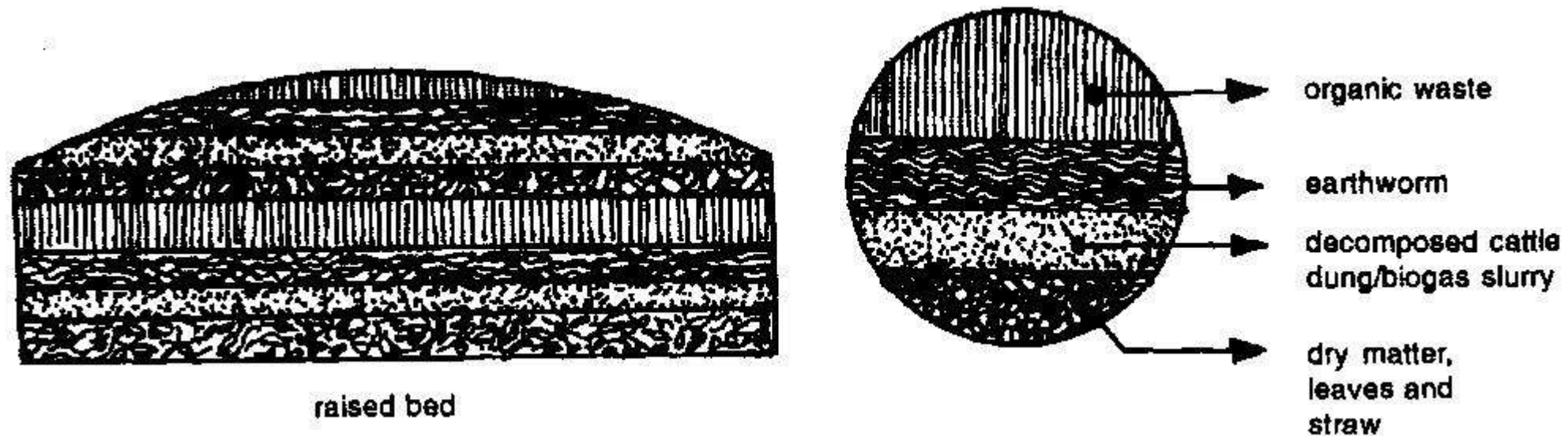
8 Turn the material after 30 days, cover it again with gunny cloth and keep it moist.

9 The whole material is converted to humus, called vermicompost, **in** 65-70 days.

10 You can build a second bed next to the first. **Use** the earthworms from the first bed to repeat the process. Two beds **of** this type will produce about 1 tonne **of** vermicompost every 3 months.

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Turn after 30 days.



Replace cover and keep moist.

Application of vermi-compost

Field-2. 5 tonnes per hectare

Pots-50 grams per pot

Trees-apply vermi-compost at the rate of 100-200 g per tree, or place 100-200 worms around the tree trunk.

Reproduction

Under ideal conditions, earthworms multiply 20 to 25 times in

65-70 days. Use a sieve to separate the vermi-compost from the earthworms.

Use the earthworms to repeat the above process to make vermi compost throughout the year.

Keep moist

- Surface-feeding earthworms can survive only if the surface soil is kept moist. This can be done with drip irrigation. (See

Efficient use of irrigation water.)



Cover and keep moist.



Turn after 30 days.



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Efficient **use of** irrigation water.)

- Where surface soil dries out, apply vermicompost each year at the beginning **of** the rainy season.

Developing an earthworm population

You can develop an earthworm population by placing earthworms or worm casts **in** the soil. After this, it is not necessary to apply vermi-compost; simply apply **organic** matter which the worms will convert into compost.

Maintenance

Take care to maintain an optimum number **of** earthworms **in** your fields. Their population is adversely affected by:

- **use of** chemical fertilizers.
- **use of** certain pesticides against soil-borne pests.
- inappropriate cultivation techniques, like **use of** rotary cultivators.
- acidification **of** soil.
- insufficient **organic** matter **in** the soil.

Earthworms are your friends. Protect them and nurture them **in** your fields. Adding vermi-compost and reducing the application **of** inorganic fertilizers will increase populations **of** deepburrowing earthworms, which turn over and aerate the soil.

Contributors: Dr. W.R. Deshpande, Dr. Chitra Srivastara and Dr. Jagdish Singh

Bio-inoculants

Bio-inoculants are living organisms containing strains **of** specific bacteria, fungi, or algae which:

- take nitrogen from the air and make it available to plants- reducing the need for nitrogen fertilizer.
- make inorganic phosphate and micronutrients soluble and available to plants.
- collect and store available nutrients.
- enhance plant uptake **of** phosphorus and zinc.
- provide physical barriers against pathogens.
- stimulate plant growth.
- decompose **organic residues**.

Biological nitrogen-fixation

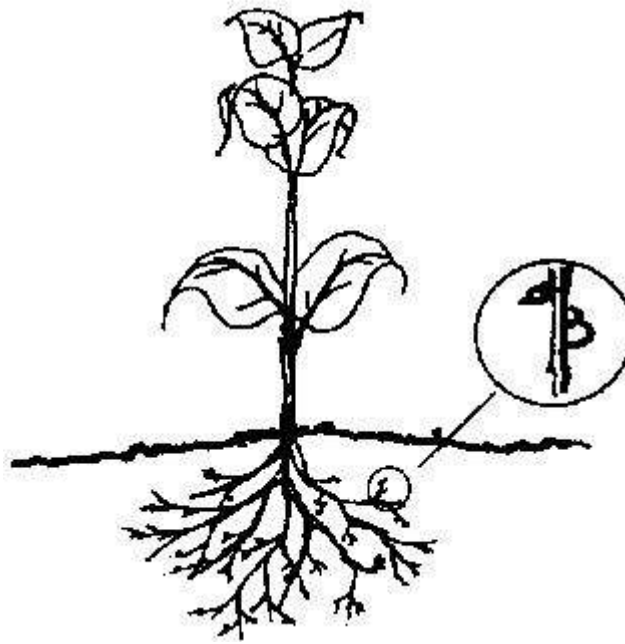
Atmospheric nitrogen is taken from the air-or "fixed"-by micro-organisms which live on some leguminous and non leguminous plants.

Rhizobium

These bacteria live **in** nodules on the roots **of** legumes. Legume seeds can be inoculated to encourage the growth **of** nitrogen fixing nodules.

Rhizobia:

- meet 80 to 90 percent **of** the nitrogen requirements **of** legume crops.
- increase production **of** legume crone.
- benefit successive crops.
- minimize the chance **of** crop failure.
- increase soil fertility.
- are cost effective.
- are pollution free.



Nodules on a legume plant

About 200 g **of** good quality rhizobium culture is enough to

An, treat 12-15 kg **of** seed. There are specific cultures for different crops. You can buy rhizobium inoculant from agricultural extension centres, agricultural universities, private dealers, and the National Biofertilizer Development Centre, Ghaziabad, Uttar Pradesh.

Azotobacter and Azospirillum

These bacteria fix atmospheric nitrogen **in** cereal crops. Azotobacter produce antifungal compounds against many plant pathogens and control nematode diseases. Azospirillum increase germination and improve vigour **of** young plants. One kg **of** seed needs 5 g **of** inoculant. This will fix 30 kg/ha **of** nitrogen per year.

Blue-green algae

Blue-green algae can fix 25-30 kg/ha **of** nitrogen per year. A paddy crop needs 10 kg/ha **of** algal powder, available from the National Biofertilizer Development Centre. Algal powder is not required after 3-4 years **of** continuous **use in** the field.

Blue-green algae **in** a paddy crop:

- produces 25-30 kg nitrogen (equivalent to 55-65 kg urea) per ha, and enhances yield 10 to 12 percent.
- is cost effective and pollution free.
- provides more oxygen to paddy roots.
- benefits the next crop.

Algae production

1 Prepare shallow trays (2 m x 1 m x 20 cm) **of** galvanized iron sheet. The size can be increased if

more material is to be produced.

2 Spread 8-10 kg **of** soil and mix well with 200 g **of** super phosphate.

3 Add water to the trays (5 to 15 cm deep) depending on the rate **of** evaporation. The soil should be about neutral. If it is acidic, add lime.

4 After the soil has settled, sprinkle the algal culture on the surface **of** the standing water. Keep the trays **in** the open air, **in** direct sunlight.

5 Growth **of** the algae will be rapid **in** the hot summer months and **in** about 7 to 10 days they will form a thick mat. If the daily rate **of** evaporation is high, add water regularly. When the algal growth becomes sufficiently thick, stop watering.

Azolla

Azolla is a floating fresh water fern. It grows **in** stagnant water. The fern forms a green mat over the water surface. It readily decomposes to ammonia which is available to rice plants. Apply 10 kg **of** powdered, dry azolla fern per hectare.

Application Seed treatment-Rhizobium and Azotobacter Top dressing-Rhizobium, Azotobacter, PSM
Crops Legumes-Rhizobium + PSM Cereal-Azotobacter + PSM Legumes mixed with
nonlegumes-Rhizobium + Azotobacter + PSM

For more information contact the National Biofertilizer Development Centre, CGO Complex 11, Ghaziabad Uttar Pradesh 201002, India.

Mycorrhiza

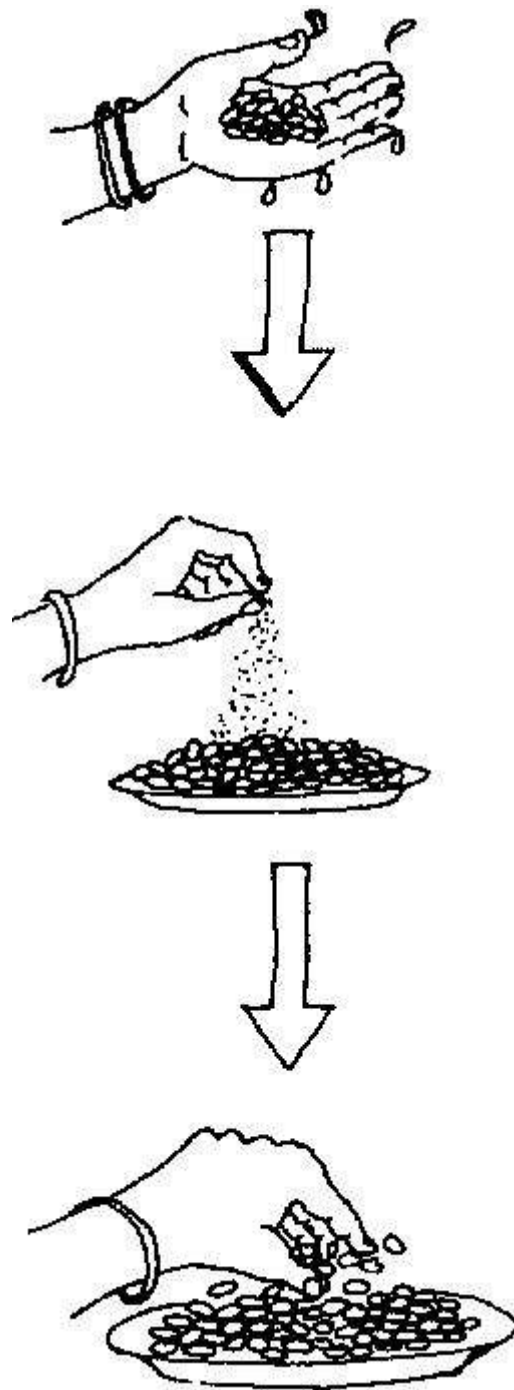
Mycorrhiza are fungi which live **in** association with the roots **of** crops. The fungi stimulate plant growth, help the plants **use** phosphate, and protect the plants from disease. One kg **of** crop seed needs 7-10 g **of** inoculant, available from Mycology and Plant Pathology Division, Indian Agricultural Research Institute, and the Department **of** Botany, Delhi University.

PSM

Phosphate solubilising micro-organisms (PSM) convert soil phosphorus into forms that plants can **use**. To **use** PSM, mix 3 kg **of** PSM, 50 kg **of** farmyard manure, and the crop seed. Drill them together.

Methods **of** application

Bio-inoculants can be used two ways: as seed treatment and as top dressing **in** the soil.



Seed treatment

Moisten the seed and sprinkle the inoculum at a rate **of** 5-10 g per kg **of** moist seed. Mix thoroughly and dry **in** the shade for an hour. Sow the inoculated seed immediately.

Top dressing

For legumes, mix 1.5 kg rhizobium or 0.5 kg Azotobacter or 3 kg PSM **in** 50 kg **of** farmyard manure or compost. Top dress.

For cereals and millets, **use** 2 kg **of** PSM.

Broadcasting

Mix 3 kg **of** PSM with 100 kg **of** farmyard manure and broadcast the granular mixture. Can be broadcast **in** a standing crop seed treatment

Source: Dr. W. R. Deshpande

Multipurpose trees and shrubs

Selection criteria

Select tree species and varieties that have these features:

- Adaptability to local climatic conditions
- Multiple uses high demand and value **of** the produce
- Fast growth, short time to harvest
- Vigorous regrowth after cutting
- Nitrogen-fixing ability
- Ability to improve soil
- Compatible with ground vegetation
- Easy management

Fuel and fodder collection is hard, time-consuming work for farm women. Multipurpose trees, grown on the farm **in** an organized manner, can significantly improve farm incomes by providing food, fodder, fuelwood, timber, gum, and building and fence poles, while reducing drudgery for farm women.

Trees consume carbon dioxide and release vital oxygen, maintain cool weather, increase rainfall, and protect soil from erosion and loss **of** productivity.

Trees on farm land

Suitable multipurpose trees can be incorporated on farm lands for a variety **of** uses.

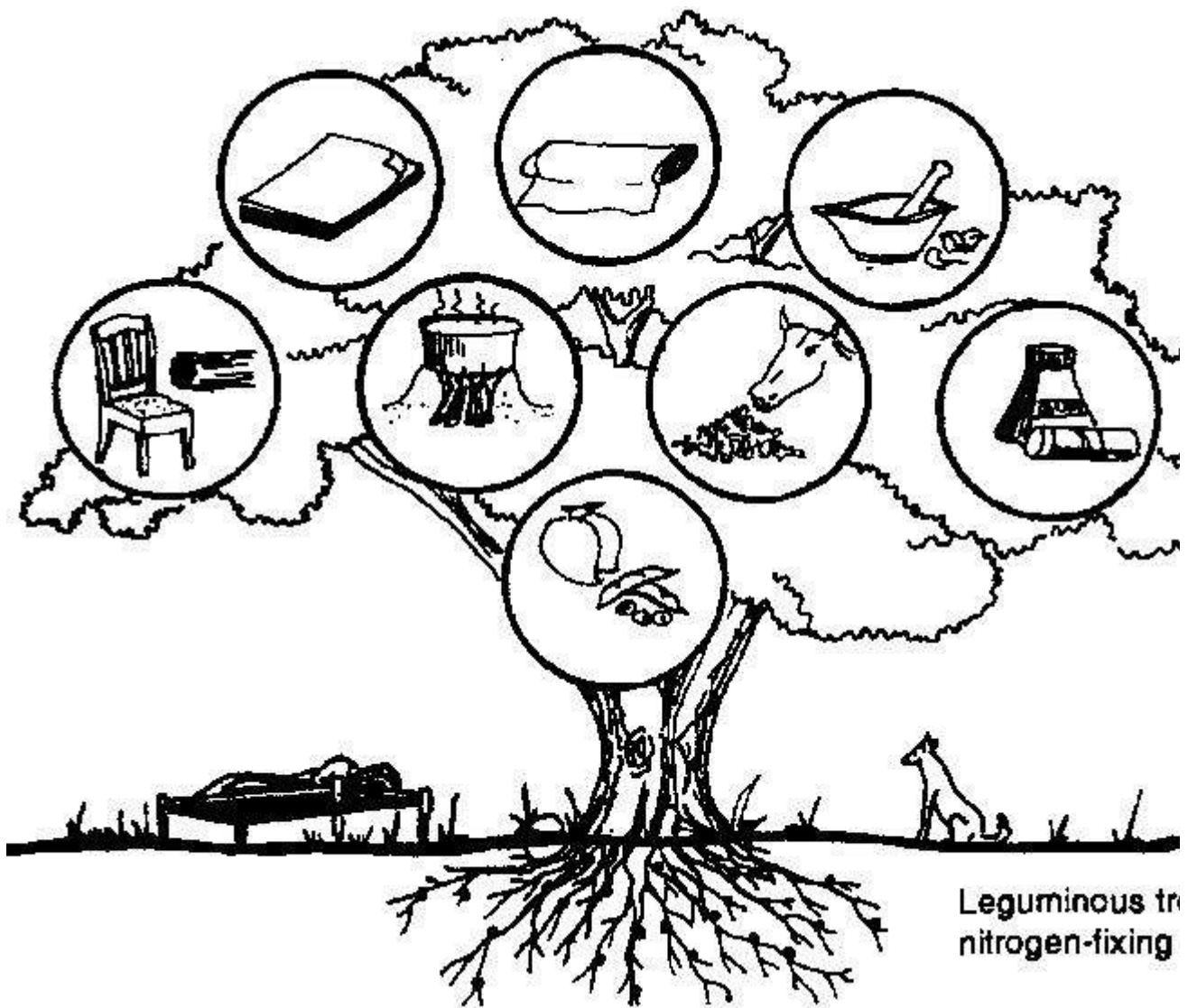
Mainly protective

Windbreaks and shelter belts

In places where wind erosion is severe, like arid and desert areas, wind breaks and shelter belts **of** trees, such as Israeli babul, can reduce erosion.

Live hedges

Species, like vilayati babul and brij babul, can be grown as hedges around fields. They can serve as animal barriers, reduce soil erosion, and provide fodder, timber, and fuelwood.



Trees have many uses.

Soil conservation

Species, like desi babul, ardu, and shisham, are reported to be good soil binders and help conserve soil.

Mainly productive

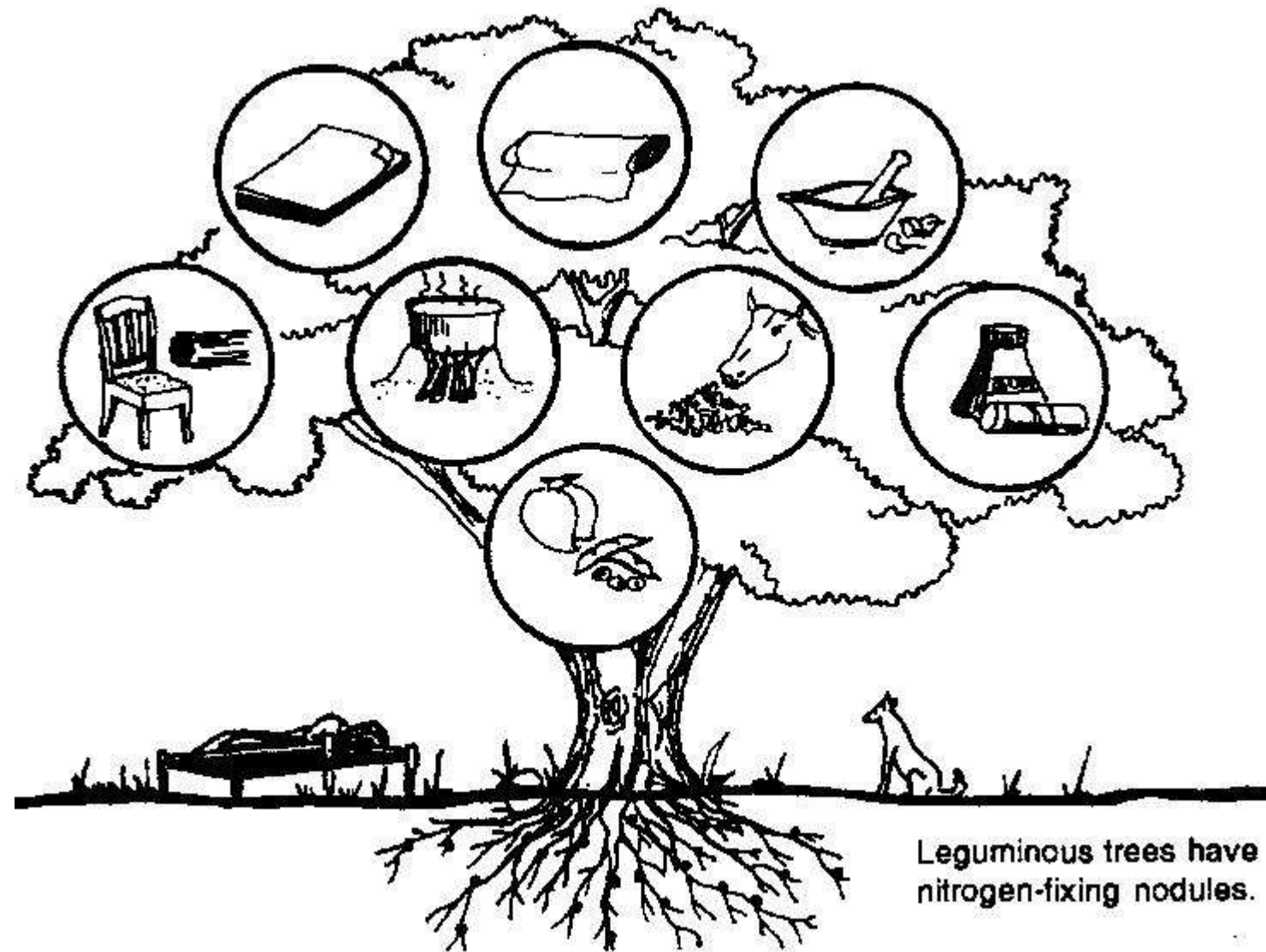
Boundary planting

Many tree species, such as eucalyptus, can be grown around farm boundaries for additional returns without adversely affecting crop yields. Care must be taken **in** site selection to avoid crop shading. Tree roots should be pruned by digging a trench along the crop boundary.

Agri-silvipasture, agri-horticulture

Forest trees, like shisham, anjan, subabul, and fruit trees, like aonla, guava, mulberry, and ber, can be introduced at suitable spacings **in** agricultural systems to stabilize the farm system and provide additional returns.

Silvipasture, hortipasture



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As above, many **of** the same forest and fruit trees can be introduced **in** pastures and grasslands.

Home gardens

In humid regions, a mixture **of** many trees and shrubs **in** a multitier system can be profitable and ecologically sustainable.

Alley cropping

Hedges **of** subabul and gliricidia can be grown 8-10 m apart. Crops can be planted between the hedges. The hedges should be pruned regularly and the prunings used as mulch or fodder.

Multipurpose woodlots

Multipurpose trees, like babul, desi siris, shisham, eucalyptus, sesbania, subabul, ber, casuarina, neem, and kathal, can be planted on community bunds for fuelwood, charcoal, timber, poles, medicine, gum, pulp, and fodder.

Contributors: Dr. Punjab Singh and Dr. R S. Chillar

Seed production and storage

Produce your own wheat, rice and pulse seeds

Note

Make sure you start with pure clean seed stock.

After three years, it is best to buy new seed from a reputable seed vendor.

Do not try to produce seed **of** cross-pollinated crops, such as maize or sorghum.

Save money by producing your own seed **of** wheat, rice, and other self-pollinated crops. Make sure you start with pure, clean seed with desirable characteristics, suited to your growing conditions and to your needs.

1 Lay out your seed plot so that the variety being produced is isolated from other varieties.

2 Before sowing, clean the seed drill properly. No other seed should remain **in** any part **of** the drilling machine.

3 Examine the seed plot at different stages **of** crop growth. Remove:

- other crop plants
- weeds
- off-types (plants with characteristics different from those **of** the variety being produced)
- diseased plants

4 Harvest and thresh the seed plot before harvesting the main crop.

5 Clean the thresher and threshing floor properly before threshing the seed crop.



Clean the threshing floor.

6 After threshing, clean the seed with a winnowing basket and remove small and cut seeds with the help of a sieve.



Winnow the seed to remove impurities.

7 Dry the seed to a safe seed-moisture level. Store the seed **in** a proper container.

8 To prevent infestation by insects, fumigate your seed with Celphos 1-2 tablets **of** Celphos will fumigate 100 kg **of** seed.

9 Before sowing, treat the seed with a proper fungicide. For example, treat wheat seed with Vitavax at 2.5 g/kg **of** seed to prevent the seed crop from infection by loose smut.



Store your seed **in** a proper container. Keep it dry, cool, and protected from rodents, birds, and insects.

Contributor: Dr. S. P. Sharma

Storage of grain and seed

About 70 percent **of** grain is retained by farmers for food, feed, seed, and sale or barter. During storage, grain declines **in** quality and quantity. These losses are caused by insects, rodents, birds, mould, heat, and spillage. Here are some simple methods which farm women can **use** to safely store grain. (See Safe grain storage structures)

Note

If you keep grain **in** cloth or gunny bags, open the windows **of** the storeroom during dry, sunny weather to allow ventilation.

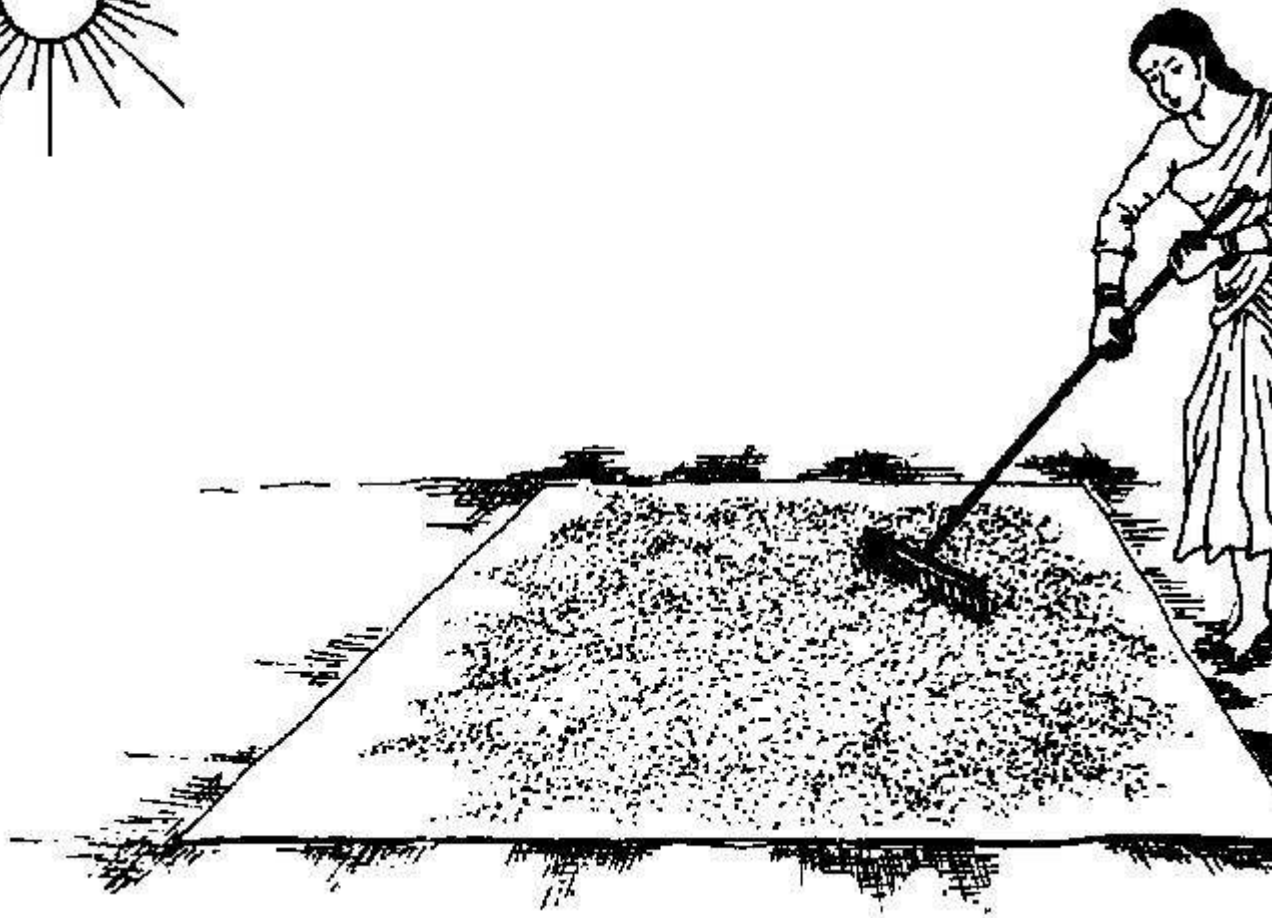
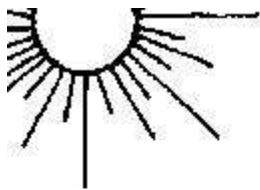
Before storage

- Dry and clean your grain. The length **of** time needed to dry the grain will depend on the weather. Bite a grain to test its moisture content: if it cracks when you bite it, it is dry enough to store. If possible, dry the grain on a cement floor or hard, smooth, crack-free floor. Otherwise **use** plastic sheets or tarpaulins spread on the ground.
- Stir or turn the grain occasionally for uniform drying.

- Cover the grain to protect it from dusty winds.
- Clean and disinfect the storage structure remove all dirt and debris.
- Bird-proof the grain storage structure by stretching nets or wire mesh over the openings.

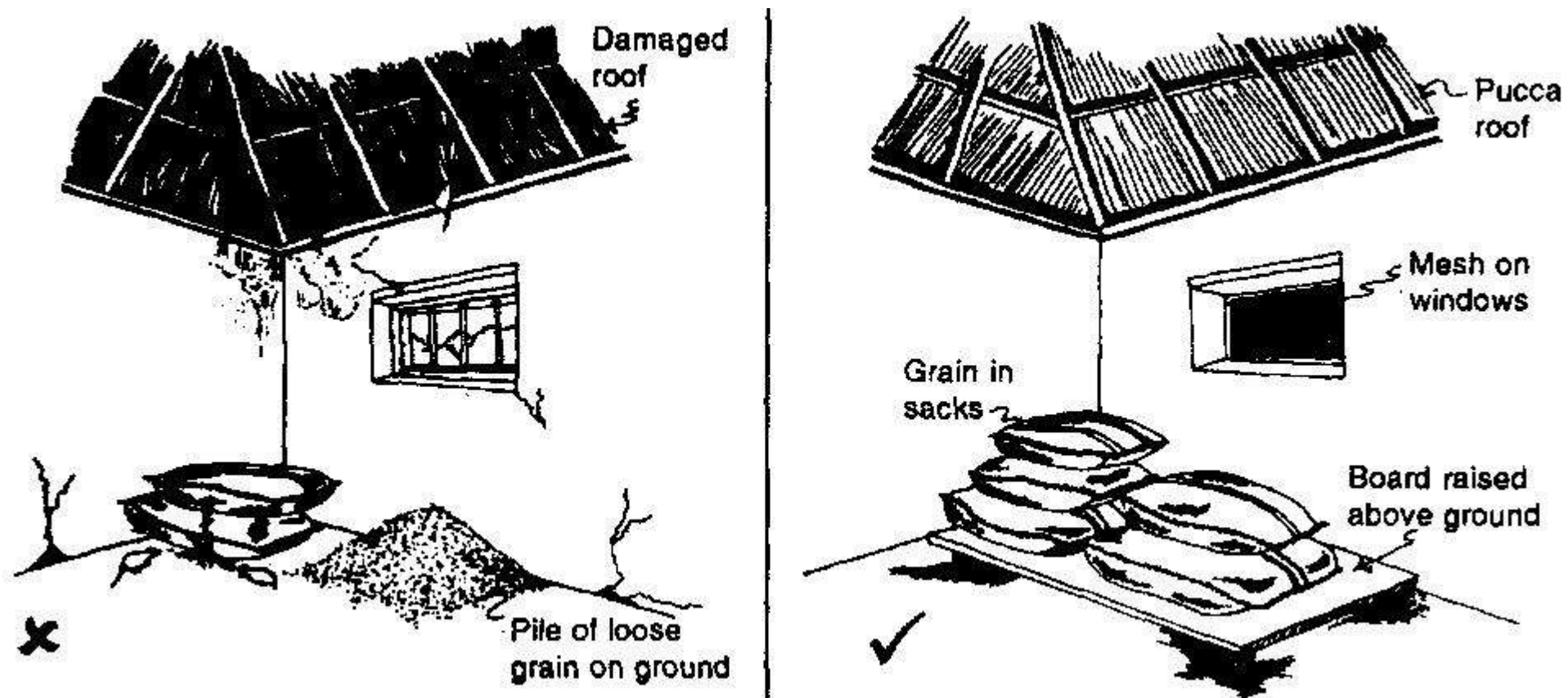
Storage

- Store only clean, dry, unbroken grain which is free from foul smell.
- Do not store grain **in** loose heaps or **in** damaged bags. **Use** gunny bags or bins.
- Store the grain away from wet areas.
- Do not place grain sacks near walls. Store grain sacks raised above the ground. This prevents entry **of** moisture from the walls and ground.
- Do not mix old grain with new grain. Also, do not store grain from a new crop near the grain from an old crop.
- Mix your grain with dried kernels **of** neem or **use** other plants with insecticidal effects, such as pyrethrum.



Storage

After storage



Roofs

- Inspect the grain regularly for insects, rodents, and other pests. Take appropriate preventive measures. (See other sections in this manual.)
- From time to time, spread the grain in the sun. Spray with insecticides only if a large number of insects are detected.
- Regularly test the grain for moisture and re-dry when necessary.
- Keep storage structures and surroundings clean.

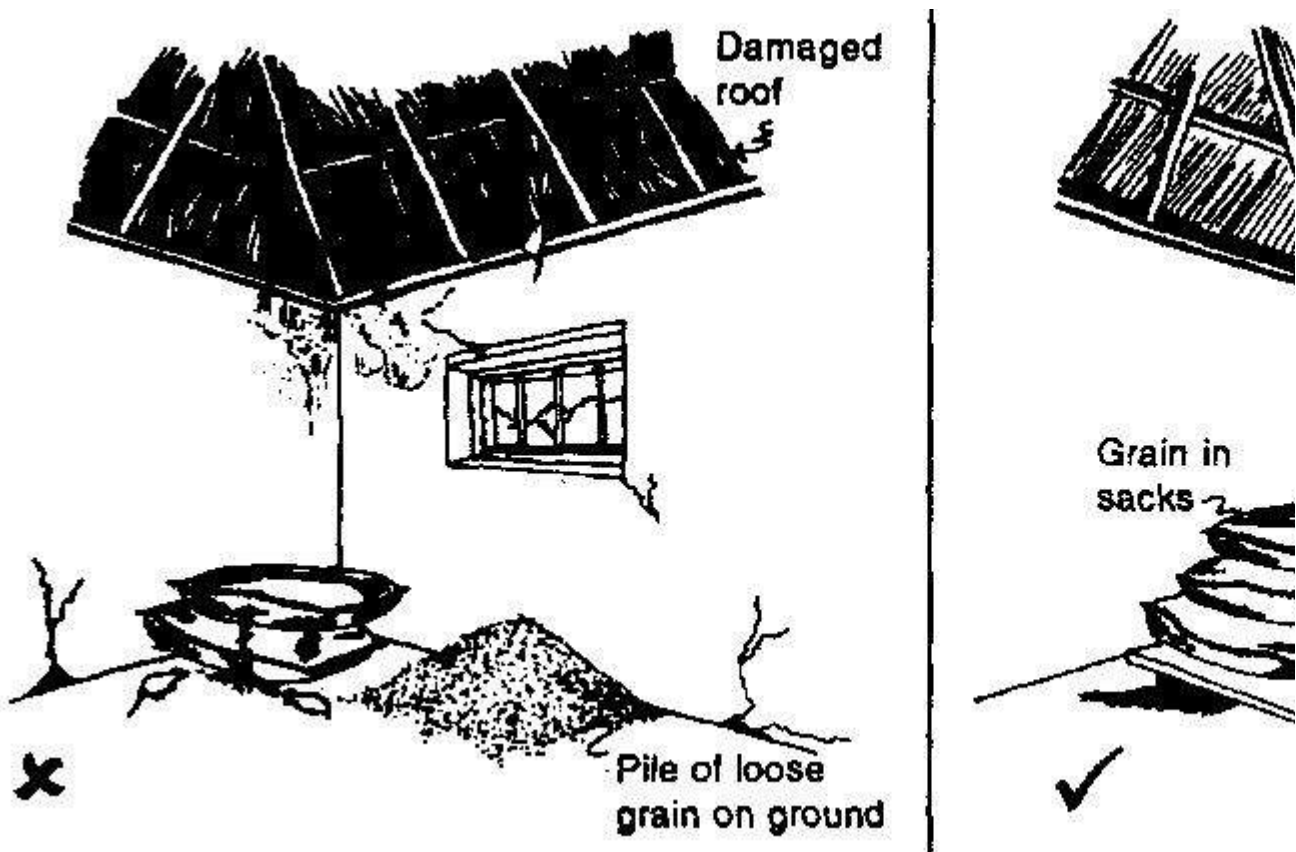
Seed storage

Generally there is a gap of 7-10 months from the time of harvest until the crop's next sowing. Depending on the crop, the seed produced in one season must be saved for planting in the next season. The quality of the seed at the time of sowing depends on the quality of the seed that entered storage and how well it was stored.

Note

Seed does not improve in storage. So, if you start with inferior seed, then you will end with inferior seed, no matter how much care you take.

Quality seed



Roofs

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Quality seed

Good quality seeds:

- germinate well.
- are free from dirt and seeds **of** other plants.
- are free from disease.

Caution

Do not eat grain that has been treated with chemicals such as Celphos (aluminium phosphide).

Seed grain needs special care

- Seed grain must be dried and cleaned more thoroughly than food grains before storage.
- During storage, **use** chemicals such as Celphos (aluminium phosphide) for seeds-but not for grains intended for consumption. Celphos is banned for food grains. One tablet **of** Celphos will treat 100 kg **of** seed. Place the tablet at the bottom **of** the seed container. It gives off a gas which keeps insects **in** check. The gas given off by Celphos is extremely harmful. After treatment, spread the seeds **in** the sun to allow the gas to escape, then wash the seeds with water and dry them **in** the sun.
- Do not disturb the seeds, but check them regularly for damage. If disease or pest damage is found, clean and disinfect the seeds.
- Try to keep seed bins airtight.
- Seeds to be stored **in** small quantities, such as vegetable seed, can be placed **in** a cloth bag inside a polythene bag. Tie the bags tightly.

Where to store seed

- Store seed separately from the grain crop. Store the seed **in** a room or bin made **of** stone, brick, or cement.
- Before sowing, test germination. Take 100 seeds at random. Put them **in** moist sand. At least 85 **of** the 100 seeds should germinate. If fewer than this number germinate, increase the amount **of** seed you sow.

Note

Seeds **of** certain crops store better unshelled, such as: maize, sorghum, millet, groundnut, cowpea, and sunflower. Shell these just before sowing.

Keep your seeds dry, cool, clean, and safe from pests. Check your seed stock regularly for moisture and pest damage.

Storage procedure

- Harvest the seed crop separately at the time **of** proper field maturity. Harvest seed only from healthy uniform plants.
- Thresh the seed gently to avoid damaging the seed coats. Remove broken, damaged, or diseased seeds, seeds **of** weeds and other crops, chaff, straw, soil, and other matter.
- Dry the seed thoroughly by spreading it uniformly over a clean sheet, or pucca floor made **of** stone,

brick, or cement.

- Bite a few seeds to test for moisture content. Seeds which are hard to crack are dry enough for storage.
- Place the clean, dry seed **in** clean bags-gunny bags, hessian bags, or cloth bags-or plastic containers, metal bins, earthen pots, or mud-plastered bamboo bins.
- Spread a layer **of** sand, straw, or wood ash at the bottom **of** the container. This will help to keep the seed dry.
- Place dry neem leaves **in** the bags or containers. Neem controls insect infestation, especially **in** pulses which are easily damaged by insects.
- Seal the lid **of** containers with a mud pack mixed with linseed oil.

Maintenance **of** the seed store

- Dry seed bags **in** the sun at least every 3 or 4 months.
- Regularly inspect your seed.
- If the seed **of** any crop shows signs **of** insect infestation, remove it from the store.
- Clean and dry the infested seed and its container. Store this seed **in** a separate place for 2 to 3 weeks. Check for reappearance **of** insects. Return it to the storeroom only if it remains free from insects.
- Empty and fumigate the seed store at least twice a year and seal it with cow dung cake and straw to keep it dry and free from insects.
- Inspect the storeroom roof before the rainy season.

Contributors: Dr. Malvika Dadlani, Dr. A. Alam and Dr. K.S. Sckhon

Safe grain storage structures

Quality

Grain quality **in** storage is affected by physical, chemical, mechanical, and biological factors.

- Temperature
- Birds
- Moisture
- Rodents
- Insects

Farm families work very hard to grow as much grain as possible from their small plots. It is a costly shame, therefore, that as much as 15 percent **of** what they keep for food, feed, seed, and sale is damaged or lost **in** storage. Considering that farm families store about 70 percent **of** the grain they

produce, this amounts to a considerable loss. But something can be done about these losses. The following are some grain storage structures especially designed to preserve and protect the grain crop.

Grain bins

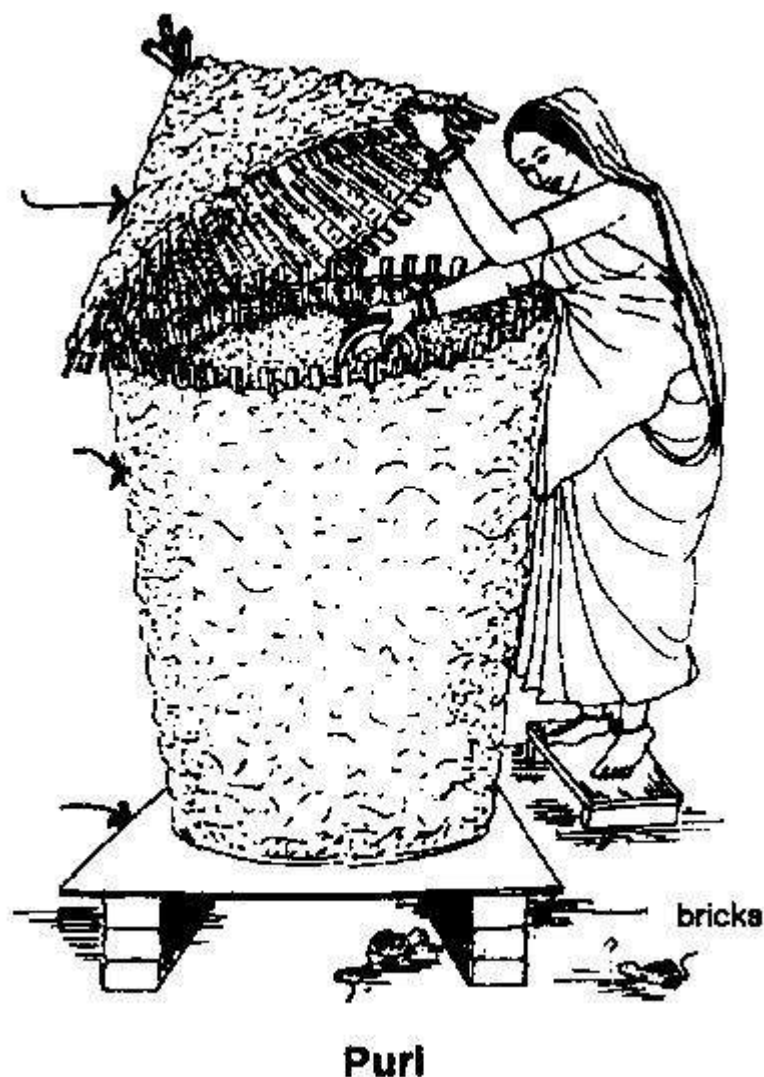
Traditional storage bins

Farm families **use** various grain bins **of** local design, made from locally available materials, such as bamboo, clay, mud, straw, jute bags, bricks, and wood. Traditional grain bins can be grouped into two main categories:

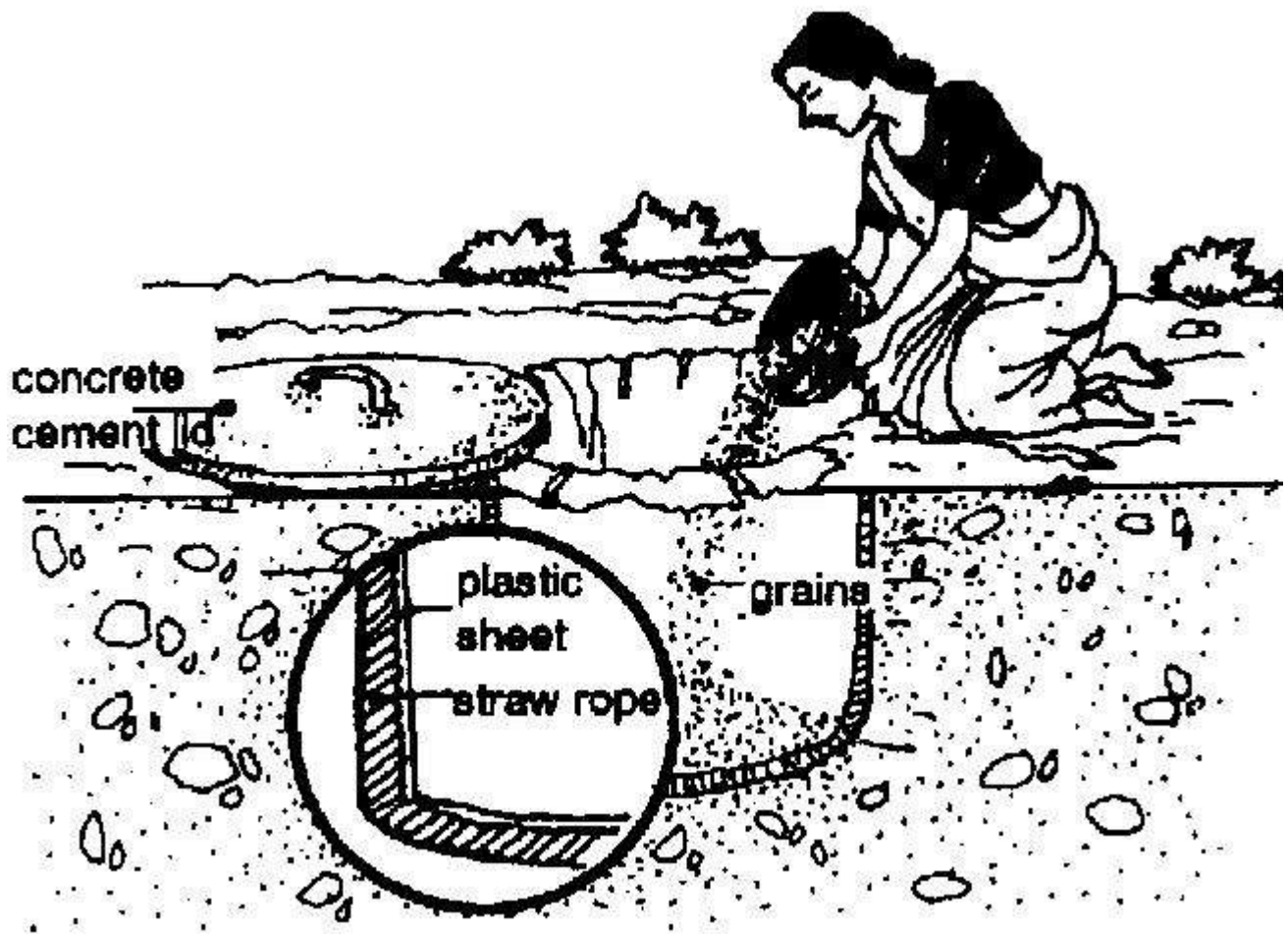
- Those made **of** unburnt or burnt clay, stone slabs, or bricks used to store grains and legumes. These bins restrict airflow but are ineffective against rodents and moisture.
- Those made **of** bamboo, wood, straw, or other dried plant material, used for storage **of** paddy and maize. These bins allow free flow **of** air for drying but are open to insects, rodents, fire, domestic animals, rain, and subsoil water.

Improvised storage structures

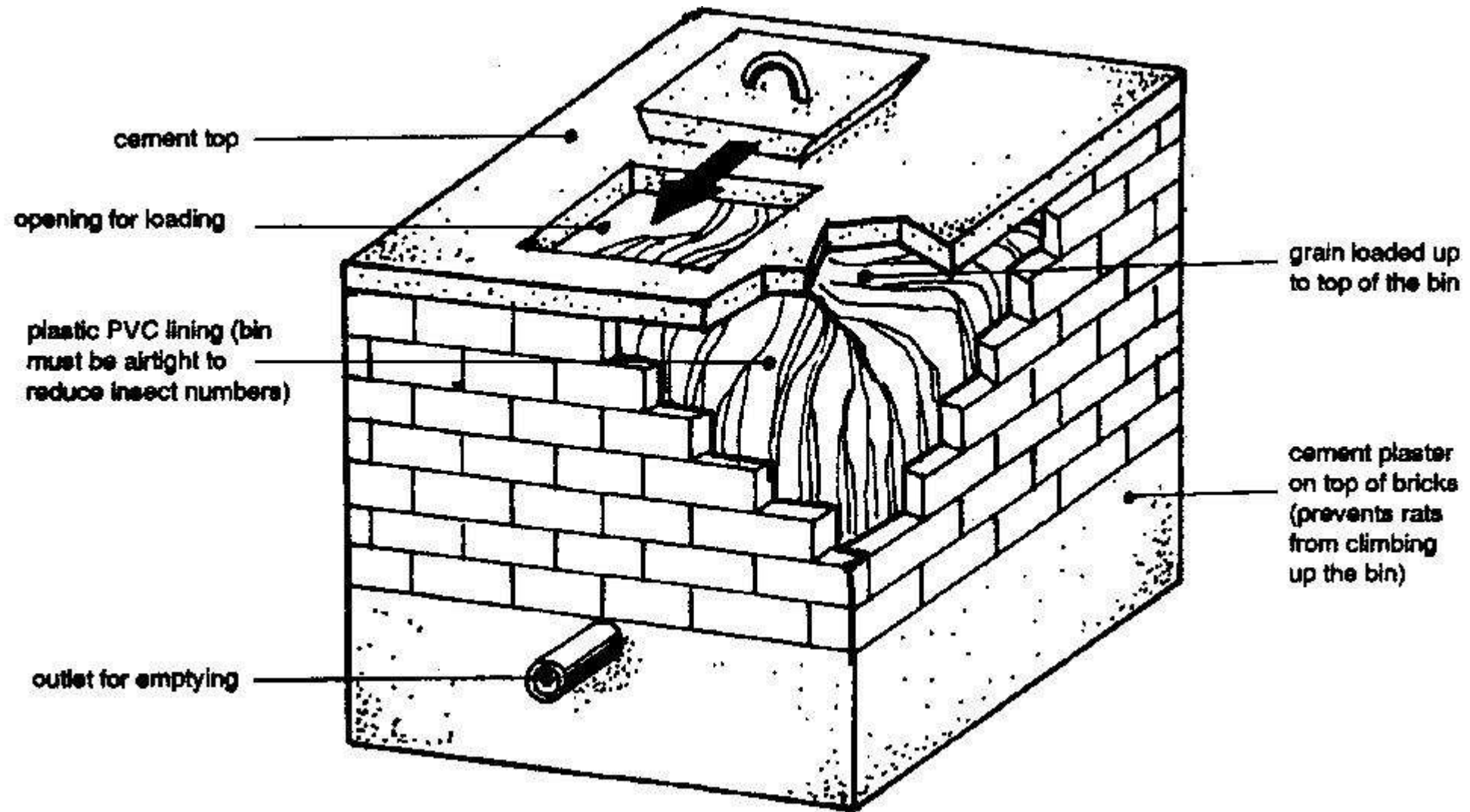
Stone slab, brick, and burnt clay bins can be made moisture-proof by placing polythene sheets between two layers **of** brick or slab and by building the bin on a raised platform. Such structures are safe for effective fumigation.



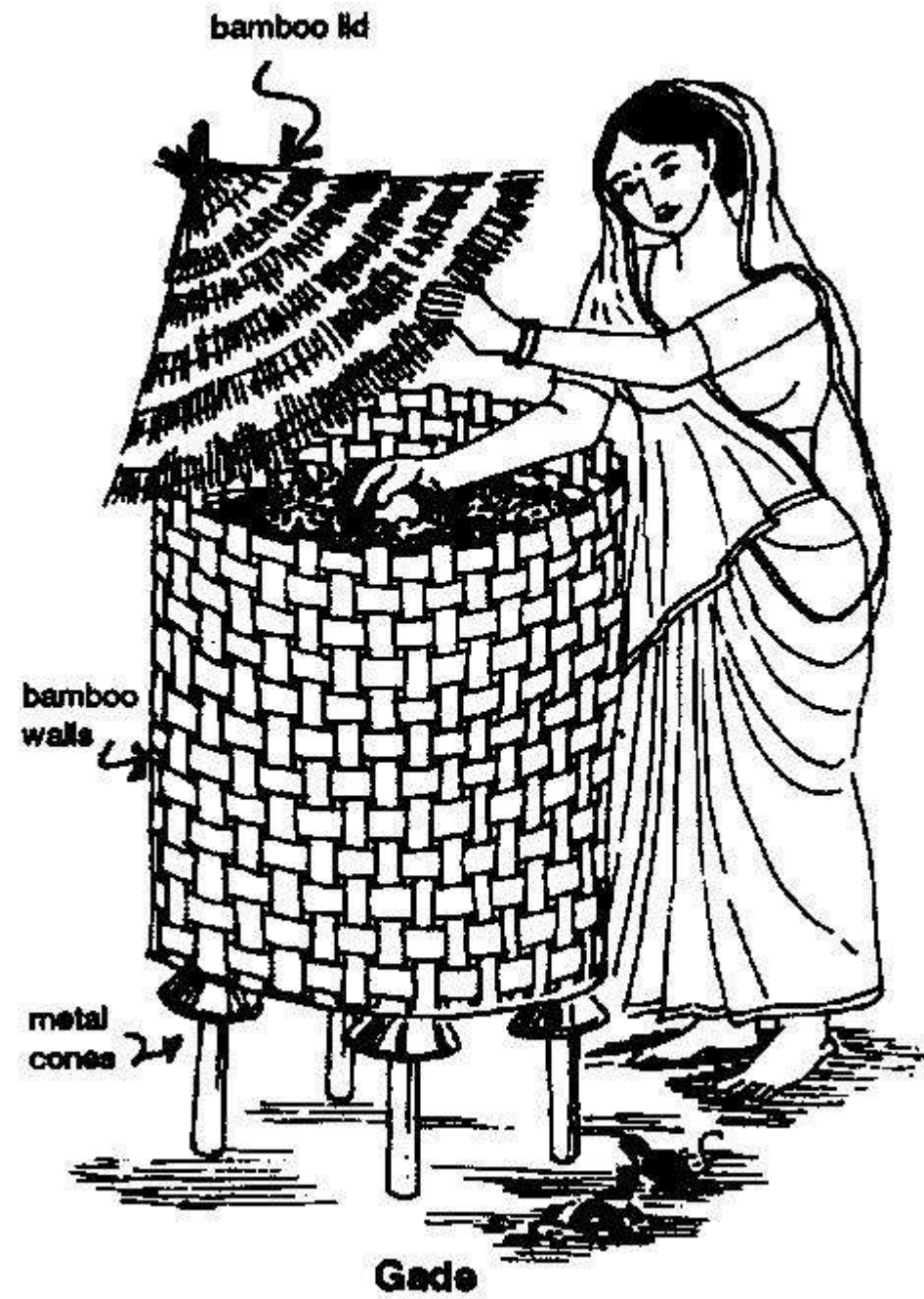
Purl



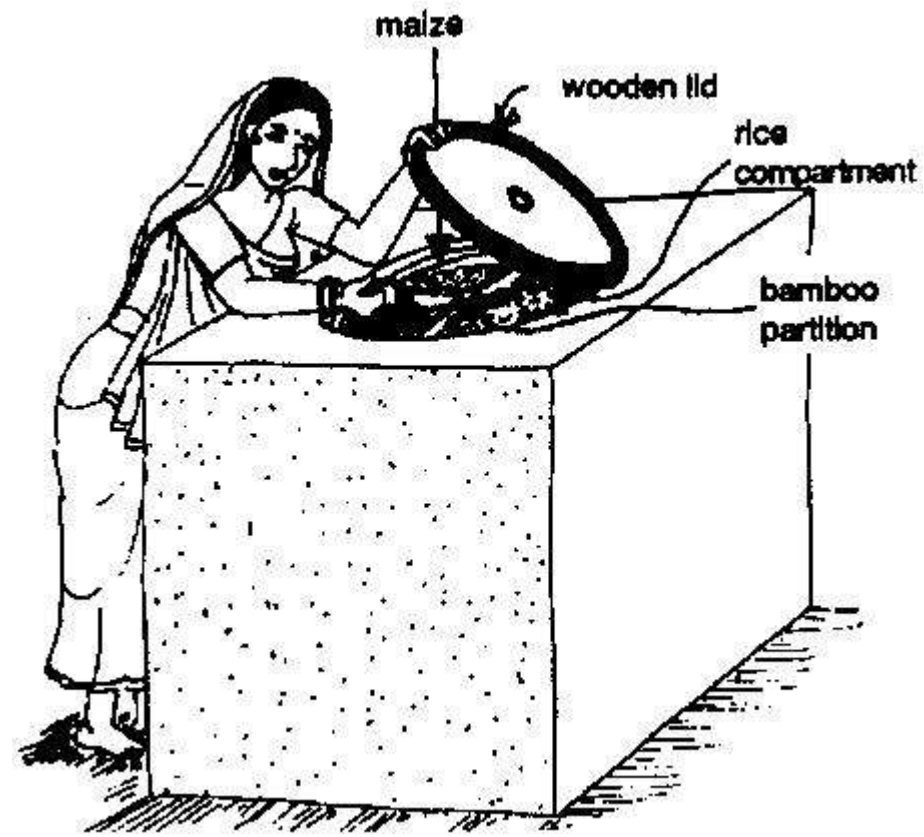
Patare



Pusa bin



Gade



Pucca-kothl



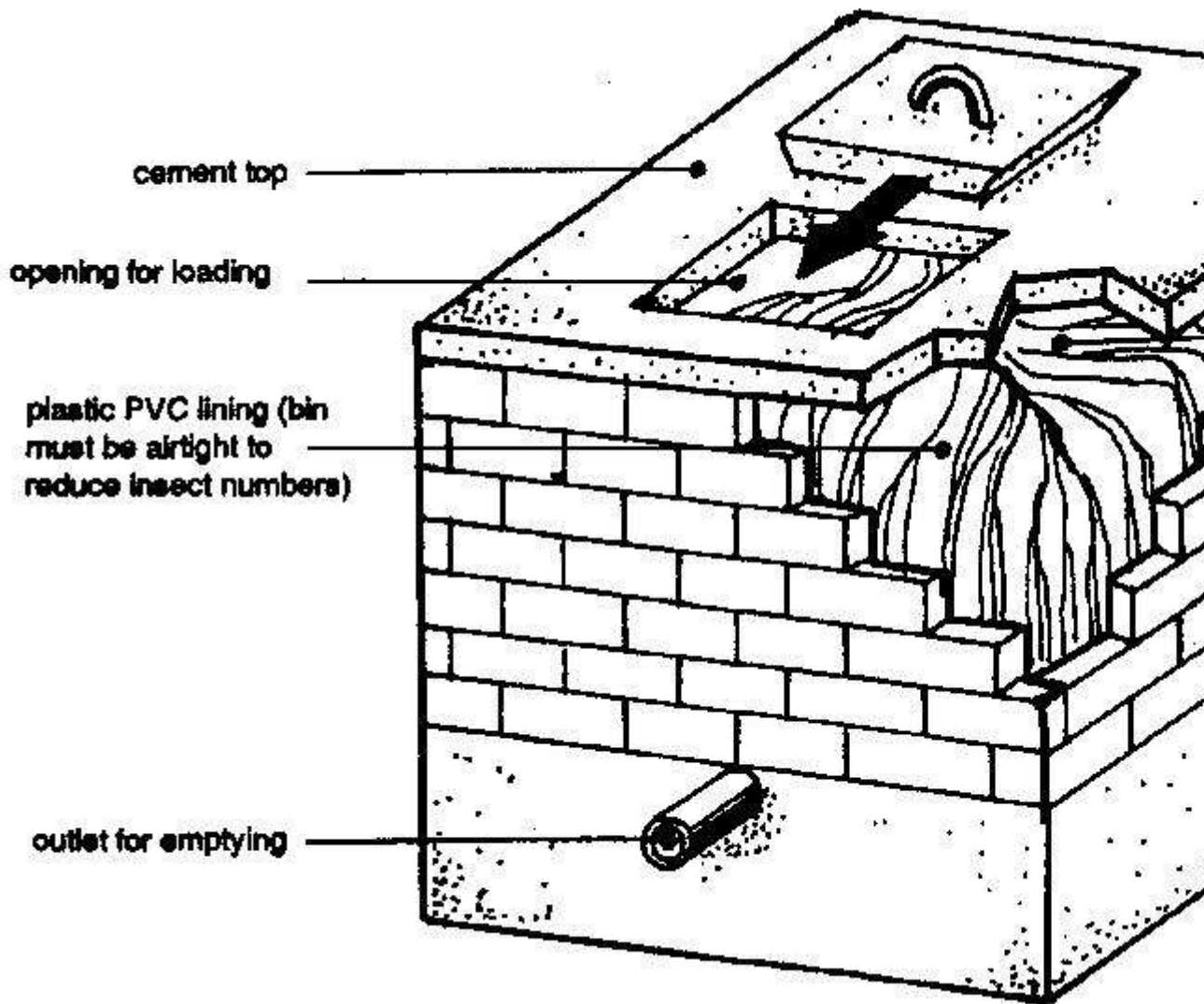
Metal bins -Outdoor design



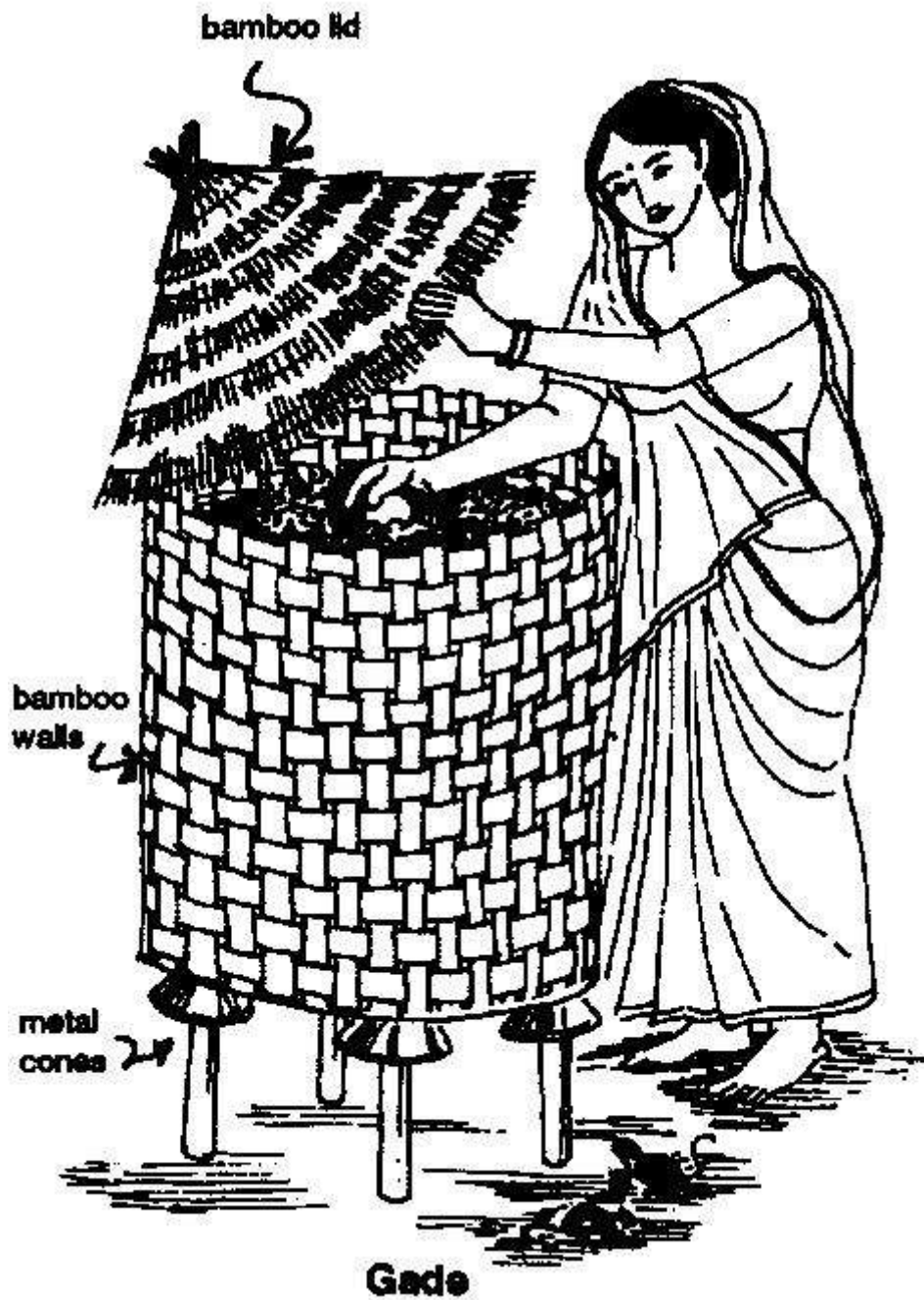
Metal bins - Indoor design

Bins for community use and for urban households Many other bin designs are available. Larger bins can be used by several households or whole communities. Smaller bins made of metal or plastic are suitable for households in urban areas. They can be bought from commercial manufacturers or made locally. Contact the addresses below for more information.

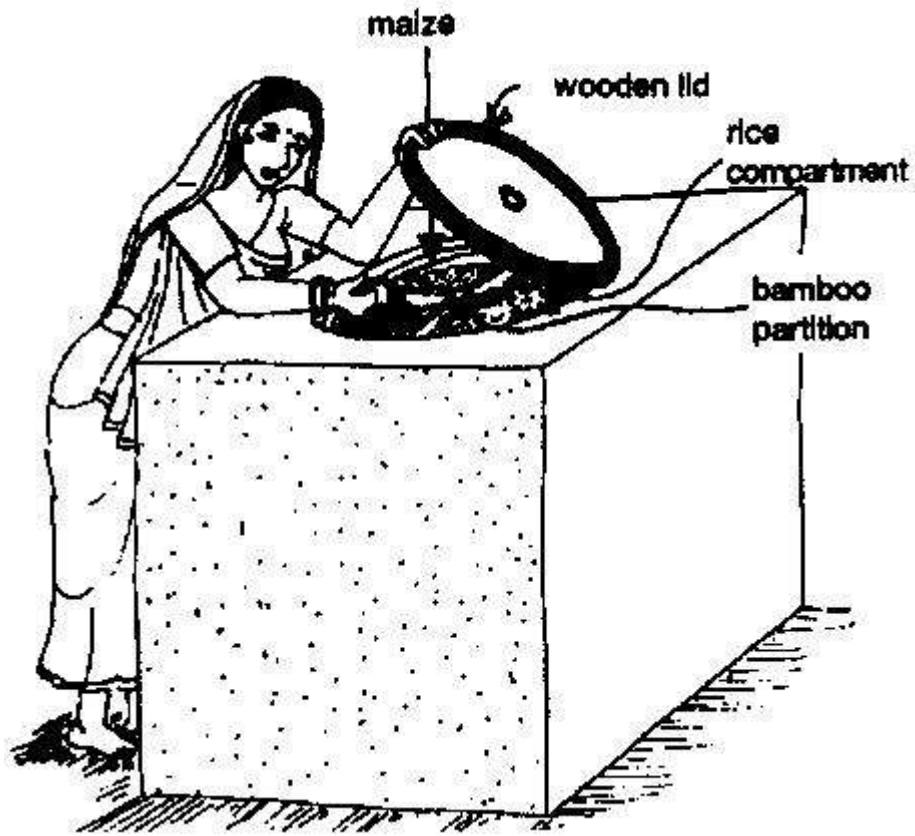
- Central Building Research Institute, Roorkee brick masonry bins
- Structural Engineering Research Centre, Roorkee reinforced concrete bins
- M/s Pest Control India Pvt. Ltd., New Delhi-reinforced concrete bins
- M/s Polyethylene Film Industries Pvt. Ltd., Madras-high-density polyethylene bins
- U. P. Agricultural University, Pantnagar-Pantnagar kutala
- Forest Research Institute, Dehra Dun-timber silos



Pusa bin



Gade



Pucca-kothl



Metal bins -Outdoor design



Metal bins - Indoor design

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- Space Research Institute, Trivandrum-glass fibre bins
- Division **of** Entomology, Indian Agricultural Research Institute, New Delhi - 12

List **of** insect pests and nature **of** damage

Common name/Scientific name	Nature of damage
Angoumois grain moth/Sitotroga cerealella severe.	Larva bores into the grain and feeds on its contents. Grains give off an unpleasant smell and appear damaged when infestation is
Rice moth/Corcyra cephalonica	When infestation is high, the entire stock of grain can be covered in a webbed mass of larvae.
Indian meal moth/Plodia interpunctuella	Grain is damaged by active, crawling caterpillars which can completely web over the surface of a heap of grain with their silken threads.
Almond moth/Cadra cautella	Caterpillars tunnel into the stored food.
Khapra beetle/Trogoderma granarium	Grubs eat the grain, finishing with the embryo. In severe infestation, grains are reduced to mere dust.
Rice weevil/Sitophilus oryzae	Larvae and adults feed inside grain.
Rust-red flour beetle/Tribolium castaneum	Does considerable damage to flour and flour products. In the case of severe infestation, flour turns greyish and mouldy.
Lesser grain borer/Rhizopertha dominica	Adult grubs cause serious damage to the grains, reducing them mere shells with many irregular holes.
Grain dhora (pulse beetle) /Callosobruchus drinensis	Young larva bores into the grain and completes its life cycle inside the grain. Pulses become unfit for human consumption.
Saw-toothed grain beetle/Oryzaephilus surinamensis	Scrapes off grain surface and burrows holes.
Long-headed flour beetle/Latheticus oryzae	Feeds on broken grains and flour.
Flat grain beetle/Cryptolestes minutus	Feeds on broken grains.

Improved rodent-free grain storage

How to detect rats

Squeaking and scratching noises

- Odour

- Rat droppings and urine marks

- Burrows
- Damage, such as torn bags, spoiled grains
- Chewed window and door sills
- Feet and tail marks on dusty floors, shelves, or table tops
- Grease marks

Prolific pests

Factors contributing to high rat population:

The life span **of** a rat is 12 to 18 months.

- Rats breed continuously throughout the year.
- First menses begins 4896 hrs after puberty.
- Rats are sexually mature at 6 to 11 weeks..
- A female gives birth to 5 to 21 young at one time.
- A female reproduces 4-6 times **in** a year.

Rats are a costly, unhealthy nuisance virtually everywhere they spread disease, destroy crops **in** the field, destroy stored food, damage household property, and damage forest and fruit trees. Rats consume and destroy more than 20 million tonnes **of** field crops, and more than 33 million tonnes **of** crops **in** storage around the world each year. **In** India alone, rats damage 11 million tonnes **of** crops annually with their urine, parasite carrying faeces, hairs, and secretions.

Control

There is no way to get rid **of** rats completely. Rats can, however, be controlled through a program **of** prevention and destruction.

Rat prevention

- Keep food **in** rat-proof containers.
- Keep left-over food **in** bins with tightly fitted lids.
- Do not pile rubbish, timber, or bricks near grain stores.

Rat destruction

When fields are flooded during monsoon, rats remigrate and concentrate near residential areas for food and shelter. As well, rats tend to breed during the rainy season. Therefore, though rats should be controlled throughout the year, trapping and poisoning rats during the monsoon is most effective.

Note

Trapped rats should be drowned in their cages in a pond.

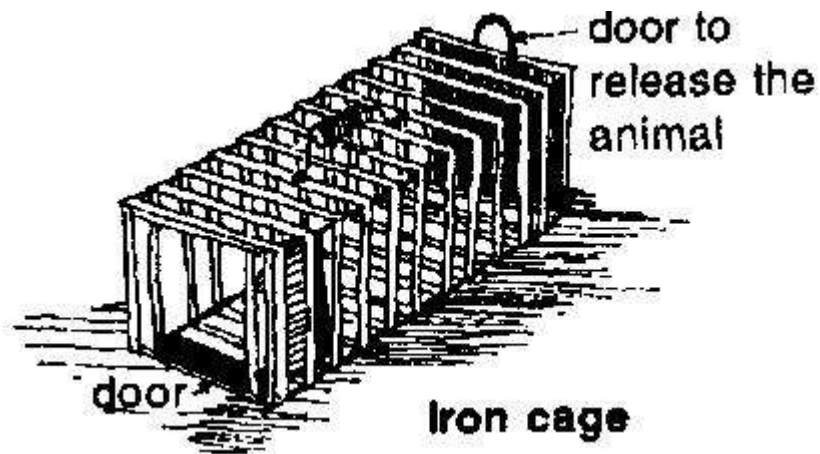
Mechanical methods

Traps

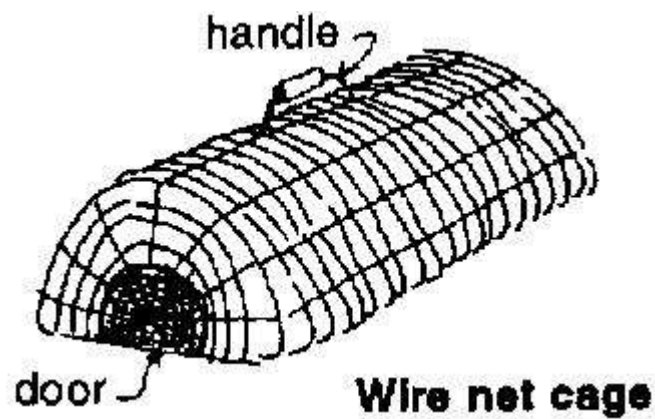
Field rats-Bamboo bow and arrow traps, pot traps and break-back bans are useful for catching field rats. Break-back traps, as their name implies, are deadly.

Household rats-Rat trapping is an age-old practice. Spring traps and multiple cage traps are common for protecting food in

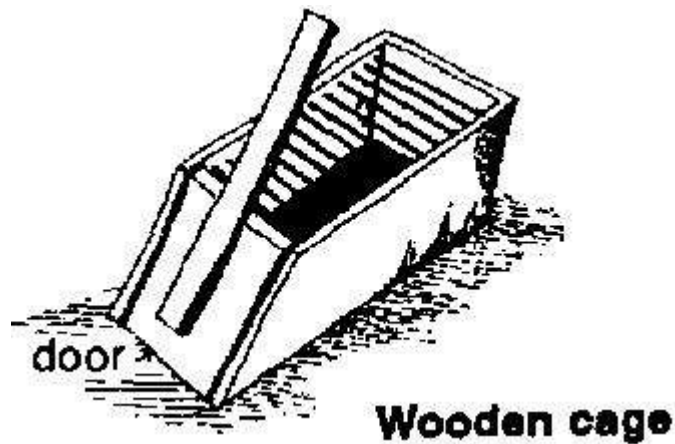
Some types of traps



Iron cage



Wire net cage



Wooden cage

Prevent entry into grain storage areas

- Plug holes with pieces **of** glass, cement, and plaster.
- Make sure doors fit tightly. Construct a solid platform 75 cm high-without steps or ladders-on which to store your grain.
- Fix metal sheets at the base **of** the door.

Flooding and smoking

Flood and smoke rat burrows **in** the field. For best results, this should be a coordinated, community effort, targeting as many rat burrows as possible.

Clubbing

Cornered rats can be clubbed with long, heavy sticks.

Chemical methods

Chemicals that kill rats are known as rodenticides. They can be single-dose or multiple-dose poisons. Among these are: zinc phosphide, barium carbonate, Warfarin, Rodafarin, Pival, and Restions. These compounds are highly toxic and cause rats to haemorrhage.

Types **of** bait

Three types **of** bait are generally available.

Ready-to-**use** Rats can be fed directly when bait is **of** the ready-to-**use** type.

- Dry concentrate - Thoroughly mix 25 g **of** bait with 450 g **of** wheat flour, 10 g **of** edible oil, and 15 g **of** sugar or jaggery Do not add water.

Water-soluble baits-These are useful **in** rat reduction campaigns when rat infestation and temperatures are high. Mix one part bait with 20 parts **of** water. Put **in** a shallow container from which rats can drink.

How to **use** bait it, Before any poison is used, train the rats for a few days to eat unbaited food. Put

the food **in** shallow containers and place these along rat runs and dark areas where the rats can eat without being disturbed. This makes the rats used to feeding on a particular food. This is called pre-baiting. After a time, add the poison to the bait.

Baits can also be pushed into rat burrows. This is called "torpedo baiting"

Note

Dead rats should be buried.

Unburied dead rats are a health hazard and pollute the environment.

Delayed - action baits

Zinc phosphide kills rats instantly. Warfarin and other poisons kill after 6-7 days.

Rats are intelligent animals.

After a few rats die from zinc phosphide, other rats or 11 not eat this bait. **Use** Warfarin or other delayed action poisons to ensure effective control.

Caution

Keep bait away from poultry and children.

After eating bait, rats look for water to drink. Therefore, keep all your drinking water protected, away from rats.

Rat damage to various crops **In** India:

Barley	5-12	%
Wheat	3	%
Groundnut	2-7	%
Coconut trees and nuts	6-28	%
Sorghum	17	%
Paddy	6-17	%
Gram	1-4	%
Sugarcane	5	%
Cocoa	1-5	%
Oil palm	3	%
Pigeon pea	7	%

Contributor Dr. L. M. L. Mathur

Pests and pesticides

Integrated pest management

Pesticides

Under IPM, pest populations are carefully monitored. Pesticides are used only when the pest population reaches a size where economic damage is likely and nonchemical methods will not work **in** time.

Integrated pest management (IPM) is an effective and economical way to control crop pests. It makes **use of** virtually all methods **of** pest control, including: natural pesticides, beneficial insects, special cultivation practices, and even chemical pesticides **in** the right measure at the right time. Some practical techniques **of** IPM are described below.

Cultural methods

Cultivation

Invert the soil by deep ploughing after harvesting a crop. This buries stubble, disease-infected trash, weeds, seeds, and insect larvae and pupae. Insects hibernating **in** the soil are exposed to the sun's rays and birds.

Crop hygiene

Destroy unwanted crop stubble. Scrape bunds and channels regularly to keep them free **of** grasses which are home to insect pests.

Fallow Land

Keep some portion **of** the land fallow and plough it deep, especially **in** summer, to reduce the population **of** some insect pests.

Flooding

If possible, flood your fields before cultivation **in** the summer. This exposes hibernating army worms, cutworms, white grubs, etc., to birds.

Irrigate before sowing

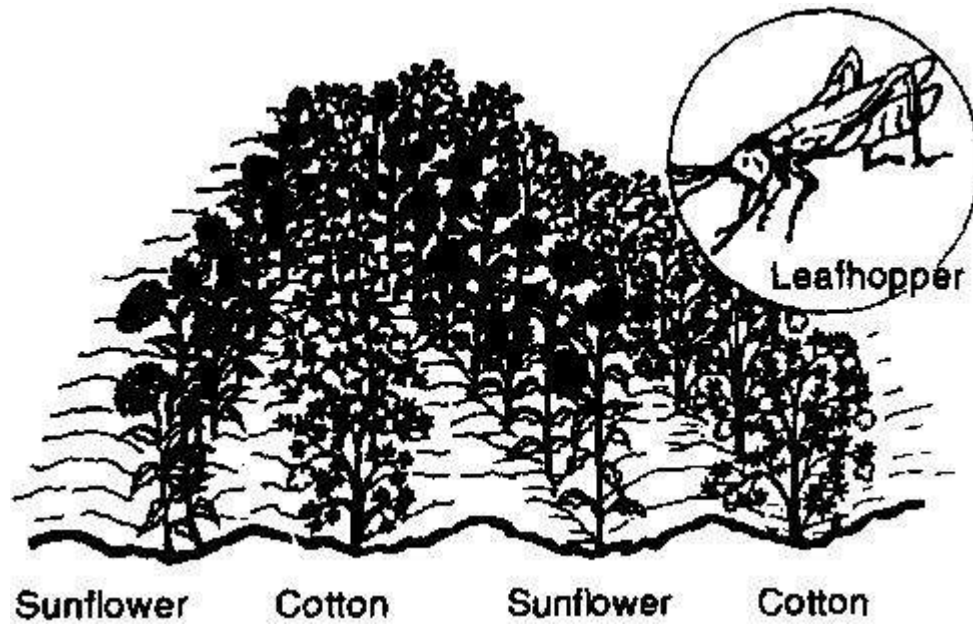
Control weeds **in** wheat crops by irrigation. Irrigate, prepare the land, and leave it for a few days. The weeds which sprout can be destroyed by ploughing.

Crop rotation

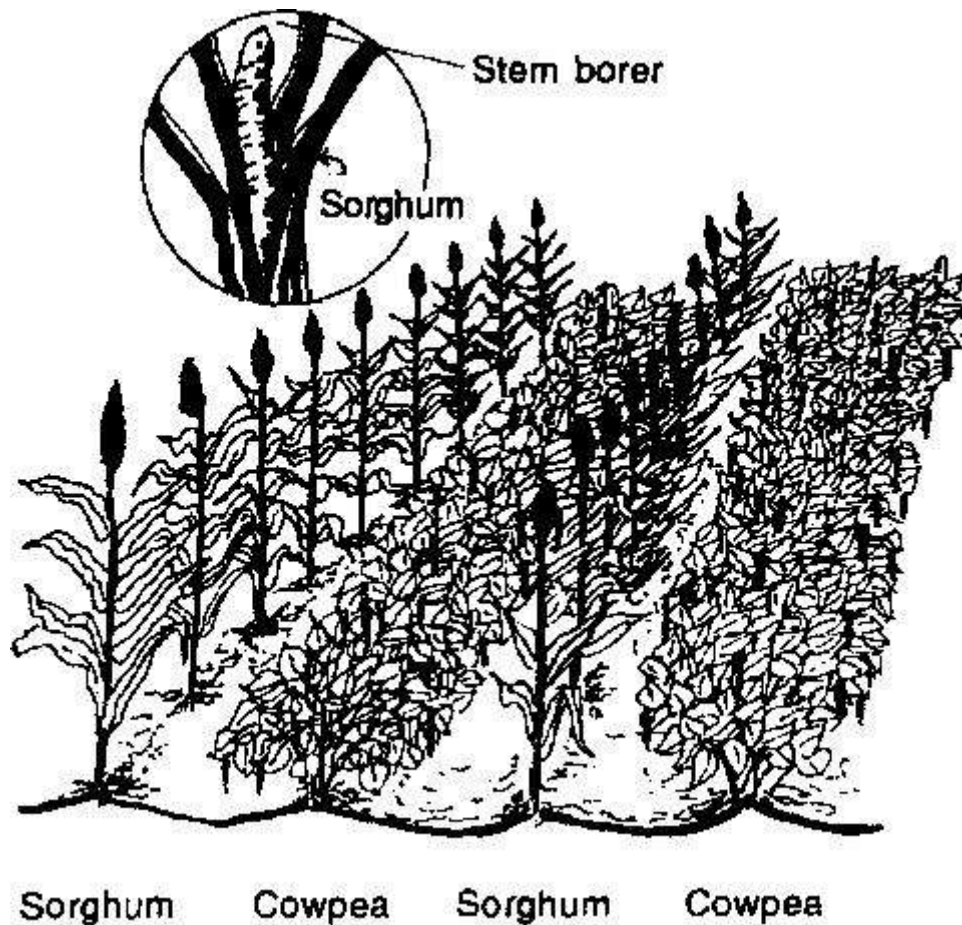
Avoid growing the same crop, or crops **of** the same family, over and over again **in** the same field. This can lead to a build-up **of** certain pests. Grow sorghum or maize before a cotton crop to reduce the incidence **of** cutworms.

Intercropping

Intercropping can reduce pest infestation. Grow sunflower side-by-side **in** the same field with cotton to reduce leafhopper damage. Grow cowpeas with sorghum to reduce stem borer **in** sorghum. Intercropping gram with wheat reduces attack from pod borer. A castor crop grown along with cowpeas will suffer less damage from aphids.

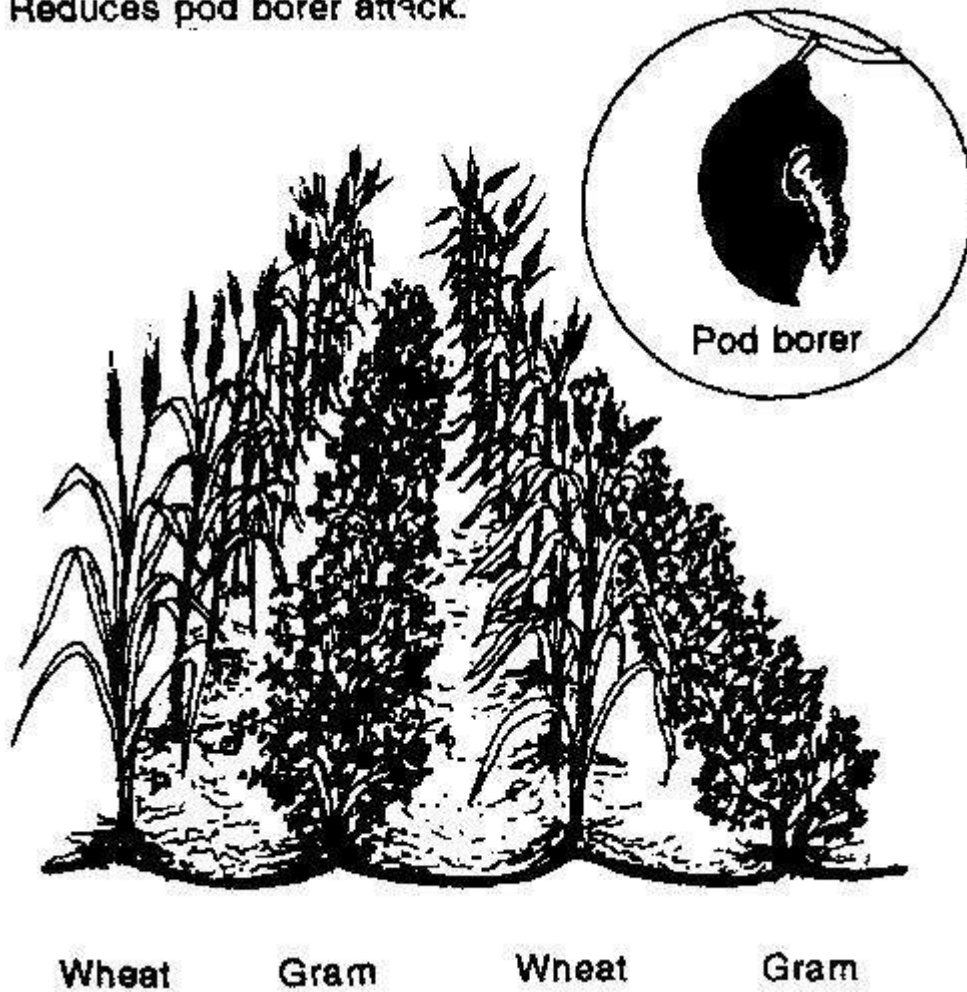


Sunflower-cotton Reduces leafhopper damage.

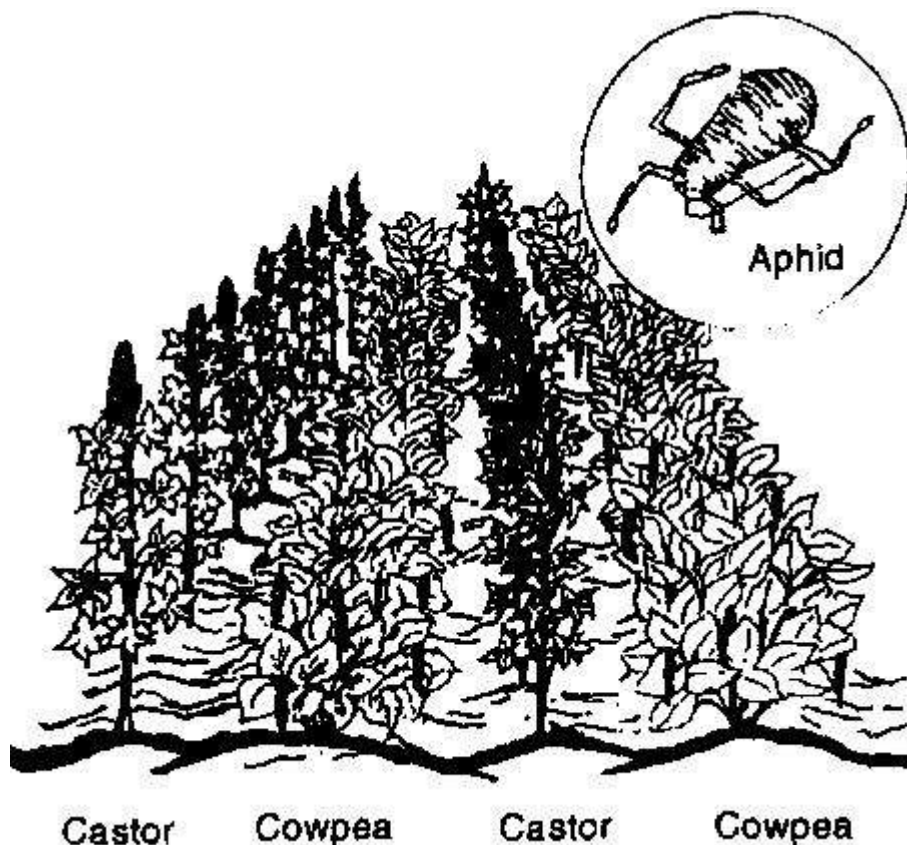


Cowpea-sorghum Controls stem borer.

Reduces pod borer attack.



Wheat-gram Reduces pod borer attack.



Castor-cowpea Reduces aphid damage.

Trap crops

A "trap crop" is a crop grown as a companion to the main crop which will attract pests away from the main crop. Grow castor as a trap crop **in** your cotton, tobacco, and chill) crops. The castor will draw cutworm larvae away from your valuable primary crop.

Resistant varieties

Several varieties **of** rice, wheat, cotton, sugarcane, and other crops have been developed which are resistant to specific insect pests. Grow the insect-resistant varieties recommended for your region.

Grow varieties **of** proper duration

Short-duration varieties **of** pigeon pea escape attack from small pod borer which appears sometime **in** February, but long duration varieties are affected.

Seed rate

Increase normal seed rate by 20 percent. Then, uproot and destroy insect-infested and disease-infected plants. Because **of** the increased sowing rate, the optimum plant population can still be maintained. This is a good method for controlling sorghum shoot fly.

Healthy seeds

Treat seeds before sowing to reduce the incidence **of** seed-borne diseases such as smut. Soak seeds **in** 10-percent salt solution to treat borer-infested seeds. When sowing sugarcane, reject insect and disease-affected sets.

Time **of** sowing

Adjust sowing time to avoid pest damage or to ensure that the crop is sufficiently developed to better withstand attack. Maize sown at the start **of** the monsoon suffers less from borer infestation than maize sown earlier.

Spacing, irrigation, and fertilization

Avoid close spacing, avoid excessive **use of** irrigation to control insects and disease, and avoid excessive **use of** nitrogen fertilizers. Feed your crop a balanced mix **of** fertilizers which includes potash to build plant resistance.

Physical methods

- Transplant only healthy seedlings.
- Clip the tips **of** paddy seedlings before transplanting to reduce the carry-over **of** insect eggs to the field.
- Observe your crop closely at least twice a week.
- Promptly remove and bury insect-infested and diseased plants.
- Control top borer **in** sugarcane by cutting off the top, one inch below the last node.
- Control malformation **in** mango by removing and destroying affected bunches.
- Hand-pick egg masses, larvae, caterpillars, and adult beetles from crops. Immerse them **in** water mixed with kerosene to destroy them.

Mechanical methods

You can **use** several mechanical methods **in** conjunction with physical and cultural methods to reduce pest populations. For example, you can **use** a mechanical trap to combat rodents. You can pull weeds by hand, or **use** a hand hoe or some other simple mechanical weeding device. (See Drudgery-reducing implements for farm women.)

Light traps

Place light traps **in** the field to control rice leaf folder and rice stem borer.

Trenches

Dig trenches around pest-infested paddy fields to prevent migration **of** hairy caterpillar larvae.

Barriers

Some pests crawl up trees and attack the fruit. Smear grease around the trunk **of** fruit trees to prevent insects from crawling up. Smear a band **of** grease around the trunk **of** your mango trees **in** November to prevent mealy bug infestation.

Biological methods

Insects have natural enemies: parasites, predators, deadly microbes, birds, and other animals. These are your important allies.

Birds

Protect birds, such as the king crow, egret, cuckoo, wood pecker stork, warbler, and babbler, which feed on insects. Owls, bats, and peacocks help to control rat and mice populations.

Parasites and predators

Several agricultural universities **in** India mass-produce helpful parasites, and release them to farmers at the right time at low cost. Learn about the biological pest control services available **in** your area and **use** them.

Ask about:

- *Trichogramma chilonis*, *T. japonicum*, and *T. achaeae*.

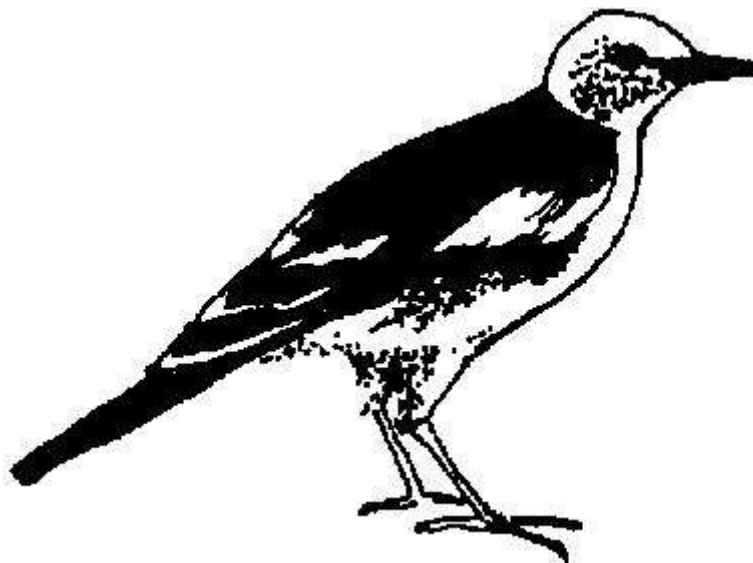
These parasites feed on the eggs **of** many insects, including sorghum stem borer, sugarcane borers, paddy stem borer, cotton boll worms, tomato fruit borer, cutworms, and others.

- *Chrysoperia carnea*

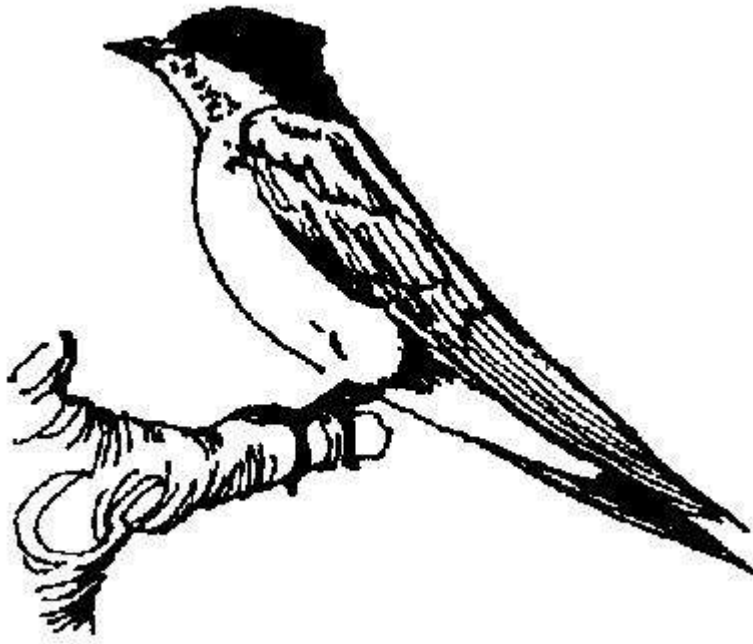
This parasite controls aphids, white flies, mealy bugs, and young larvae **of** various borers, cutworms and cotton boll worms, and other soft-bodied insects.

Viruses

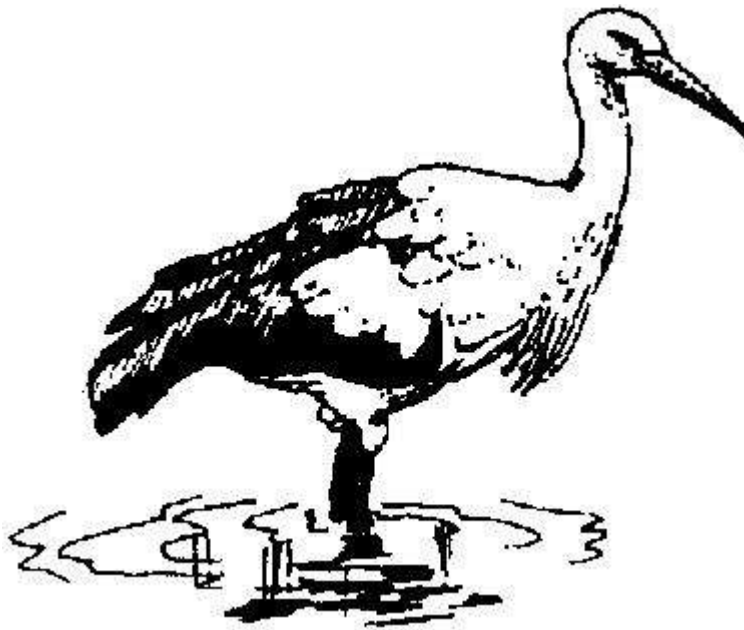
Some agricultural universities **in** India mass-produce helpful viruses (called mpv) which can be released into crops to control certain insect pests. The Tamil Nadu Agricultural University has succeeded **in** controlling fruit borer **in** gram, tomato, cotton, and other crops by this method. Contact the agricultural university **in** your region for more information.



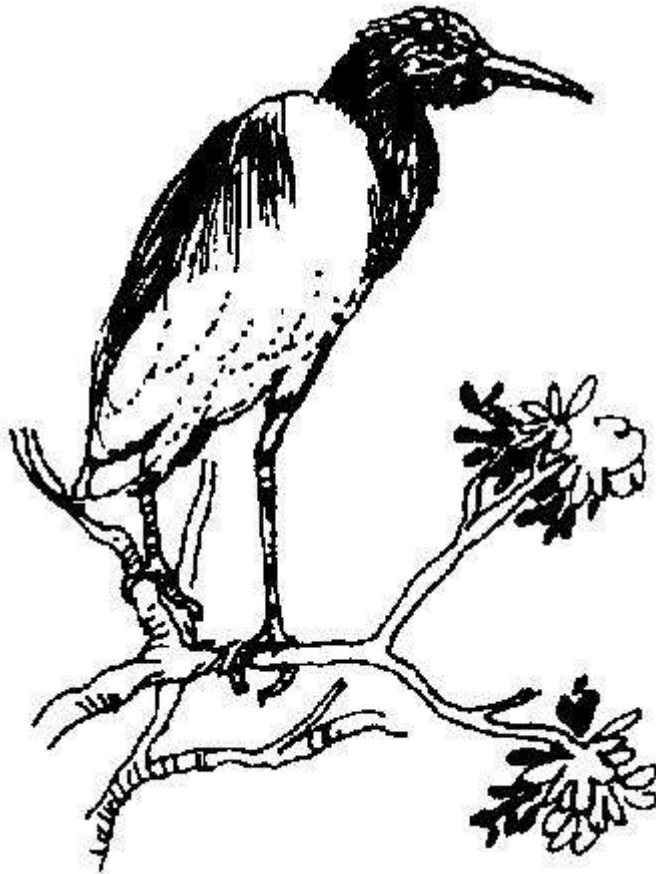
Yellow-headed wagtail



Wire-tailed swallow



White stork



Cattle egret

Botanical pesticides

Use plant extracts to ward off insect pests **in** your fields and at home. Some plant extracts kill insects; others repel insects; still others deter insects from feeding, or inhibit their growth. These are effective and less toxic to mammals and birds than are chemical pesticides.

Powdered neem kernel (1-2 kg per 100 kg **of** grains) will reduce damage caused by insect pests **in** stored grains and pulses.

Neem oil mixed with karanj oil (ratio **of** 5 parts neem oil to 1 part karanj oil) is effective against aphids **in** cotton. Mix 3 g **of** the oil **in** 1 litre **of** water.

Leafhoppers, caterpillars, and army worms are less attracted to a paddy crop treated with 3 percent neem oil.

Spray neem seed kernel extract (5 percent) mixed with water to control katra worms and borers.

Apply neem cake at the rate **of** 150 kg per ha to control rice hoppers.

Apply karanj cake at the rate **of** 150 kg per ha to control beetles **in** tobacco.

Dature, agave (cactus), pyrethrum, annona, and other plants are also known for their effectiveness **in** controlling insects.

Chemical method.

Judicious **use of** pesticides

Apply chemical pesticides only when other effective methods are not available. **Use** pesticides judiciously: the right pesticide, **in** the right amount, at the right time, **in** the right place. Choose less toxic and less persistent pesticides. Choose pesticides which control the pest species, but leave beneficial species and neutral species unharmed.

Consider the cost

Only spray when the value **of** me threatened crop justifies the expense.

Timing

If you must spray, apply pesticide **in** the right amount, at the right time, **in** the right place. Good timing is important. For example, spray early **in** me growing season when the pest is active but before natural predators and parasites have built up **in** large numbers.

Contributors and sources: Dr. N. K. Roy, Dr. L. M. L. Mathur, Dr. Jagdish Singh, Dr. V. N. Shroff, and Dennis H. Hill

Neem for plant protection

Use of synthetic pesticides for controlling pests and diseases **in** field crops and stored grain is hazardous. It is also-often unnecessary since a number **of** common plants can be fumed into effective pesticides. Neem is one such tree.

Neem

Neem is a large evergreen shade tree grown **in** all parts **of** India. It bears flowers **in** February-April and its fruit matures after 4 months. Important parts are the fruit, leaves, twigs, and bark. About 40 percent **of** the seed weight consists **of** the kernel which contains 25-35 percent oil and 65-75 percent neem cake. One neem tree gives 15-30 kg **of** seeds per year.

Uses

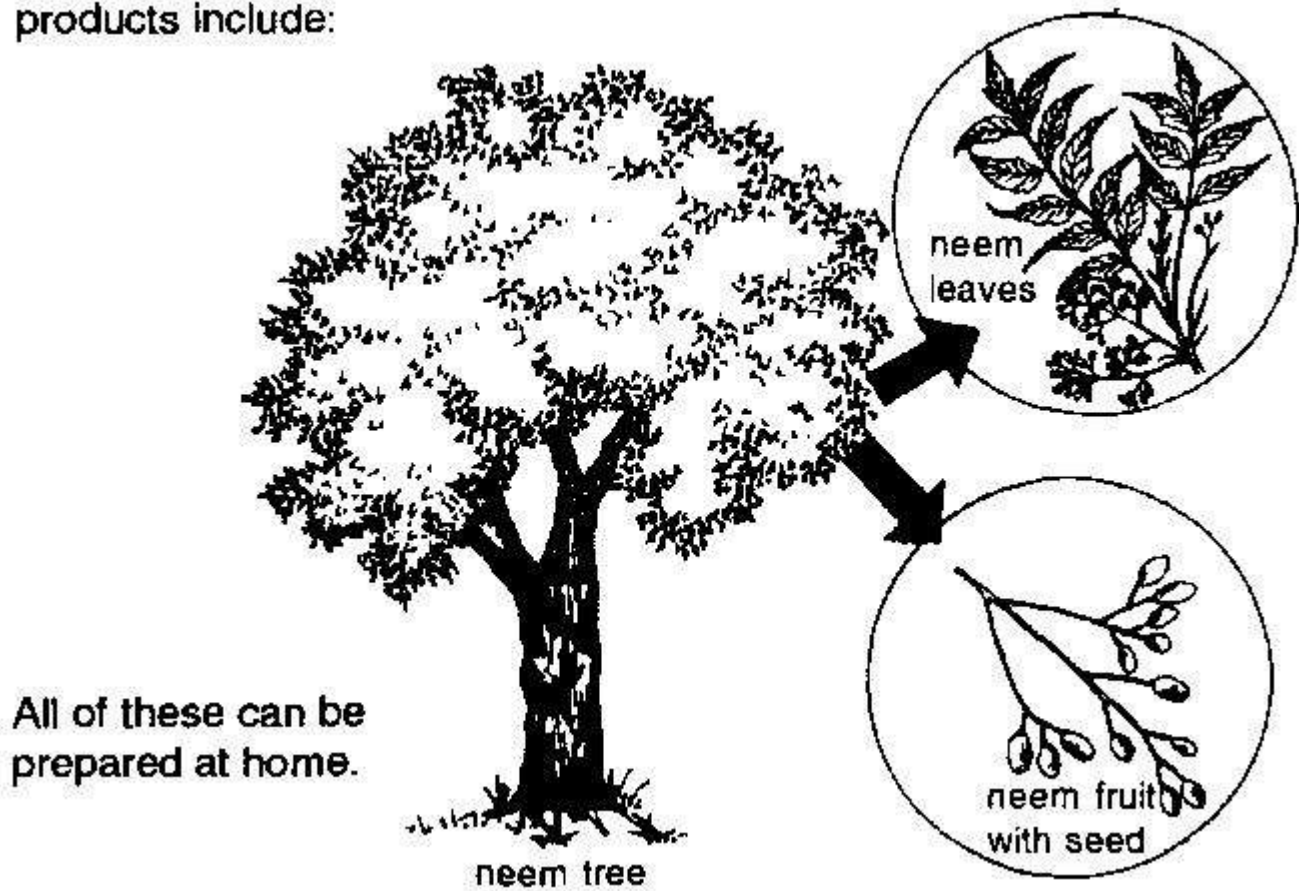
For centuries, neem has been used as a pesticide. Dried leaves protect clothes and books against termites and other household pests. Dried neem leaves also help to keep stored grain free **of** pests. Neem cake mixed **in** soap helps control soil-borne pests **in** field crops. Neem seed chemical repels insects, deterring them from landing, feeding, and laying eggs on crops. Neem seed chemical reduces the growth and development **of** some insects, or causes them to be infertile or eventually die.

Advantages

Neem products kill insects more slowly than synthetic pesticides, but neem has many advantages:

- Neem products are nonpoisonous. They do not affect people, birds, fish, and wildlife.
- Crushed neem seed kernel extracts are less costly than synthetic insecticides.
- Neem products do not pollute the air, water, or soil.
- Farmers can grow their own pesticides.
- Neem products can be made easily and cheaply at home.

Although most parts of the neem tree can be used, its seeds are most products include:

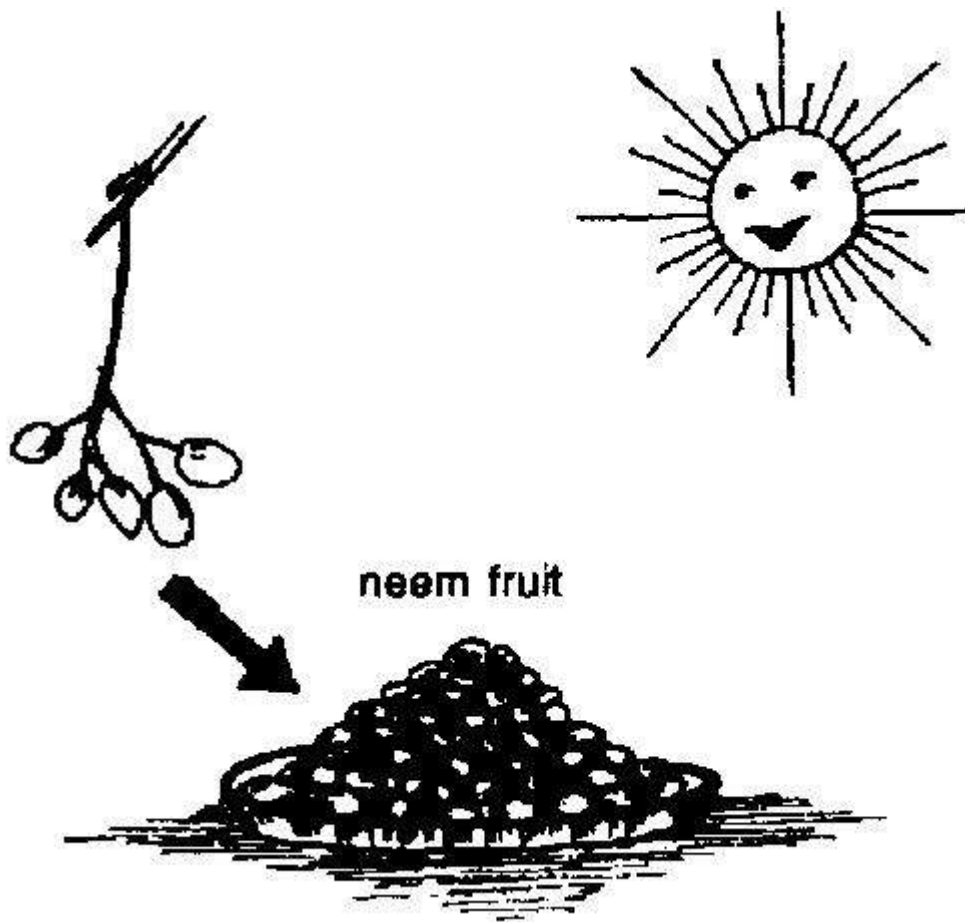


Neem products

Collecting and preparing seed

- 1 Collect ripe fruit fallen on the ground, or shake the tree branches and collect the fallen fruit.
- 2 Depulp immediately by hand or with a mechanical depulper.

3 Wash the seeds and dry them **in** the sun. Spread the seeds evenly on the ground and turn them regularly to ensure even drying. Make sure the seeds are thoroughly dry to avoid mould. (Mould affects both the amount **of** oil that can be extracted and the efficacy **of** the product.)



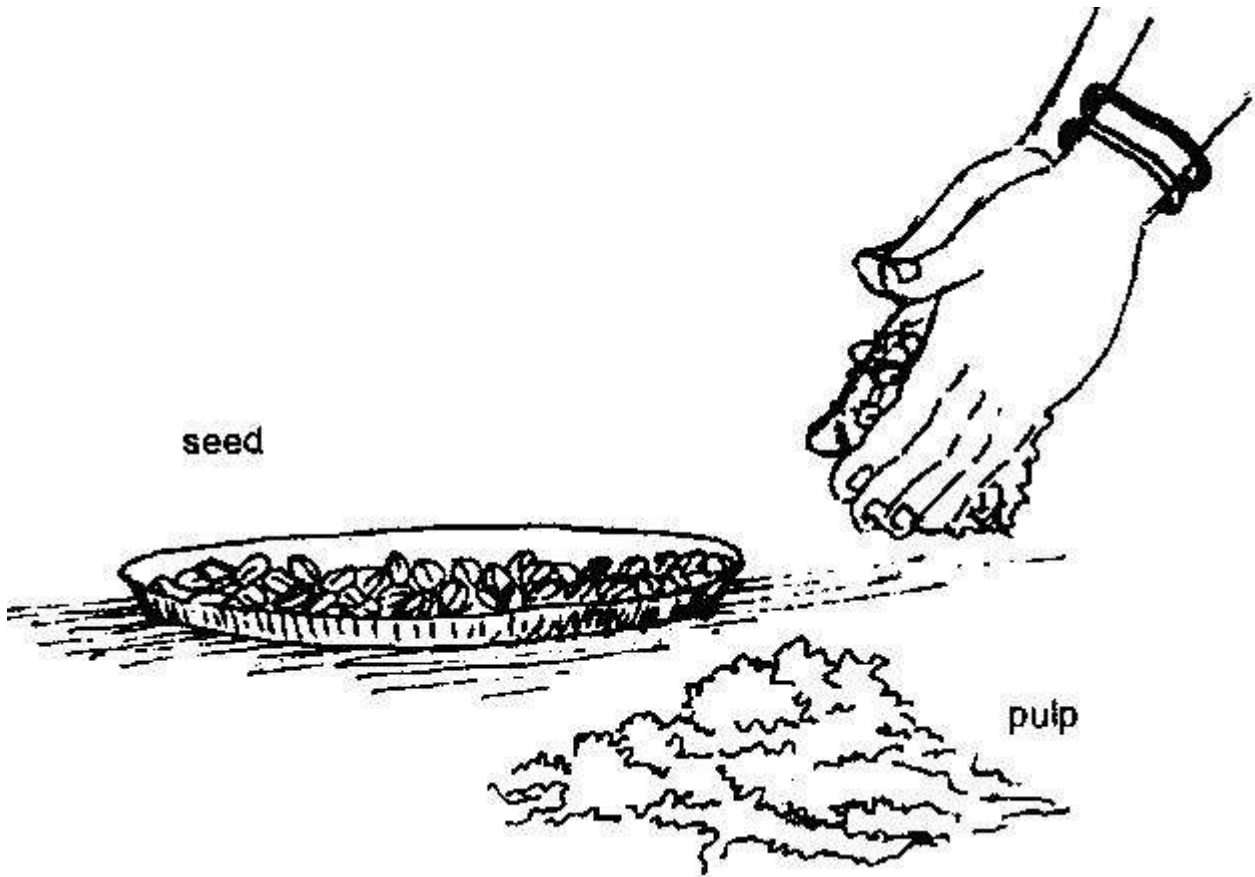
Depulp immediately

4 Store dried seeds **in** airy containers, such as baskets, jute or cloth bags, **in** a cool, dry place. Seeds can be stored up to one year, but not longer. Never store seeds **in** plastic bags.

Preparation **of** neem seed kernel extract

1 Collect fruit.

2 Remove seed coats.



Seed

Neem brands

Ready-made commercial neem products cost less than synthetic pesticides.



Neem gold

Neem gold



Neemark

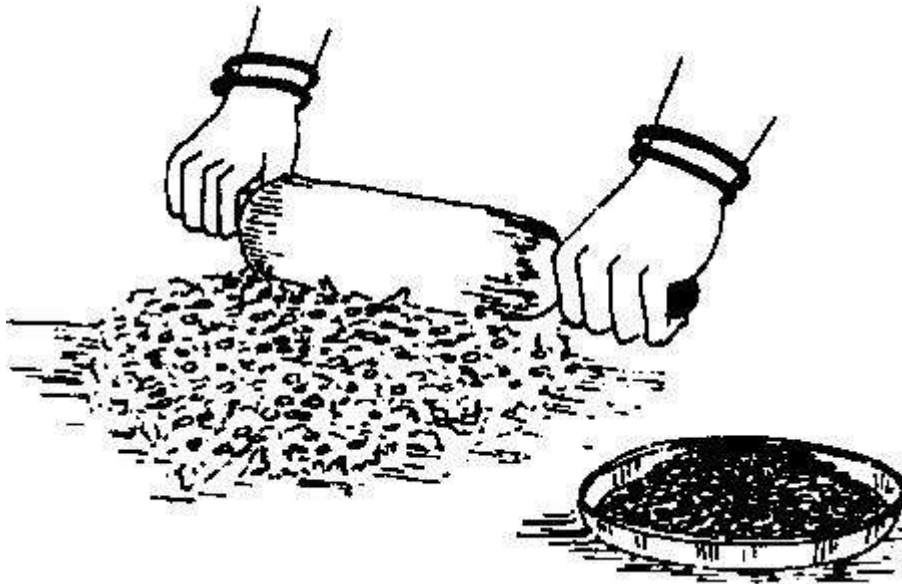
Neemark



Nethrin

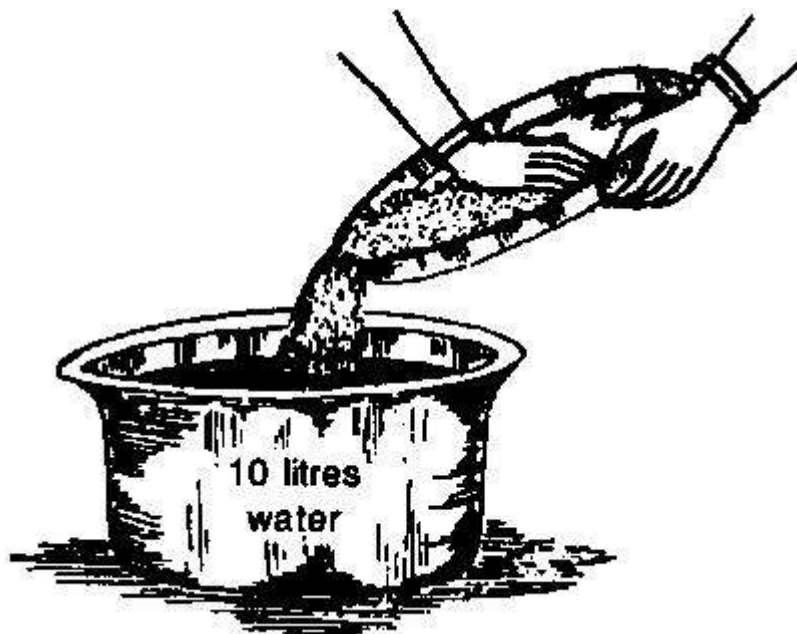
Nethrin

3 Crush 2 handfuls of kernels.



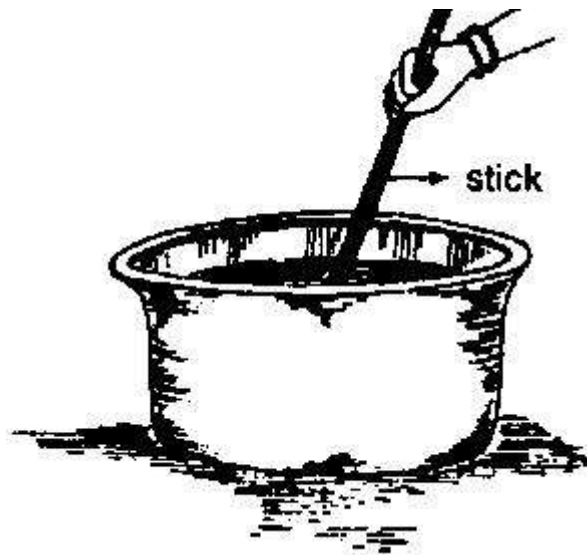
Kernel

4 Add to 10 litres of water.



Add to 10 litres of water.

5 Stir for 20 minutes with a stick. Leave for 6-16 hours.



Stick

6 Add about a teaspoon **of** soap powder and a teaspoon **of** soap thoroughly.

7 Filter the contents through a muslin cloth.



neem seed kernel extract

Neem seed kernel extract

8 Spray on crop. Depending on the size **of** the crop, you will need 2.5-4 barrels **of** liquid (500-750 litres) to spray 0.4 ha (1 acre) **of** crop.

9 Repeat the spray after 5-6 days.

Preparation **of** neem oil emulsion

1 Put 500 ml **of** neem oil **in** a 10-litre bucket.

2 Add 50 g (10 teaspoons) **of** soap powder or Teepol. Stir well.

3 Add water to fill the bucket and stir until a white creamy liquid is formed.

4 If the oil forms on the surface as a separate layer, add more soap powder and stir again.

5 Spray the emulsion on a few plants before large-scale spraying. Wait for two days and check whether the spray has damaged the plants. If the plants are damaged, add more water to the liquid to reduce its concentration.

6 Spray 500-750 litres per acre, depending on the type and size **of** the crop. Spray until moisture runs off the plants. The crop should be completely covered (completely wet) with spray.

Contributors: Dr. R.P. Singh and Dr. Jagdish Singh

Neem oil as mosquito repellent

Mosquitoes and sandflies

- Neem oil is more effective against Anopheles mosquitoes (which carry malaria) than Culex mosquitoes (vectors **of** filaria).

- Neem oil is also very effective **in** repelling sandflies.

Mosquitoes are a terrible nuisance, both **in** urban and **rural** areas **of** the country. They also transmit dangerous diseases, such as malaria, filaria, Japanese encephalitis, and dengue fever.

A number **of** mosquito repellents are used **in** India. Many **of** these repellents contain synthetic chemicals which can be harmful with prolonged exposure. Many people are also allergic to the vapours **of** these chemicals. There is an alternative. Neem oil is an excellent mosquito repellent. It is safe, cheap, and simple to **use**.

Method

Application on skin-Buy fresh neem oil **in** the market or press dry neem seed kernels to obtain the oil. Mix 2 ml **of** neem oil **in** 100 ml **of** coconut or mustard oil. Apply about a teaspoon **of** the mixture on exposed parts **of** the body such as the face, arms, and legs. One application **of** neem before going to bed **in** the evening will repel mosquitoes for 12 hours.

Neem oil **in** kerosene lamp-**Use** a tin lamp, 100 ml capacity, without a chimney. Mix 2 ml **of** neem oil with 100 ml **of** kerosene. Allow the kerosene to burn all night. Vapours from the lamp will keep mosquitoes away.

Powdered neem **in** water-Add 10 g **of** powdered neem cake to 100 litres **of** stagnant water (for instance, **in** household water tanks). This will prevent mosquito larvae **in** the water from developing.

Neem oil on heated mats-Make a 5 percent solution **of** neem oil **in** acetone. Apply this to a used mosquito mat for **use** **in** a commercially available mat heater. Mats, impregnated with nonneem-based repellent, and heater units are available under the brand name Baygon.

Contributor. Dr. V.P. Sharma

Biological control **of** malaria

Malaria is a serious, sometimes fatal illness caused by parasites spread by mosquitoes. Fortunately,

there are simple, low-cost ways to control malaria without resorting to dangerous chemicals.

Note

Children and pregnant women are especially at risk from malaria.

Mosquitoes and malaria

In order to protect yourself from malaria, you must first understand the life cycle **of** mosquitoes. Female mosquitoes live 4-6 weeks. They take a blood meal on alternate days; they also consume liquids from wet surfaces. Male mosquitoes live 7-10 days. They feed on wet surfaces and fruit juices. They do not feed on blood.

Mosquitoes complete part **of** their life cycle **in** water. Mosquito eggs are laid **in** water; they pass through larval and pupal stages **in** water before they emerge as adult mosquitoes. The process takes about a week.

When a female mosquito feeds on a person infected with malaria parasites, the mosquito becomes infected. The parasites develop within a week inside the abdomen **of** the mosquito. When the mosquito next feeds, the parasites are released into the bloodstream **of** the healthy person.

Mosquito breeding habitats

Mosquitoes breed **in**: wells, ponds, ditches, pits, drains, water tanks, irrigation tanks, rainwater collectors, marshy areas, rice field irrigation channels, seepage spots, stagnant water **in** fields, stagnant rivers, fallow fields with ditches, **in** any small or large amount **of** still water.

Prevention **of** malaria

The most common method **of** malaria control involves the **use of** insecticides, mainly DDT. Insecticides destroy mosquitoes but also harm many other organisms-insects, aquatic animals, and people.

Larvae-eating fish

A number **of** fish species eat larvae, but not all can be used to control mosquitoes. Fish suitable for controlling mosquitoes must be:

- small so that they can reach the grassy pond edges which shelter mosquito larvae.
- prolific breeders to keep up with the fast-growing mosquito populations, and to compensate for losses to fish-eating birds.
- **of** no commercial value.
- able to live **in** turbid, polluted water and withstand temperature variation.
- surface feeders to control the floating mosquitoes.
- hardy enough to withstand transportation and handling.
- prefer to consume mosquito larvae.

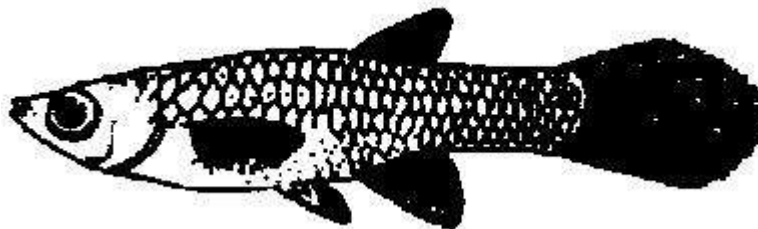
Two fish which meet the above criteria

- Guppy (*Poecilia reticulata*)
- Gambusia (*Gambusia affinis*)

Each consumes 200-300 mosquito larvae per day.

Guppy

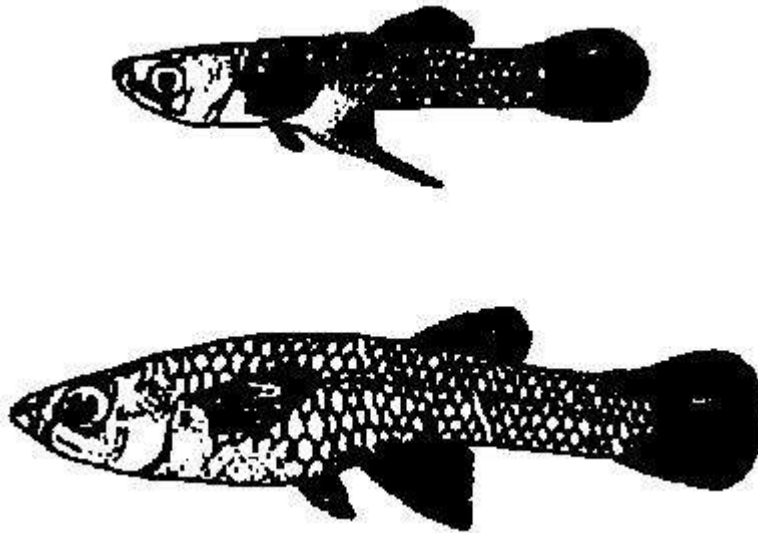
- Guppy live 3-5 years.
- They mature **in** 90 days, when males are 1.8 cm long and females 2.5 cm long.
- The female produces 50-200 offspring a month **in** broods **of** 57.
- The guppy breeding season **in** the tropics is from April to November.
- They are ideally suited to polluted waters, such as drains, ponds, pits, and sewage tanks.
- They cannot survive at low temperature (below 5 C) or **in** highly polluted water, such as water contaminated with industrial wastes.



Guppy

Gambusia

- Gambusia live 3-5 years.
- Males reach a maximum size **of** 4.5 cm and females 6.8 cm.
- Females mature **in** 3-6 months.
- Females produce 8-10 offspring per brood and usually produce 2-3 broods **in** a year.
- Gambusia are suited to fresh water, brackish water, and salt marshes.



Gambusia

Transporting fish

Fish can be transported short distances **in** any water filled tin or plastic container or plastic bag. For long distances, fish must be packed **in** water-filled polythene bags. The water must be oxygenated every 5-6 hours. (Slap the water surface with a small stick

Breeding larvae eating fish

Larvae-eating fish are available free from:

Fisheries Department, Delhi Administration, Timarpur, New Delhi or contact

Director, National Malaria Eradication Programme, 22-5 ham Nath Marg, New Delhi 1 1 0054.

Note

Fish are sensitive to chlorine.

Note

Mosquitoes travel about 3 km; so for best results, your control program should cover a 3-km radius around your village.

Fish multiplication **in** perennial village ponds

- Clear the pond **of** predatory fish by reseated netting or by application **of** mahua cake.

Release your breeding stock into a container **of** pond water to allow the fish to become acclimatized.

After 30 minutes, release the fish into the pond.

Usually there is enough fish food-zooplankton and phytoplankton-available **in** the pond and no artificial feed its needed

For faster growth **of** fish, dung and nitrogen fertilizers can be added to the pond.

Collect the multiplied fish **in** a tin container or elastic bucket.

Release **in** mosquito breeding sites

- Release the fish **in** mosquito breeding habitats at the rate **of** 510 males and females per square meter.
- Remove the grass from the edge **of** the pond or ditch where the fish will be released.
- Periodically net and remove predatory fish.
- Periodically check the fish for survival. Look for dead fish floating on the surface. Restock as needed. Try to discover what is killing the fish and remedy the problem. Consult the fisheries officer **in** your area for help.

Non-chemical methods of weed control

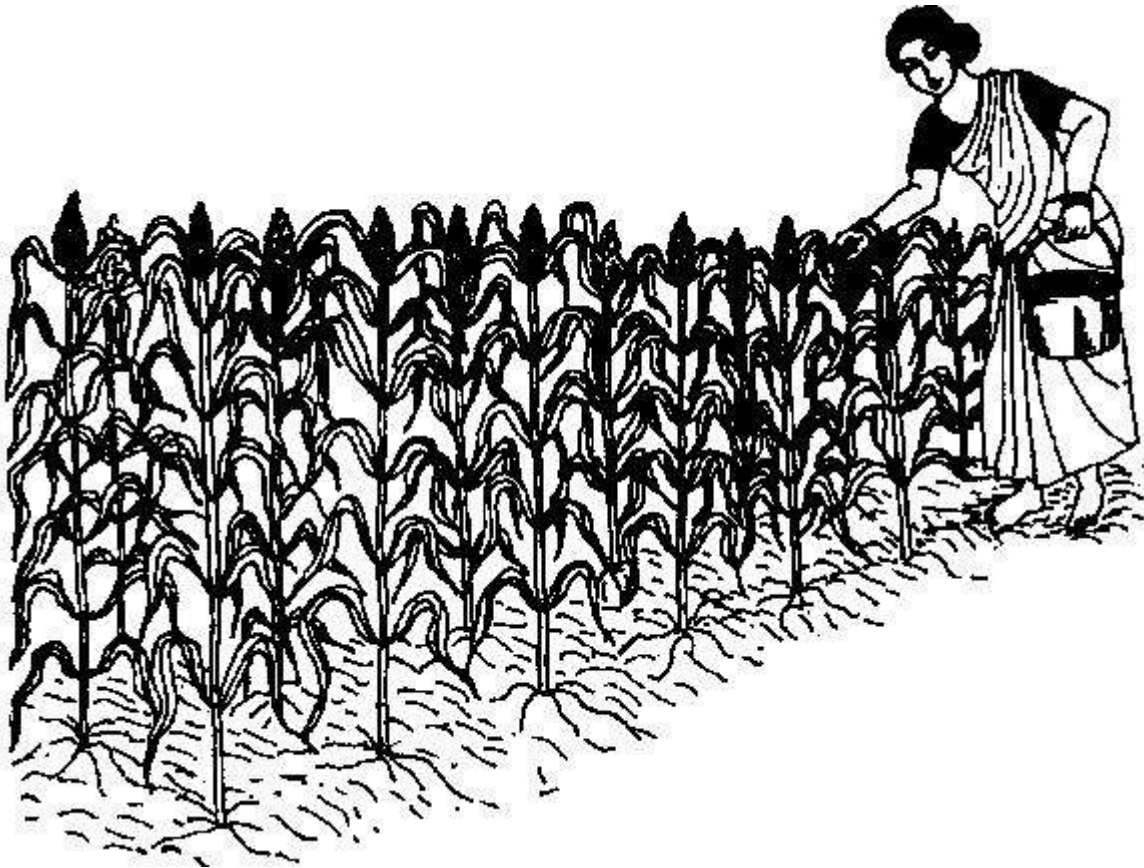
Weeding is an important but physically demanding chore mostly performed by women. Although many experts recommend chemical methods **of** weed control, chemicals pose serious hazards to human health and the environment. Therefore, nonchemical, less hazardous, yet less laborious methods should be considered.

Weeds are plants which compete with crops for water, nutrients, and sunlight. They are hardy, with deep root systems, and produce many seeds which, **in** some cases, remain dormant and viable for decades.

Controlling weeds Weeds can be controlled through proper management, using simple implements and biological methods.

Proper crop management

1 Place fertilizer on the ground near the stem **of** crop plants. This will give nutrients only to the main crop, rather than to weeds.



Place fertilizer on the ground near the stem.

2 Keep channels clear **of** weeds. This will reduce the number **of** weed seeds washed into your crop. It will also keep the water flowing freely. Good irrigation practices give crops a good start over weeds.

3 Grow crops **in** proper rotation to keep weeds down. Two to three short-duration crops should be grown **in** rotation **in** the same field. Change the crop rotation periodically (after a few years) to prevent problem weeds from establishing. Grow at least one soil-maintaining legume crop **in** each rotation. If a problem season is expected, select a crop which will prevent weeds from growing.

4 Clean your seed to remove weed seeds. Destroy the weed seeds by burning or burying them.

5 Major sources **of** weed seeds are farmyard manure and compost. Weed seeds withstand partial decomposition. Therefore, apply only fully decomposed farmyard manure or compost to your fields.

Mechanical methods

Irrigate your field a few days before sowing the crop. Plough the field to destroy the weeds that emerge before sowing the crop.

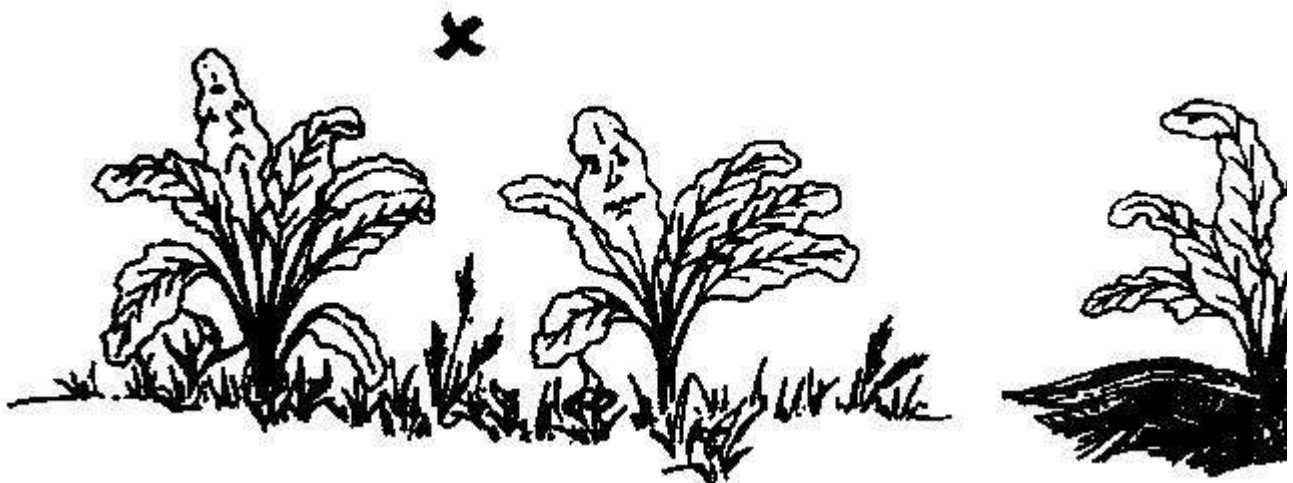


Implements make weeding easier.

2 A few implements are available which make weeding easier. Among these are the wheel hand hoe and Triphali. (See Drudgery-reducing implements for farm women.)

3 Burn weeds to get rid **of** accumulated vegetation or destroy dry tops **of** mature weeds. Burning will kill even green weeds and will destroy buried weed seeds.

4 Mulch the crop by spreading dry or green crop straw, sawdust, bark dust, and other plant parts. Paper, plastic sheets, or polythene films are also used as soil covers. This method is effective against annual and perennial weeds.

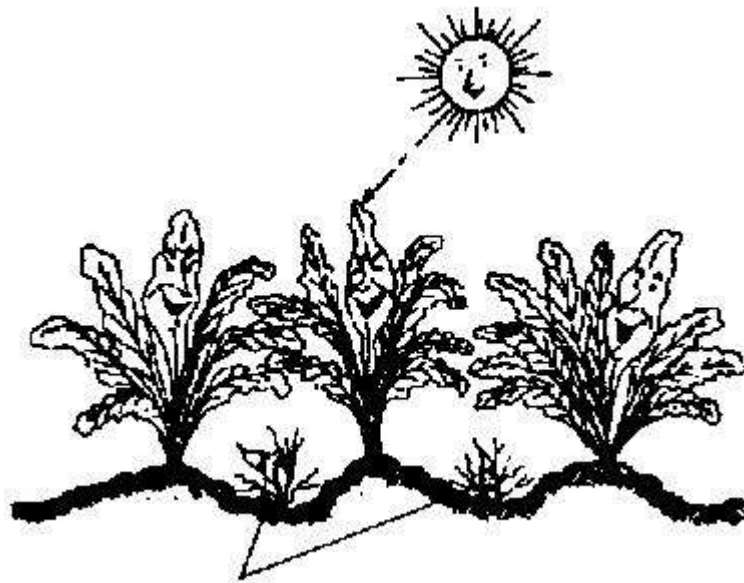


Mulching discourages weeds.

5 Flooding is used for weed control **in** fallow rice fields. Surround the weed-infected area with dikes, and maintain the water at 15-30 cm depth for 3 to 8 weeks.

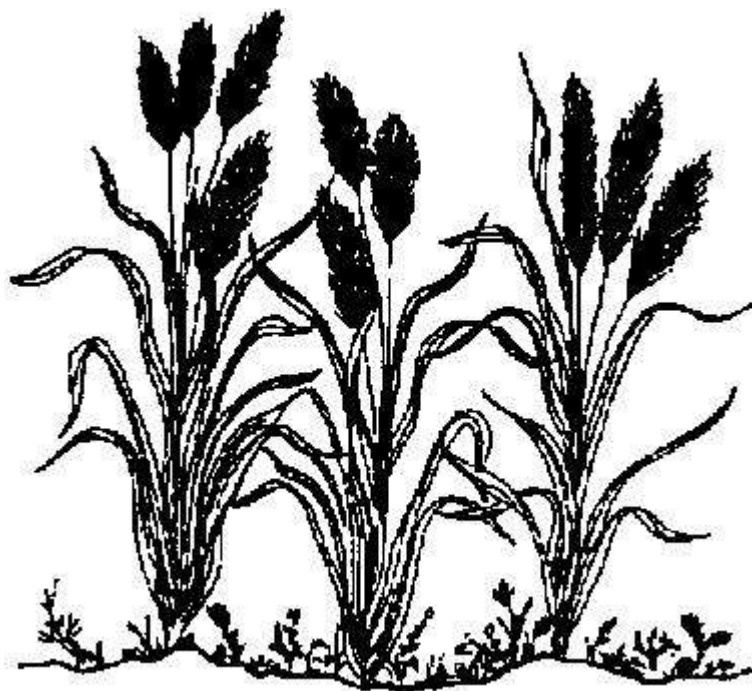
Biological weed control

1 Some crops which grow rapidly have an advantage over slow-growing or late-emerging weeds. Such crops include maize, sorghum, soybean, and cowpea.



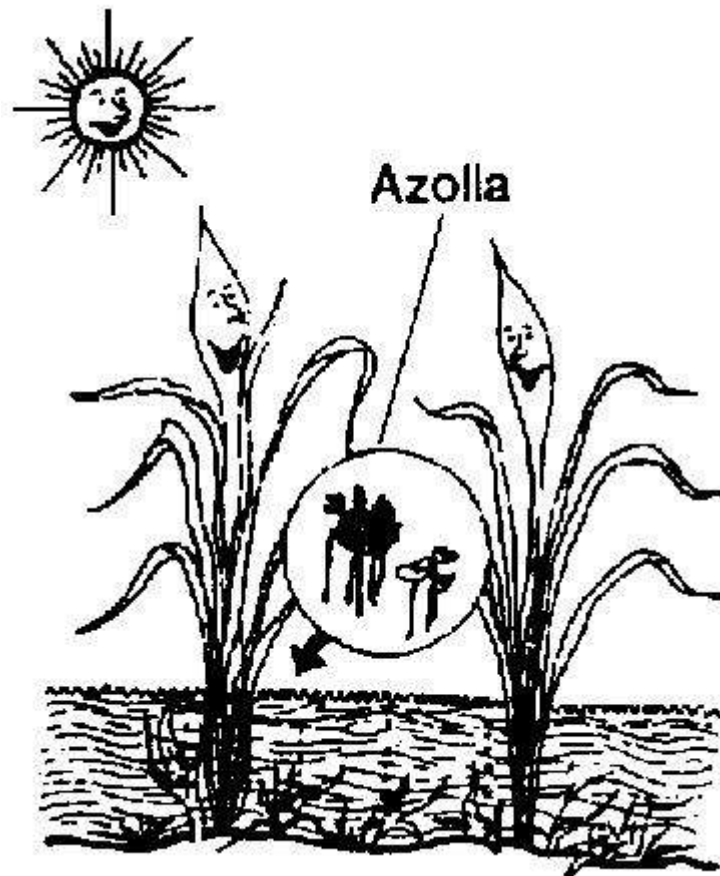
Slow growing weeds.

2 Weeds face tough competition when the crop plant population is high. Plant population can be increased by reducing the row spacing or plant-to-plant spacing within the row. This has a smothering effect, reducing weed emergence and establishment.



Maintain high plant population.

3 Bio-control agents, like azolla, can also be used to control weed populations **in** rice fields.



Azolla

Contributor. Dr. V. M. Bhan

Safe use of pesticides





Pesticides are toxic chemicals. They must be used with extreme care. Most farm women, however, have no formal training or information on proper **use of** pesticides. A large majority **of** women take no precautions whatsoever when working with pesticides. The result: many women handle, transport, and apply pesticides **in** ways which can lead to deadly consequences. It is critical, therefore, that you learn the following techniques for safe pesticide **use**.

Buying pesticides

Before buying pesticides, you must answer the following questions:

- Which pest is to be controlled?
- How much damage has the pest done?
- Are sufficient predators already **in** the field or are they likely to be there soon?
- What are the recommended pesticides for the pest problem?
- Which is the least toxic and least persistent among the recommended pesticides?

Buy pesticides from a reputable and reliable licensed store.

Pesticide labels		Label colors
Extremely toxic		red
Highly toxic		yellow
Moderately toxic		blue
Slightly toxic		green

Pesticides

Do not buy **in** bulk, buy only as much as you expect to **use** within a short period. i Do not buy if the container is rusted, torn, leaking, or if the date **of use** has expired

4 Buy only pesticides **in** their original package with proper labelling.

5 Buy only pesticides with the ISI mark. This shows that the pesticide conforms to the standards laid down by the Bureau **of** Indian Standards.

6 Do not buy banned, restricted, or highly toxic pesticides.

Note

Use pesticides only as a last resort and as part **of** an integrated pest management strategy. See Integrated pest management.

Transportation

1 Avoid carrying pesticides on public transport.

2 Do not transport pesticides together with food products, fodder, or other commodities.

3 Make sure that pesticides are adequately packaged and do not spill or leak out.

4 If the pesticide spills or leaks, wash the vehicle that has been used for transporting the pesticides. For this, apply bleaching lime paste (1 kg **of** lime for every 4 litres **of** water) and wash it off with water twice or three times within an hour after its application. If the pesticide spills onto clothing, follow the instructions below, under "After application."

Storage

1 Do not keep pesticides **in** the kitchen or living room. Keep them away from food, animal feed and fodder, and containers **of** potable water.

2 Keep pesticides locked away and ensure that they are out **of** reach **of** children and pets.

3 Preferably, store pesticides **in** a separate room which is well-ventilated and is away from sunlight, fire, and water.

4 Be careful **of** cross-contamination. Store herbicides separately from other kinds or pesticides.

5 Do not keep medicines for humans and livestock together with pesticides.

6 Reseal containers after partial **use**.

Waiting period

Pesticides leave **residues** on crops. Observe the waiting period specified on the label or recommended by your extension worker. The waiting period depends on the type **Of** crop, the pesticide used, and the dosage.

Application

The waiting period is the minimum length **of** time you must wait after applying the pesticide before it is safe to harvest the crop. Do not harvest crops (especially vegetables) until the waiting period for the pesticide has passed.

- Do not work alone while handling or applying pesticides.

- Never allow children, animals, or unauthorized people near the site **of** mixing and application.

- Always **use** a long wooden stick for mixing pesticides **in** water.

- Spray early **in** the morning or **in** the evening. Suspend spraying during midday **in** summer months.
- Avoid excessive spraying. The spray should not drip onto the soil.
- Read the label and the instructions care fully before opening the pesticide packet or bottle.
- While mixing, pour the liquids carefully. Prevent splashing. Prevent powdered pesticides from blowing into your face. Mix with a long stick to prevent the liquid from splashing onto your hands.
- Never eat drink or smoke while mixing or applying pesticides.
- Wear protective clothing: rubber boots, a rubber apron, goggles, face mask and respirator. If a face mask is not available, cover your mouth and nose with a clean cloth Women must not wear loose clothing, such as sarees. Keep a separate set **of** clothing to wear when handling and applying pesticides. Wash these clothes immediately after **use**.
- Avoid application **of** pesticides on rainy or cloudy days.
- Never blow out clogged nozzles or hoses with your mouth. **Use** a fine wire or pin.
- Check the wind direction before starting to spray. Start spraying at the downwind edge **of** the field and move upwind so you are always moving into an unsprayed area. Always move along the wind while spraying and dusting so that the spray or dust is directed by air current away from you. Do not spray **in** strong winds. Try to avoid spraying when large number **of** bees are visiting the crop, normally when the crop is **in** flower.

Caution

Do not spray **in** strong wind. Mix pesticides only **in** the field where you will spray. This will reduce the risk **of** spillage. Never mix pesticides inside your house.

Caution

Pregnant women and nursing mothers should not handle or apply pesticides.

After application

- 1 Immediately after spraying, take a bath and change your clothes.
- 2 All clothes must be washed immediately after spraying. Wash them separately from other clothes.
- 3 Never leave pesticide **in** sprayers and dusters. Clean equipment with soap, detergent, or soda solution and fresh water. Rinse with clean water once or twice before returning the equipment to storage.
- 4 Dispose **of** all empty pesticide containers by burning or burying them **in** the field. Do not **use** them to store food, water, or as cooking utensils. Do not sell empty containers to hawkers because they might end up being misused.
- 5 Return unused pesticide to the storage place and keep it under lock and key.
- 6 Do not go into a treated field until the recommended safety period has passed. Read the pesticide label or ask your extension agent about safe waiting periods.

Contributors and sources: Dr. N. R. Roy, Dr. L. M. L. Mathur, Dr. Jagdish Singh, and Dr. Nelia Maramba

Hazard of pesticides

Exposure

Human beings can be exposed to pesticides **in** two ways:

- Environmental exposure Indirectly through pesticide contaminated food, air, and water.
- Occupational exposure directly during the mixing, loading, or application **of** pesticides.

Symptoms **of** exposure

There are two main groups **of** pesticides, organochlorines and organophosphates. Look for these symptoms **of** exposure.

Organochlorines-skin irritation, burning sensation, stiff and sore muscles, headache, nausea and vomiting, abdominal pain.

Organophosphate-(mild exposure) headache, fatigue, dizziness, blurred vision, excessive sweating, nausea and vomiting, diarrhoea;(moderate exposure) inability to walk, chest discomfort, muscle twitching; (severe exposure) unconsciousness, convulsions.

While some people might understand the hazards **of** pesticides to human beings and animals, few know that indiscriminate **use of** pesticides can lead to deterioration **of** the environment and ecological imbalance. By far, most insect species are beneficial to humans. Each has an important place **in** the ecological system. But, pesticides kill beneficial insects and pests alike, disturbing the natural balance and leading to surges **in** pest populations. **In** time, the continuous **use of** pesticides leads to resistant pest populations. Combating these resistant populations with higher doses **of** pesticides leads to poisoned soil and water.

Effects on people

Disturbed cell metabolism

Human bodies are made up **of** tiny living cells. Pesticides make these cells sick, unable to fight off disease..

Congenital deformities

Pesticides accumulate **in** people, particularly **in** their fatty tissue and reproductive cells. This can lead to birth defects, abnormalities, abortions, and premature deliveries.

Impaired eyesight

Farm workers who regularly spray pesticides can suffer from impaired eyesight.

Liver damage

The liver is particularly susceptible to damage by one group **of** pesticides, the chlorinated hydrocarbons, which can lead to higher risk **of** serious infection.

Environmental exposure

Poisons are released into the environment when crops are treated with pesticides.

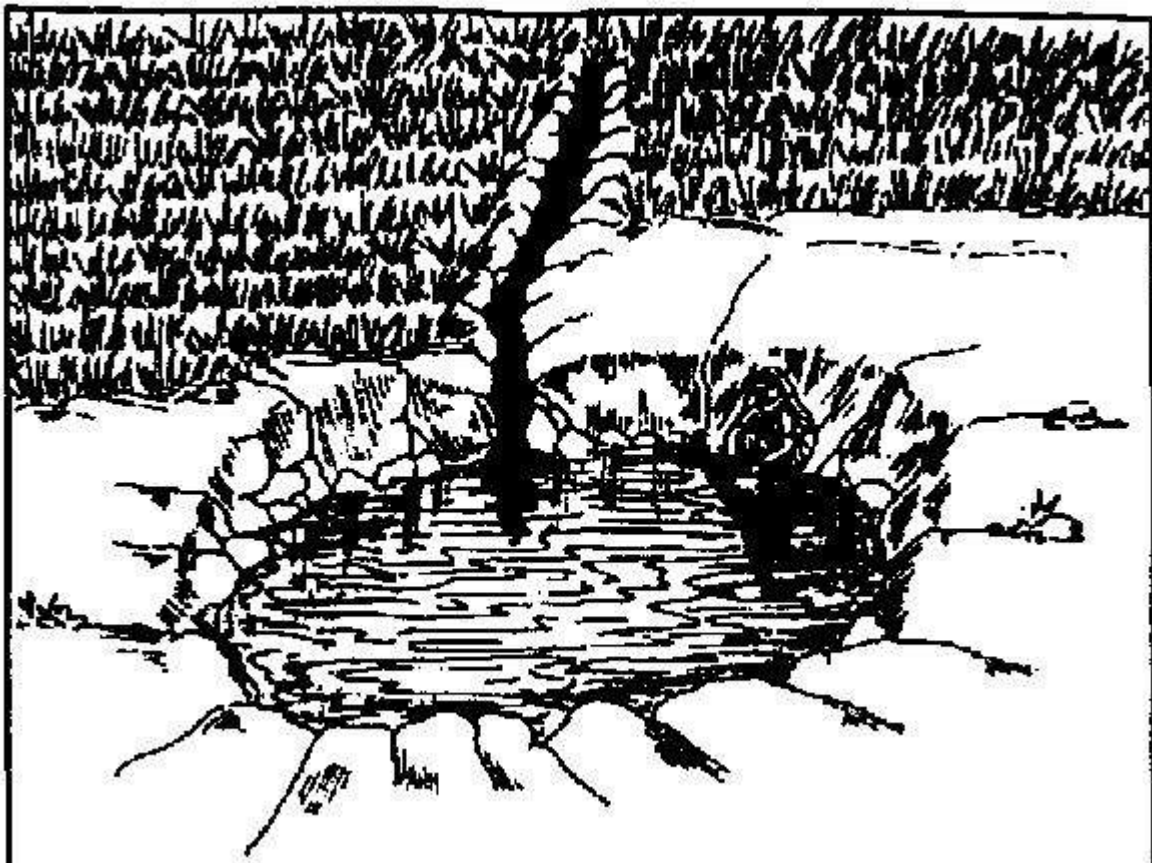
Air pollution

Air pollution results from spraying and dusting **of** pesticides **in** the field. Factories manufacturing pesticides also contaminate the air with their emissions.

Hazards **of** pesticides

Soil and water pollution

Rain soon after the application **of** a pesticide can wash poisonous pesticides into the soil and into surface and groundwater. Factories that manufacture pesticides might discharge pesticide-laced effluents that flow into surface water



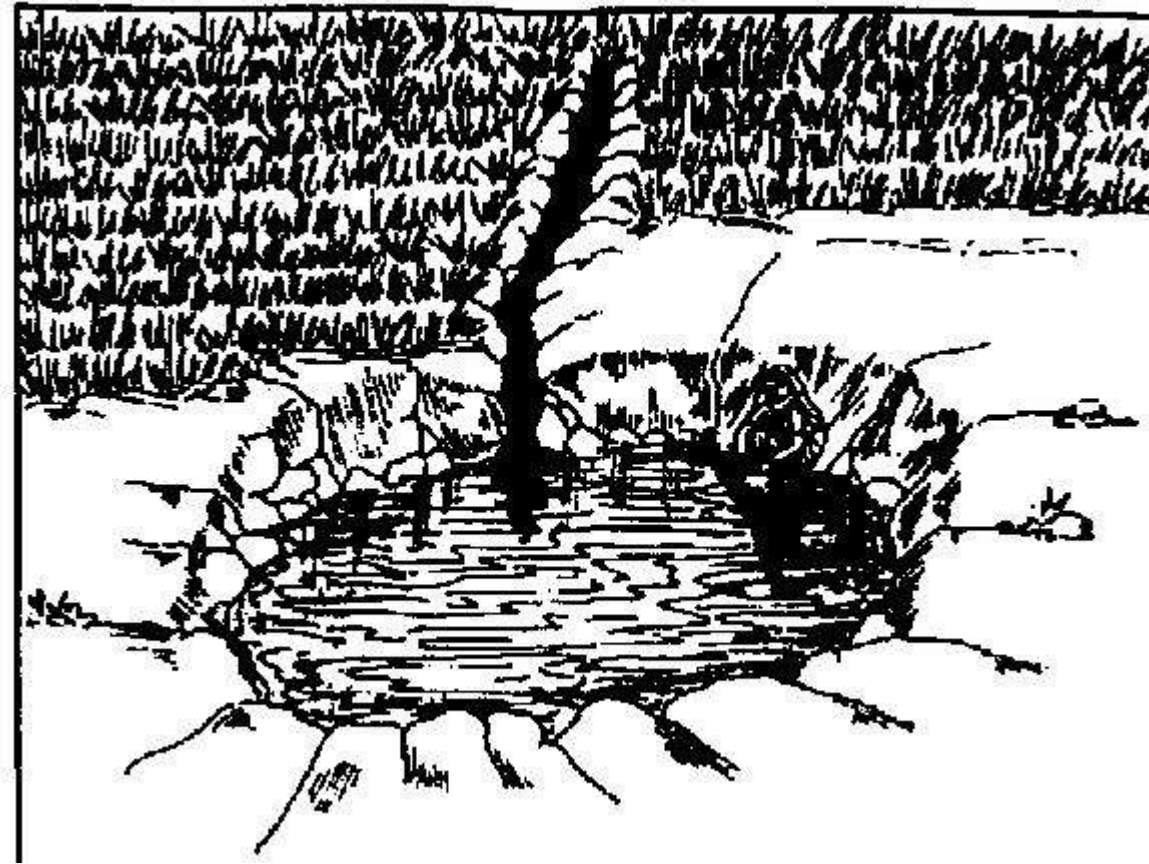
Pesticides applied to crops can wash off into sources **of** water used for drinking and cooking.

Food contamination

Pesticide residue on fruits, vegetables, and grains is another threat to human health.

Animal products meat, milk, and eggs-can also contain pesticides. (Animals are often treated with pesticides to remove lice. They can also feed on fodder and grains treated with pesticides.)

Human bodies store pesticides, especially **in** fatty tissue. As a result, breast milk can be contaminated, affecting the health **of** infants. **In** fact, babies can be exposed to pesticides before birth.



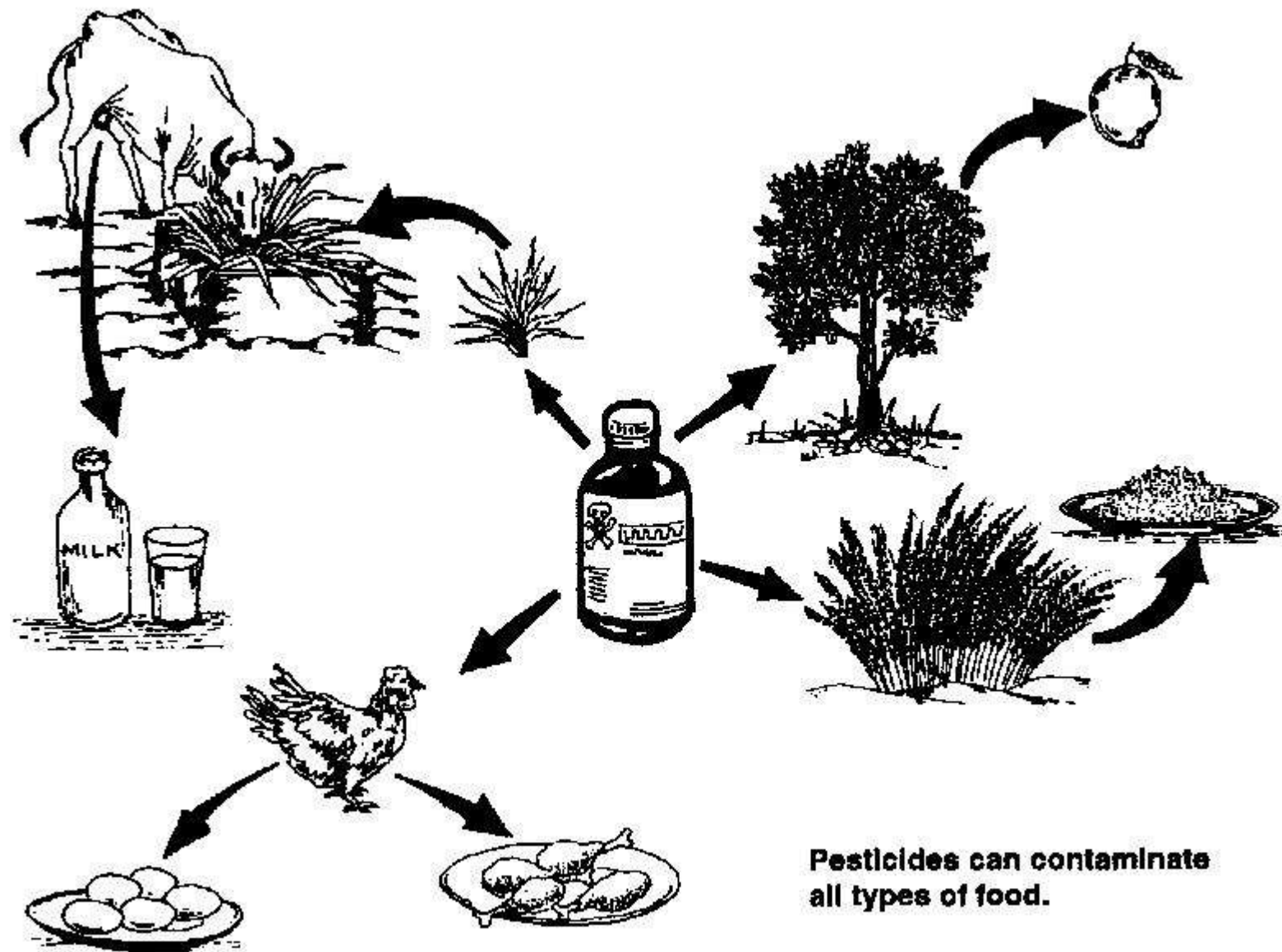
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Pesticides can contaminate all types of food.

Occupational exposure

Farm workers handle concentrated forms of pesticides. For them, the most common routes of pesticide exposure are:

Skin contact

Pesticides enter the body when liquid pesticides splash or spill on clothes or directly on the skin. Skin also absorbs pesticides in dust form. Cuts, abrasions, sores, and wetness on the skin allow pesticides to enter more easily.



Do not let pesticides touch your skin.

Inhalation

Dusts, sprays, and fumes can enter the body through the lungs. Poor ventilation in pesticide stores results in increased exposure. (See Safe use of pesticides.)

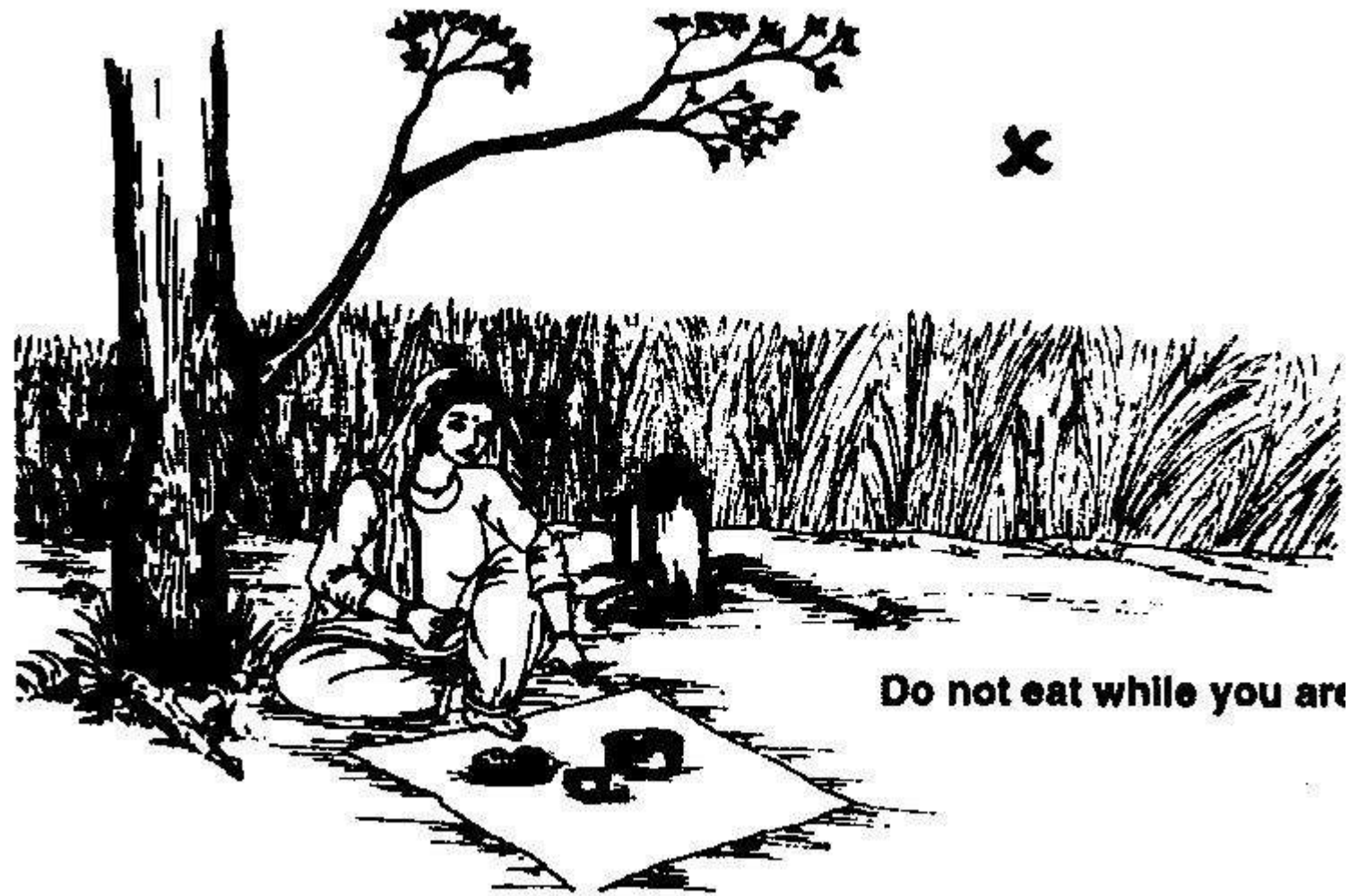


Avoid Inhaling.

Oral contact

Pesticides are absorbed through the lips, mouth, and skin.

Pesticides are taken in by people who eat, drink, and smoke while handling pesticides, or who try to blow out clogged nozzles and hoses.



Do not eat while you are handling pesticides.

Eye contact

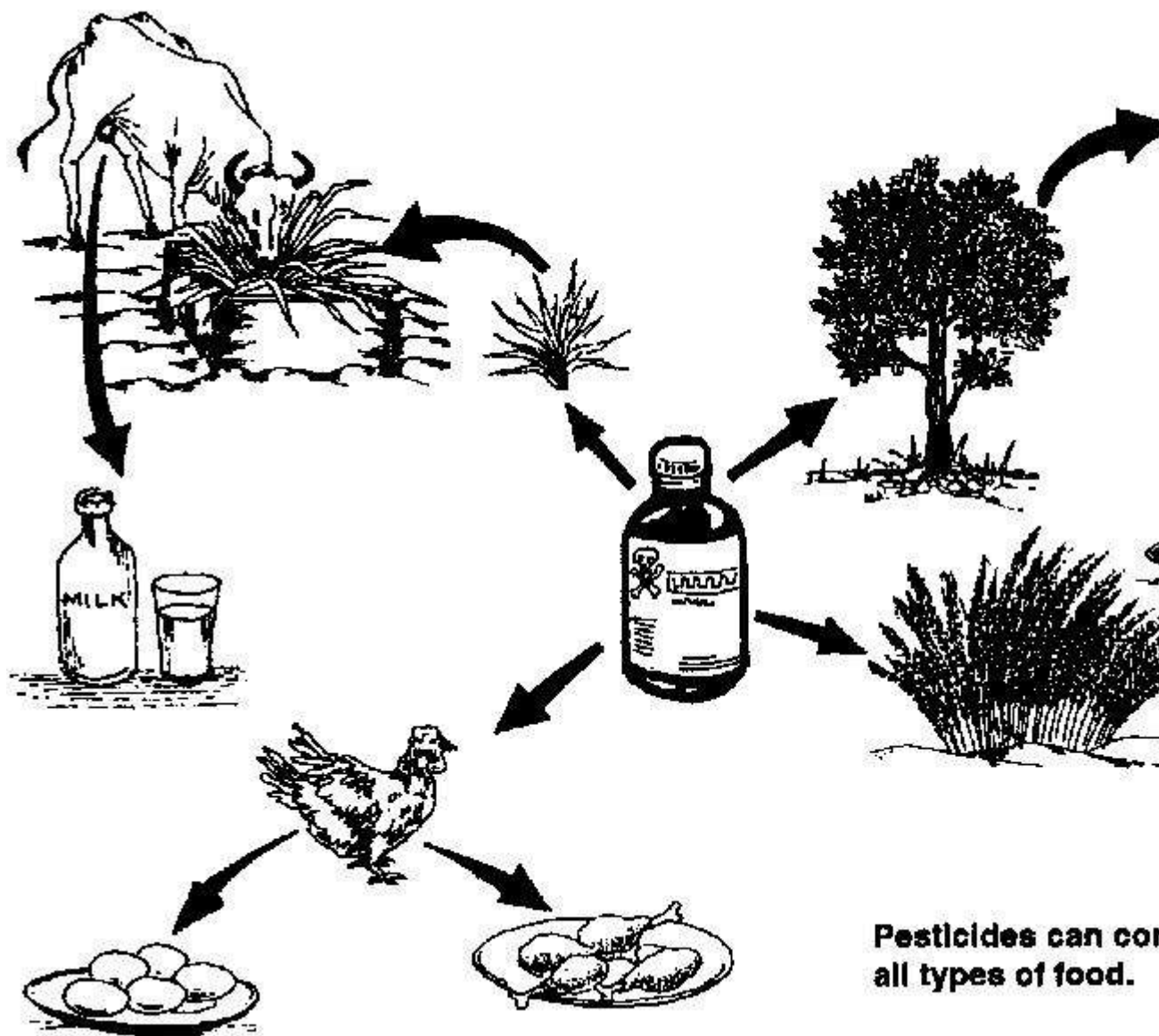
Pesticides can be absorbed into the body or eyes can be damaged, if pesticides blow or splash into the eyes.

Effects on insects

Besides killing insect pests, insecticides also kill beneficial insects, such as honey bees and other pollinators, parasites, and predators, thus disturbing the balance in nature. Uncontrolled, prolonged use of an insecticide can result in the breeding of insecticide-resistant pests, causing a resurgence or more virulent attack by insects.

Effects on plants

Excessive doses of pesticides can harm crops. Improper use of herbicides can harm the main crop, the following crop, and other useful vegetation grown later.



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Effect on animals Pesticide **residues** can harm or even kill domestic animals as well as fish, birds, and other wildlife.

Contributors and sources: Dr. A. K. Kaheja, Dr. G. C. Tiwari, Ms. Sarojini Rengam and Karen Snyder

Pesticide facts and fiction

Consumers beware

Large quantities **of** pesticides are used on vegetables which go directly from the farm to consumers. Both farmers and middlemen apply pesticides to vegetables

Cotton

Only 5 percent **of** India's crop area is used to grow cotton, but cotton accounts for 50 percent **of** the pesticides used **in** the country.

Pesticide **use in** India has increased rapidly **in** the past few decades. At present, the annual consumption **of** pesticides **in** the country is approximately 80,000 tonnes **of** active ingredients, with an average consumption **of** about 400-450 g/ha. India ranks second **in** Asia after Japan and tenth **in** the world **in** pesticide **use**. The states **of** Andhra Pradesh, Madhya Pradesh, Punjab, Gujarat, and Karnataka alone account for 83 percent **of** pesticide consumption **in** India. Nearly 67 percent **of** the pesticides are used for cotton and rice cultivation. About 70 percent **of** the pesticides **in** India are insecticides; many **of** these are organochlorine compounds which leave harmful **residues**.

Popular misconceptions

Misconception 1

We need pesticides to grow more food for hungry people.

Facts

- Currently, the world produces more than enough food for everyone. The problem is not insufficient production but the inability **of** the poor to pay for, or to grow, the food they need.
- It is possible to grow enough food using a minimal amount **of** pesticide.

Misconception 2 Pesticides are a cheap, effective way to control pests.

Facts

- Indiscriminate **use of** pesticides can increase crop losses **in** the long run
- Pesticides lose their effectiveness over time.
- At first, chemical pest control seems cheap and effective, but soon pests develop resistance to these chemicals.
- Since the natural enemies **of** pests are destroyed as well, pests multiply **in** greater numbers.
- Farmers tend to apply ever larger doses **of** more powerful, more costly pesticides, or even mixtures **of** pesticides to combat resurgence. The cycle continues.

Misconception 3

The adverse effects **of** pesticides, if any, are confined to the areas where they are applied.

Facts

- Particles **of** pesticide can be carried thousands **of** miles by wind, rain, snow, and surface water.
- Pesticides can enter the water and soil and affect large areas.
- Pesticides can alter the ecological balance over a wide area.
- Pesticides can also get into the food chain, harming fish, livestock, and people.

Misconception 4

Plants, animals, and people can only be affected by direct exposure to pesticides.

Facts

- Direct exposure to pesticides (through touch and inhaling) are harmful. But, indirect, long-term effects, such as groundwater poisoning, are also very serious.

Misconception 5

Pesticides usually disappear after they are applied.

Facts

- Many pesticides do break down rapidly, but others, such as DDT, Dieldrin and BHC, can remain toxic for as long as 20 years.
- Breakdown products **of** some pesticides (e.g., Malathion and Aldicarb) are more toxic than their parent compounds.

Misconception 6

Pesticides are tested **in** laboratories and **in** extensive field trials before they are sold **in** the market.

Facts

- The United States has the most stringent testing standards **in** the world. Yet, few pesticides have undergone all the legally required tests, especially for birth defects, genetic effects, and damage to the body's nervous and immune systems.
- Many pesticides sold **in** the developing world do not conform to accepted standards. Many are fake products or are adulterated.

Misconception 7

Application or handling **of** hazardous chemicals is done solely by men, women have nothing to do with pesticides.

Facts

- **In** a large number **of** cases, women handle pesticides directly while mixing and spraying. Women are often responsible for mixing pesticides and maintaining and cleaning the spraying equipment.
- During storage **of** household food grains and seeds, the chemicals are handled mostly by women.

- Women head 12-16 percent **of** farm households **in** India. **In** these households, women must perform all agricultural tasks, including pesticide handling and application.
- Many women are employed **in** rice mills, dal mills, ginning factories, and **in** the bidi industry, where they are exposed to pesticide **residues**.
- Agricultural operations like sowing, weeding, and harvesting are done almost exclusively by women. Women also work on coffee, tea, cashew, spice, cotton, and other plantations, all **of** which involve heavy **use of** pesticides.

Contributors: Dr. H. K Sawhney and Aarti Gombar

First-aid measures for pesticide poisoning

Pesticide poisoning symptoms: at first

Irritation **of** eyes, skin, throat, and lungs, headache and tiredness. then

Giddiness, blurred vision, nausea, vomiting, muscle twitching, abdominal cramps, diarrhoea, breathing problems, convulsions, and unconsciousness.

Be prepared

When you spray or handle pesticides. always make sure you have dean water, soap, and a dean cloth at hand. You can **use** these to wash off any spilled pesticide.

Farm women often suffer from itching, burning sensation on their hands and feet, as well as watery eyes after spraying pesticides or working **in** freshly sprayed fields. Some pesticides are more toxic than others. Misuse **of** such pesticides can cause illness or even death. Simple first-aid measures, if applied at the right time, can help to save many lives.

First-aid measures

In case of skin contact

- 1 Remove the patient from the source **of** contamination.
- 2 Remove the patient's contaminated clothing.
- 3 Wash the patient thoroughly with plenty **of** water and soap.
- 4 Hold her eyelids open, and wash her eyes with cool, clean water.

In case of Inhalation **of** pesticide

- 1 Remove the victim from the place **of** exposure. Bring her to fresh air. Loosen the victim's clothing to allow easier breathing.
- 2 If conscious, place the victim **in** a sitting position with head and shoulders elevated.
- 3 If not conscious, turn the victim to lying position with head to one side. Watch her breathing.
- 4 If breathing stops, give artificial respiration.

It pesticide Is swallowed

1 Check the pesticide label to see if you should induce vomiting.

If so

2 Make the patient sit or stand up.

3 Give 1 to 2 litres **of** salt water.

4 To induce vomiting, tickle inside the patient's throat using a blunt instrument, such as the handle **of** a spoon. **Use** two fingers **of** your other hand to force the patient's cheeks between her teeth.

5 After vomiting, give the patient milk to drink. This helps counteract the poison.

6 Make the patient lie on her side, with her head lower than the rest **of** her body.

If breathing stops, provide artificial respiration

1 Turn the patient on her back.

2 Pull the chin forward and head backward to prevent the tongue from dropping to the back **of** the throat.

3 Remove any vomit or obstruction from the air passage.

4 Pinch patient's nose and blow into her mouth.

5 Make sure the patient's chest expands each time you blow into her mouth.

6 Continue until the patient resumes normal breathing.

In case **of** convulsion

1 Insert a padded gag between the teeth to prevent the patient from biting her tongue.

2 Gently restrain the patient to prevent her from hurting herself.

High body temperature If the patient is extremely hot or is sweating excessively, sponge her with cold water.

Low body temperature

If the patient is cold, cover her with a blanket.

General management

1 Take steps to obtain immediate medical attention.

2 Keep the patient calm and comfortable.

3 Place patient on her side, with her head lower than the rest **of** her body.

4 Keep a close watch on the patient's breathing and state **of** consciousness. Take immediate action **in** case breathing stops

5 Identify the product(s) to which the patient was exposed Save the pesticide container, label, and leaflet to show to the doctor.

Source: Dr. Nelia Maramba

Save your crop from bird damage

Bird pests-the main culprits

- Common house sparrow
- House crow
- Common myna
- Blue rock-pigeon
- Red-ringed parakeet
- Dove

Some types **of** birds are useful to farmers because they eat insect pests. But some birds do a lot **of** damage. They can virtually destroy a crop and spoil tons **of** produce **in** storage. Scaring harmful birds is an important but tedious task most often the responsibility **of** children and women.

Damage

Crops commonly damaged by birds include pearl millet, barley, maize, mustard, sorghum, sunflower, and wheat. A single bird consumes 8-25 grams **of** fruit and grain per day. This is a fraction **of** what a bird can spoil with its scratching, pecking, faeces, and feathers

Control

Birds are difficult to control; they are intelligent, adaptable, and move from place to place. Birds can get used to certain control methods, so it is important to change the method used, to innovate. Farmers are generally seen slinging stones or making noise to scare birds. These are inefficient and uneconomical ways to reduce crop loss.

Cotton and nylon nets

Cotton string nets **of** different size and mesh are usually spread over mango groves and fruit orchards. Cloth bags are tied to individual fruits, such as pomegranate and papaya. Nylon nets with 1/2-inch mesh to prevent the passage **of** small birds are used on small crop areas. Nets are expensive and not feasible to protect larger areas. They are recommended to protect valuable crops, such as breeder seed for multiplication.

Scarecrows

Scarecrows **of** different sizes and shapes scare birds at the sowing and dough stage **of** the crop.

Protokrop

Protokrops are simple machines which produce regular loud blasts, effective for scaring birds.

Fireworks

Fire or sudden flashes **of** light, often accompanied by loud noise, are frequently used **in** the form **of** crackers and rocket crackers.

Recorded noise

Recorded distress calls are amplified over speakers to drive away perching birds from the fields. This is more expensive than protokrops but more effective **in** orchards and smaller crop areas.

Reflective ribbons

Polypropylene, metallic, shiny red and silvery white strips, 1015 m long and 15 mm wide, are tied to stakes **in** the field. Between 50 and 60 such strips, tied from north to south, are required per hectare. The reflection **of** bright sun rays and the humming sound produced by the wind over the strips scare birds from the fields.

Neem extracts About 23 neem-based pesticides are produced commercially **in** India. Some **of** them are: Neemhit

- Neem oil emulsion
- Nimbecidine
- Neem-based emulsifiable concentrate Dispersible powder or granules

Stickers

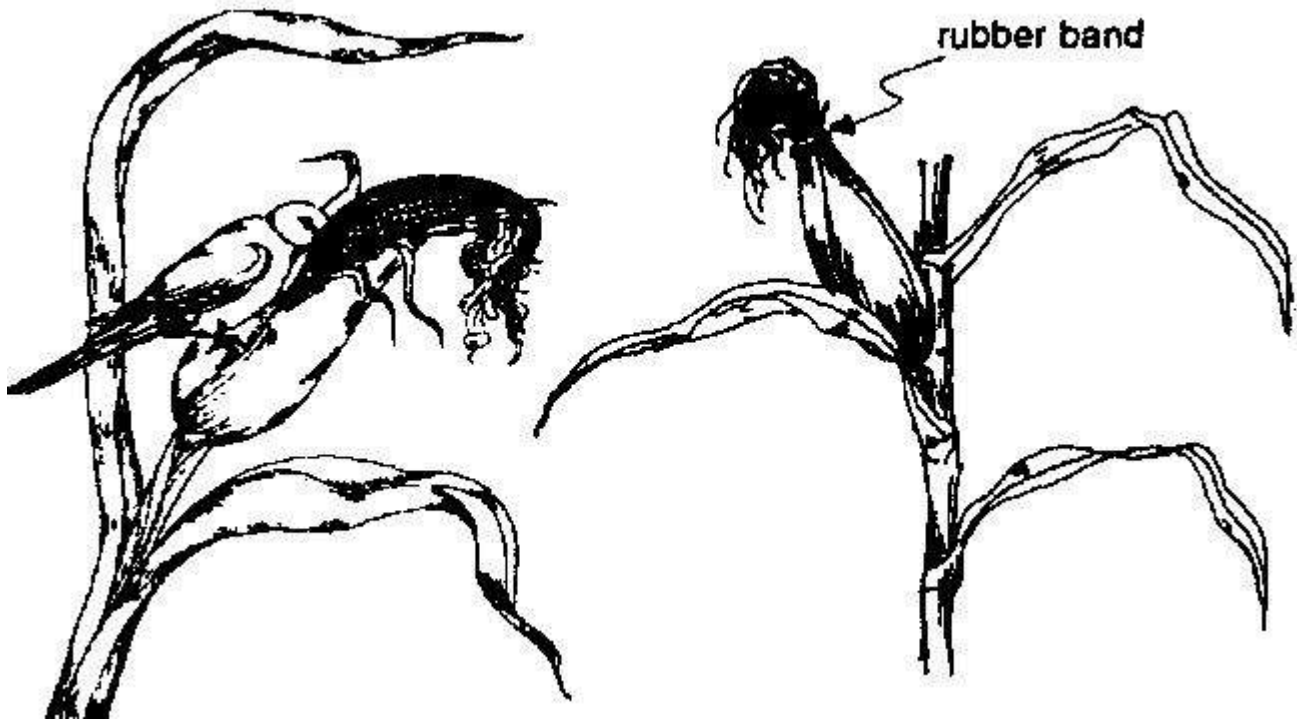
Sticky repellents, with or without toxic chemicals, can be painted on tree bark. Among these, lassa, made out **of** jackfruit milk, gum arabic, or commercial coal tar on a silica-based paint are the common products used as stickers to repel birds.

Repellents

De-oiled neem cake broth (300 g **of** cake per litre **of** water) sprayed on maize ears repels birds from fields.

Tightening **of** husk

Some people wrap maize cobs with leaves. This is effective, but only to a point. At maturity, these leaves dry and loosen their grip, leaving cobs exposed to birds. Parrots peel the cob husks, destroying more than they consume. Bicycle tubes and polyethylene net cones offer effective alternatives. Wrap the tip **of** cob husks with rubber bands made from 1.75-cm-wide strips **of** inner tube. Or, **use** polyethylene net cones. Both are easy to apply and will protect cobs until harvest. They can also be reused, season after season.



Polyethylene net cones or rubber bands protect cobs until harvest.

Culling

If the bird pest population is alarmingly high, you can reduce the natural population **of** birds around the fields and orchards by tipping nests, trapping birds, destroying eggs, and fumigating the perches. Be careful to destroy only nests **of** those species that damage crops.

Contributor: Dr. L. M. L. Mathur

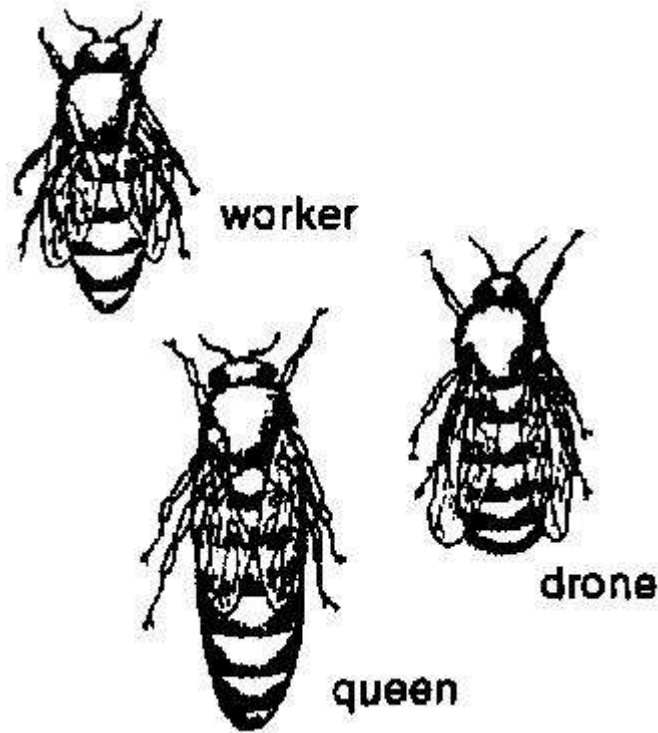
Beekeeping

Raising bees for honey is called beekeeping or apiculture. With knowledge **of** bees, a little equipment, and practice, farm women can harvest honey and wax for home **use** and sale.

And, honey bees are important pollinators **of** field crops. which means better harvests.

Honey bee colonies

Honey bee colonies can be established easily **in** areas rich **in** flora. Places abundant **in** flowering plants can yield honey almost year-round.



Honey bee colonies

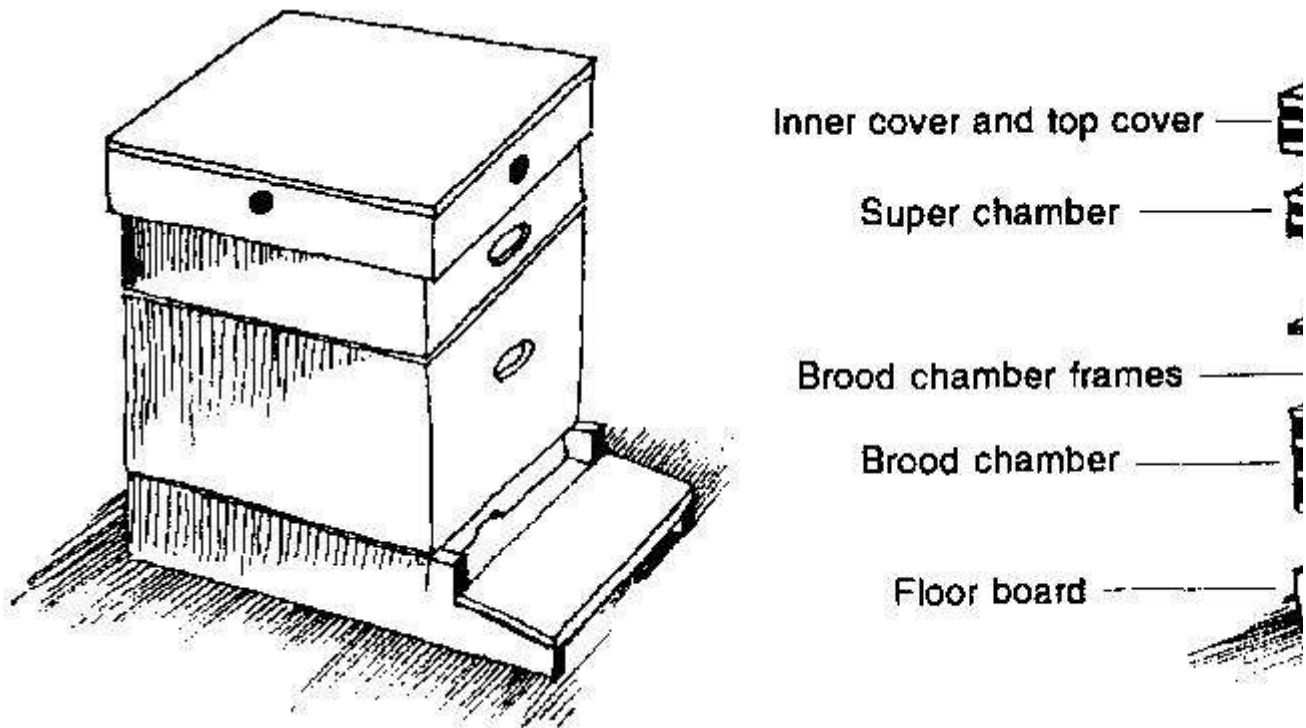
Honey bees are social insects and form three distinct castes **in** a colony. The queen bee mates with the drone once or more during its lifetime and continues to lay eggs until she dies. The drones are attended by worker bees during the breeding season. The worker bees maintain the colony, gather pollen, take care **of** the young, the queen bee, and the drones.

Beehives

Beehives or nests are built downwards from ceilings or the lower surface **of** tree branches. Hives are comprised **of** thousands **of** six-sided cells made **of** wax and filled with honey.

Building a beehive

Bees can be encouraged to build their hives **in** special frame structures for easy care and harvesting. Several designs are available.



Beehives

Money-maker

Beekeeping is a low-cost source **of** income for small and marginal farmers.

There are two main species **of** honey bees for domestication:

- Apis melifera Western honey bee
- Apis Indira Indian honey bee

Beekeeping tools

Smoker. Smoke makes bees docile and easier to handle.

Hive tool. This piece **of** flattened iron bent at one edge is used to carry frames, scrape combs, and pull out nails.

Bee veil. Cotton or plastic netting will protect your face from bee stings. You will also need thick, loose-fitting clothing, such as overalls, to protect yourself from stings.

Uncapping knife. A long, broad knife with a strong, sharp blade is used to remove the wax that caps each honey cell.

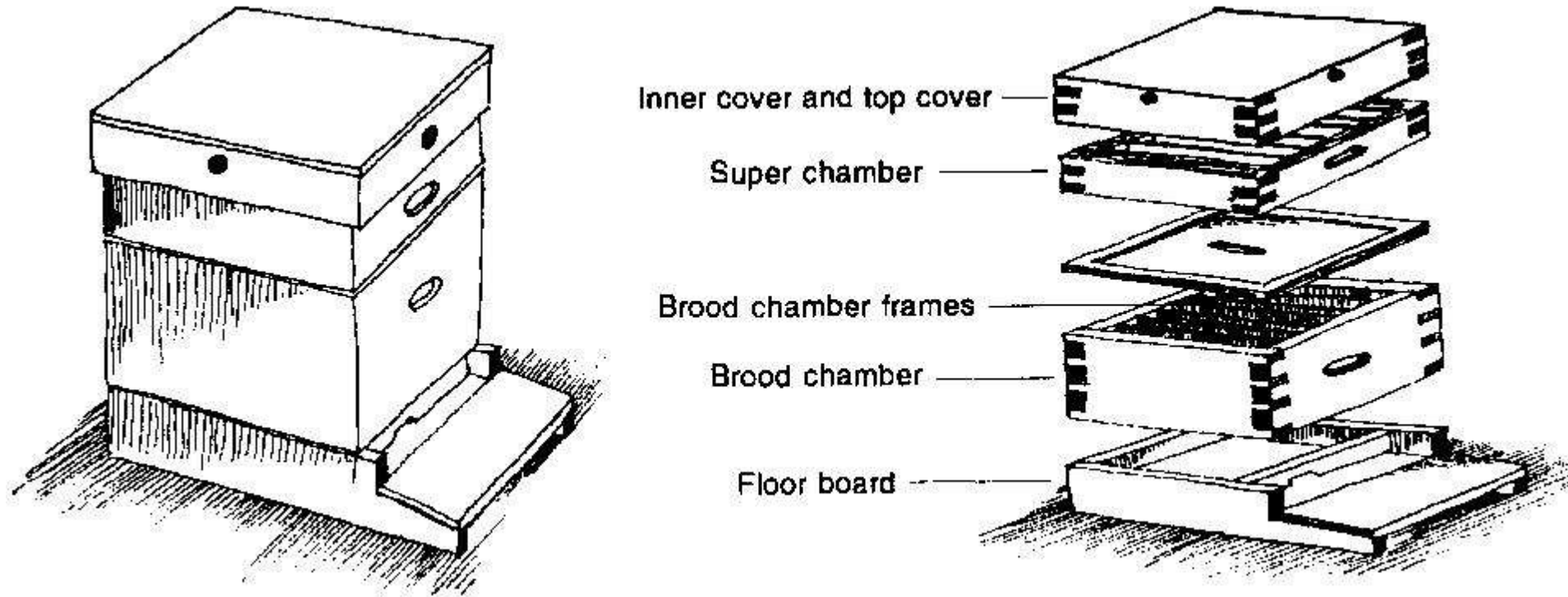
Queen excluder. This is a perforated aluminum or zinc sheet through which the workers can pass but not the large queen.

Honey extractor. Combs full **of** honey are uncapped with the uncapping knife. The combs, one after the other, are then placed **in** a holder attached to a device which spins the combs at great speed. Honey is thrown out by centrifugal force into a collection bucket.

Embedder. This device is used to emboss the foundation plate. See the box on "Making a starter

Building a beehive

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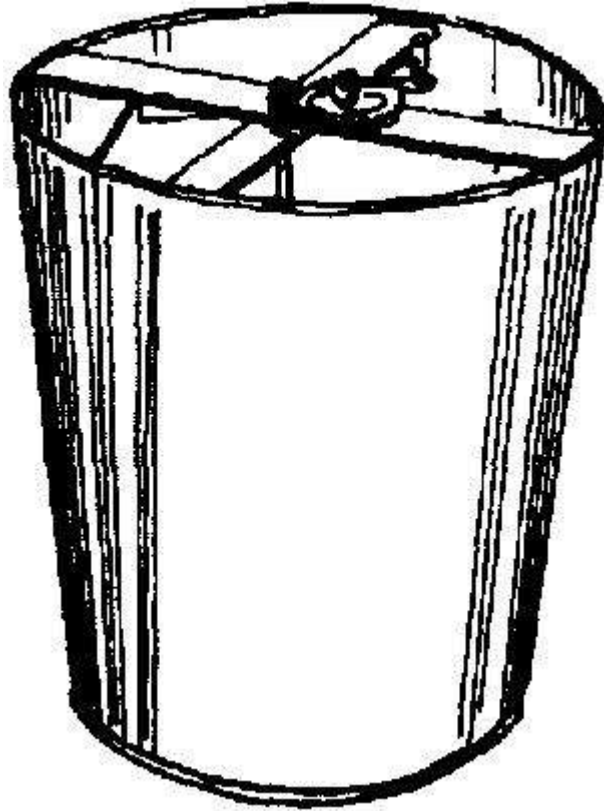
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Beekeeping tools

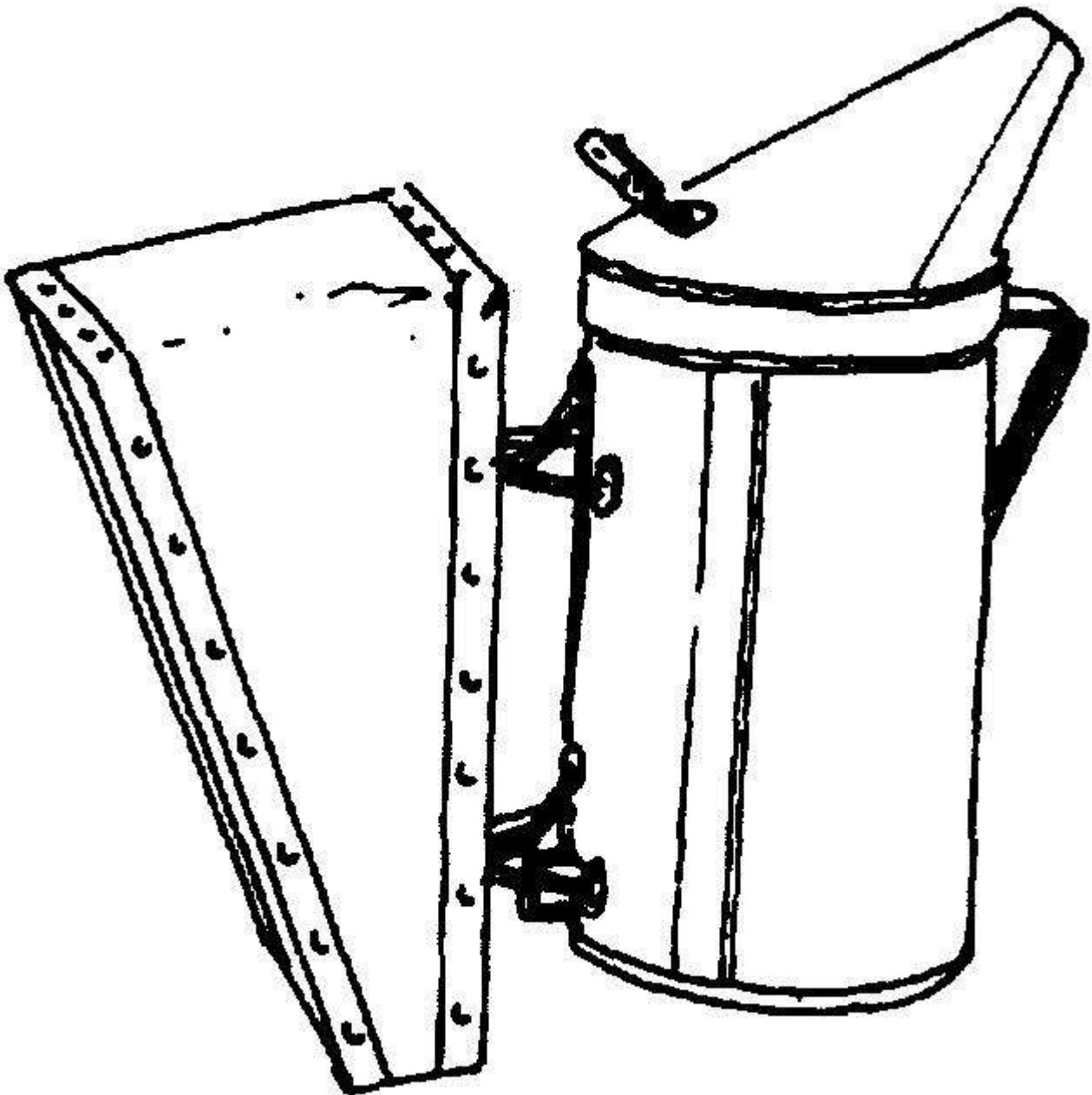
Smoker. Smoke makes bees docile and easier to handle.

Hive tool. This piece of flattened iron bent at one edge is used to carry frames, scrape combs, and pull out nails.

comb."



Honey extractor



Bee smoker



Hive tool

Bee management

Note

Some cells **in** a honeycomb are brood cells where bees grow to maturity. The cells **of** worker bees are sealed with a bulging cap **of** wax. The cells **of** drones are sealed with a bulging cap **of** wax with a hole **in** the centre. A developing queen occupies the "royal cell" which is always located **in** the centre **of** the comb. Honey cells have flat, air-tight caps.

Making a starter comb

Bees build their combs on foundation combs prepared by the beekeeper. A smooth piece **of** wood is dipped **in** molten wax. A device called an embedder is used to stamp outlines **of** the six sided cells. The six-sided pieces **of** wax stamped out by the embedder are removed to leave shallow impressions around which the bees will build their cells.

Beeswax Uses **of** beeswax:

- Candle-making
- Batik-making
- Ointment preparation
- Leather strengthening
- Waterproofing fabric honey extractor hive tool bee smoker

1 Place your beehives **in** a shaded area, on wooden benches 45 cm off the ground. Face hives **in** different directions. Do not place them **in** a straight line. This will help bees to find their hives.

2 Smear grease on the legs **of** the benches to prevent ant attack.

3 Start beekeeping **in** the spring.

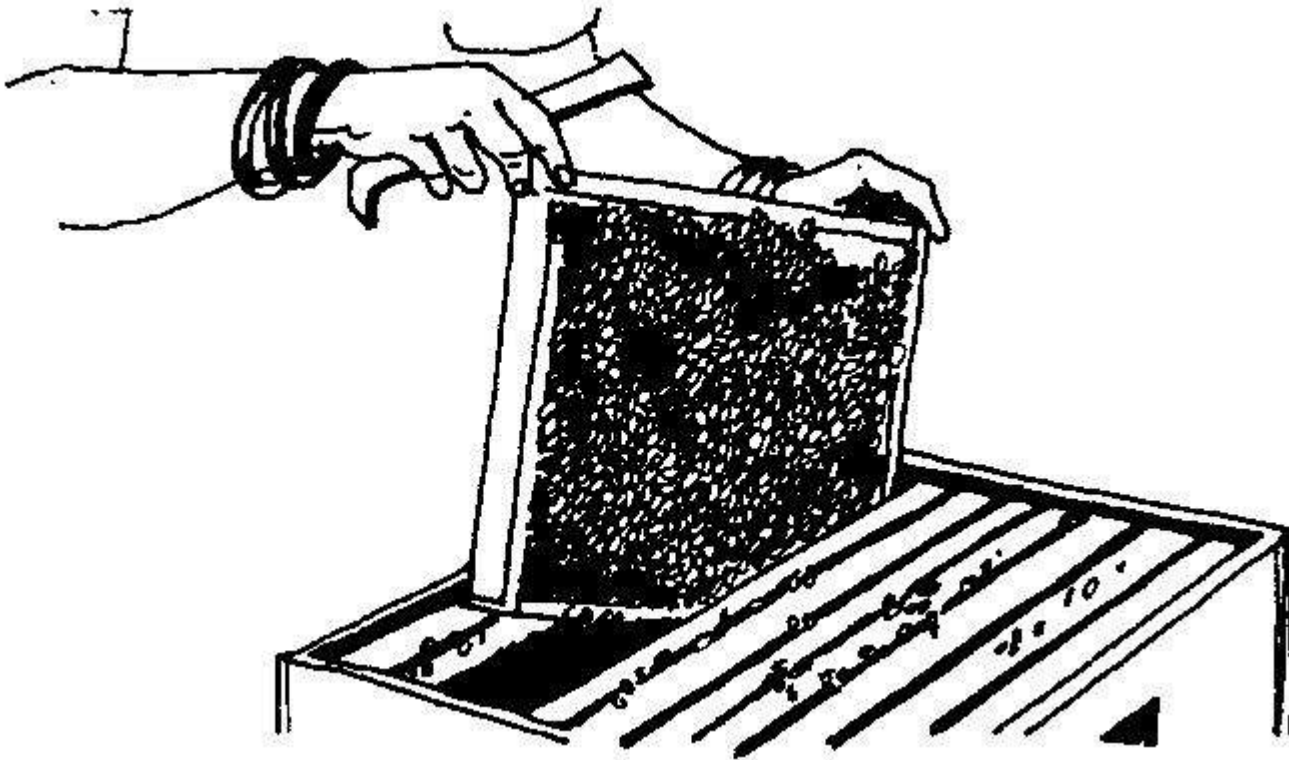
4 Remove the queen cells when you notice overcrowding (when you notice bees crawling over one another), and distribute brood frames to make equal-sized colonies.

5 Feed the bees sugar syrup **in** summer when plant nectar is not available. Place a water dish outside the hive.

6 Add combs to avoid overcrowding.

7 Sprinkle water over the hives at least twice a day to reduce high temperatures during summer months.

8 Store strong and disease-free colonies during winter. Cover hives to protect them from extreme cold.



Talk to a beekeeper

Advice to beekeepers

- Literature on honey bees and their management can be obtained from expert beekeepers.
- Training courses and bee colonies can be obtained from state agriculture extension agencies, Khadigram Udyog Industries, and subject matter specialists **of** agricultural universities.

Hive frame covered with bees and filled with honey.

You will need help to establish your first hive. Seek advice from a local beekeeper.

Contributor: Dr. L. M. L. Mathur

Drudgery reduction

Drudgery-reducing implements for farm women

Women do many **of** the most difficult farm tasks **in** India. Transplanting, weeding, harvesting, and post-harvest processing **of** produce. All **of** these tasks are time-consuming and full **of** drudgery. Below are some improved implements and machinery which can help reduce drudgery and physical exertion

Weeding implements

Dryland weeder

This peg-type weeder is excellent for row crops on sandy and loamy soils. It can be operated easily by one person. When the weeder is pushed forward, the drum rotates through the soil and the curved blade cuts the roots **of** weeds. The weeder has a working width **of** 15 cm and can weed about 0.025

ha/hr.

Multipurpose weeder

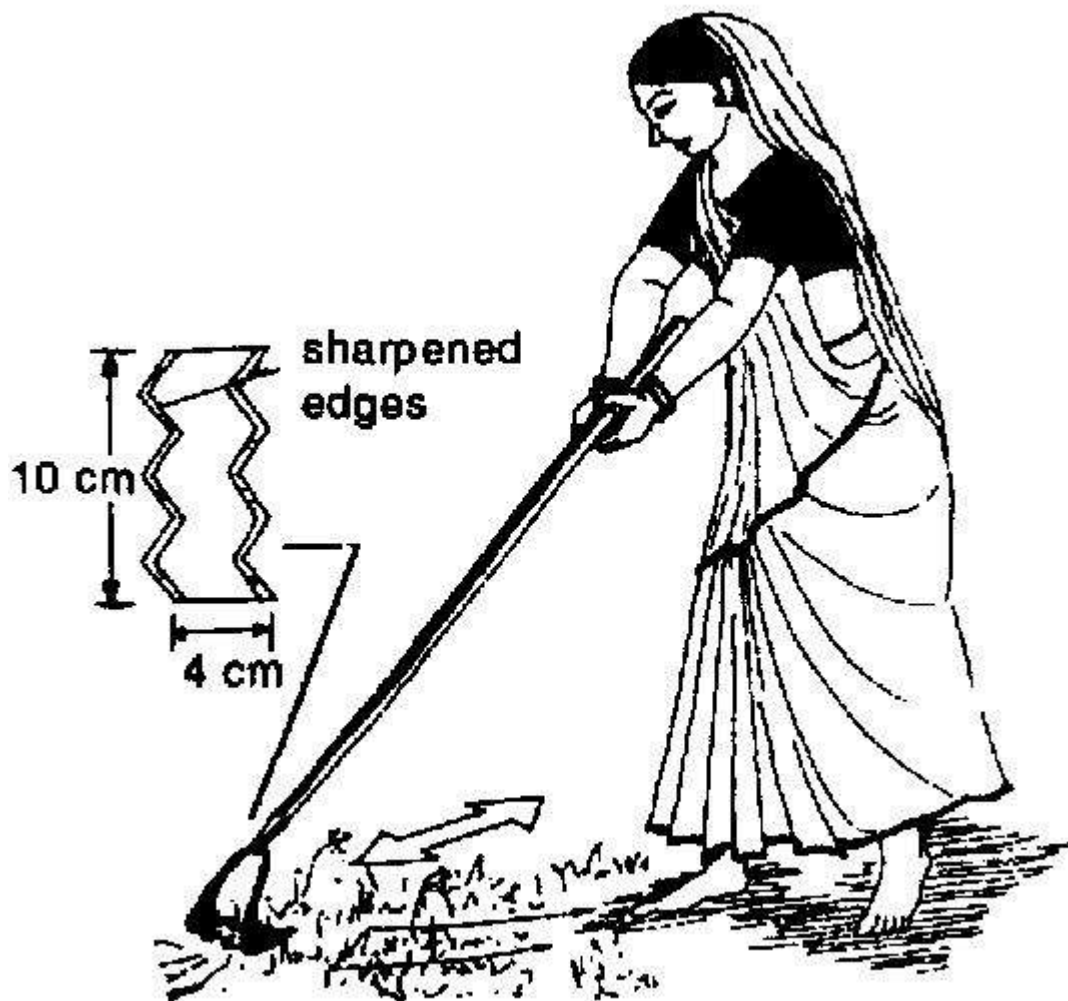
This multipurpose weeder is especially useful on hilly terrain. The weeder's cutting edge can cut small bushes and the curved blade can be used for weeding between crop plants. Its designer says this weeder reducer drudgery by 25 to 30 percent compared to traditional hand hoeing on terraced or sloping land.

Rotary paddy weeder

This manual weeder is effective for light weeding in paddy fields. It can be operated easily by one person. The weeder is pushed and pulled, forward and back, continuously between paddy rows. The rotating blades go below the surface to cut and turn up weeds. It can weed about 0.025 ha/hr. This rotary weeder can be made using local skills and local materials.

Draw weeder

This weeder is best suited to dry areas. It consists of a toothed, double-edged blade attached to a long handle. The sharp-toothed blade cuts weeds just below the soil surface.



Draw weeder

V-blade hand hoe

This tool, designed for light weeding, consists **of** a long wooden or bamboo handle joined to a sharpened, V-shaped blade. The blade cuts through soil, cutting weeds just below the soil surface.



V-blade hand hoe

Post-harvest Implements

Tubular hand-held maize sheller

This tubular sheller consists **of** a 7-cm length of steel pipe, 6.25 cm **in** diameter, with four tapered fins **of** light sheet metal fitted inside. At one end the space between fin tips is 26.5 mm, while at the other, the space is 39 mm. To operate, hold the sheller **in** one hand and insert a dry cob with the other hand. Twist them **in** opposite directions. The fins detach corn kernels from the cob at the rate **of** about 20 kg per hour.



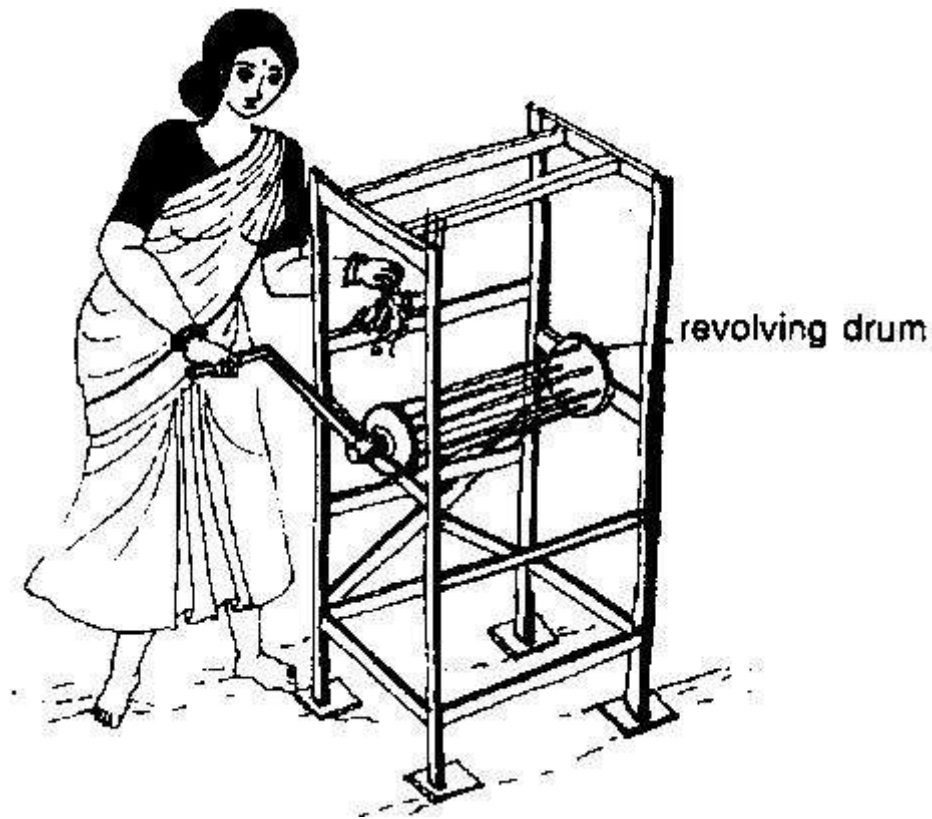
Tubular hand-held maize sheller

Comb-type groundnut stripper

This manually operated machine detaches pods from groundnut vines. The machine consists **of** a rectangular frame with vertical pegs and a horizontal strip **of** expanded metal (used **in** wire fences) fixed on each side **in** the shape **of** a comb. Handfuls **of** groundnut vines are pulled across the comb with force. This strips pods from the vines at a rate **of** 200-300 kg **of** pods per hour, with four people working at the same time.

Drum-type groundnut stripper

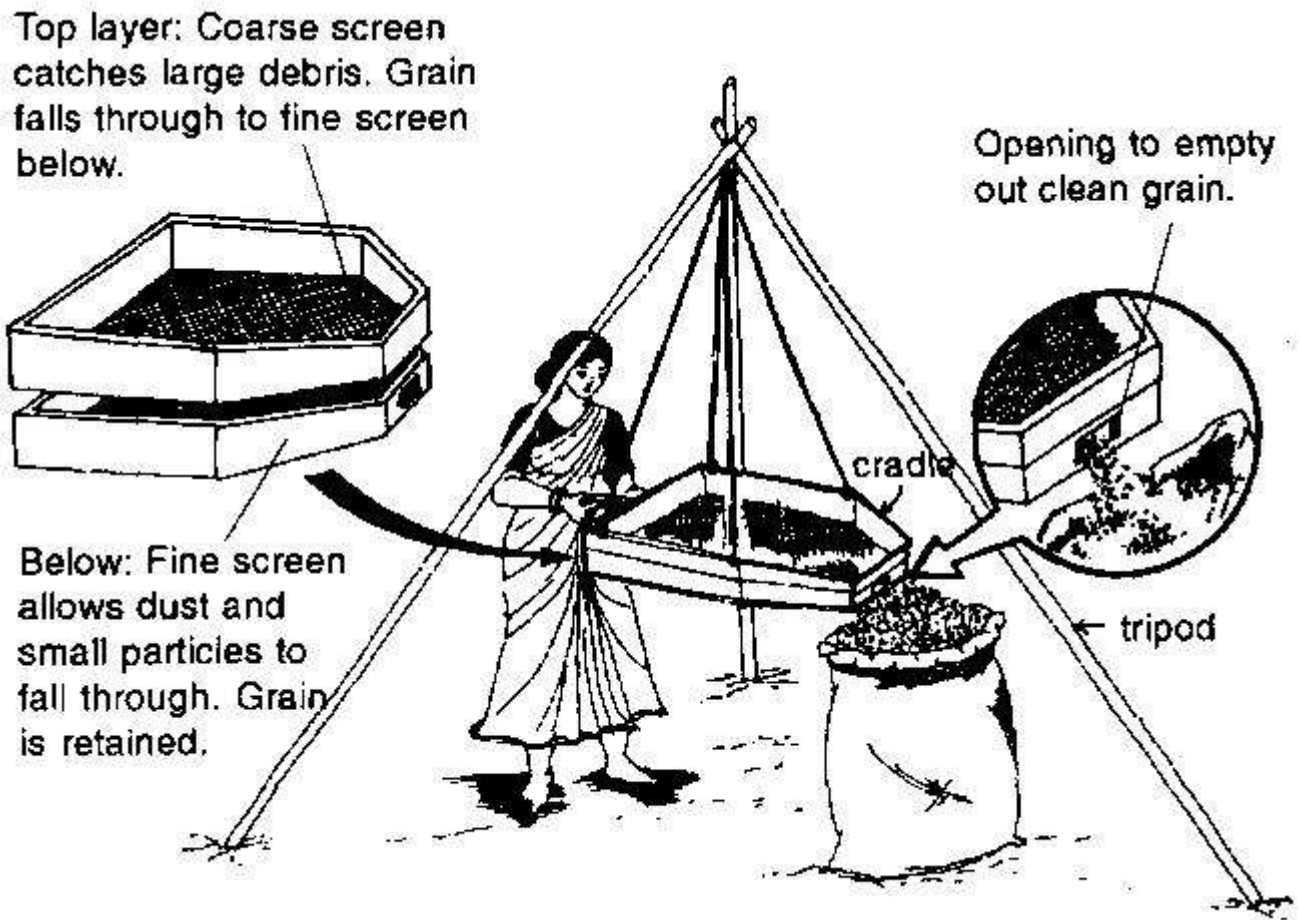
This stripper removes groundnut pods from green vines. It can be operated easily by one person and is quite effective **in** minimizing postharvest losses. The device consists **of** a hollow drum constructed from two metal disks connected by metal rods covered by rubber tubing. The operator cranks the drum handle and beats the groundnut vines on the rotating drum rods. A framed canvas hood keeps pods from scattering. (Canvas hood not shown **in** illustration at left.)



Revolving drum

Hand-operated grain cleaner

Used for removing foreign matter from Bengal gram, wheat, and soybean. This device consists **of** two metal screens **in** a frame suspended by rope. About 10 kg **of** grain is fed into the sieve and the cradle-like cleaner is swung briskly back and forth. Grains fall through the screen but debris remains. The cleaned grain is sieved again to remove finer debris.

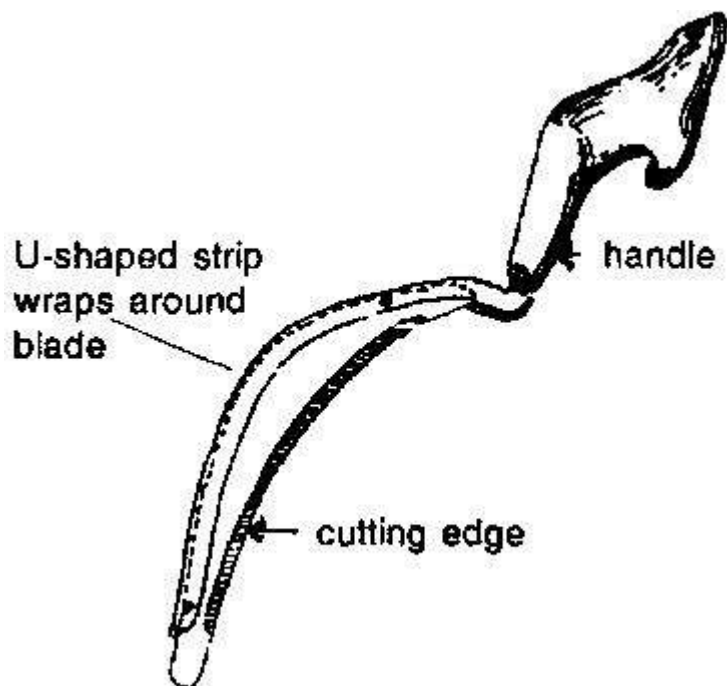


Hand-operated grain cleaner

Caution

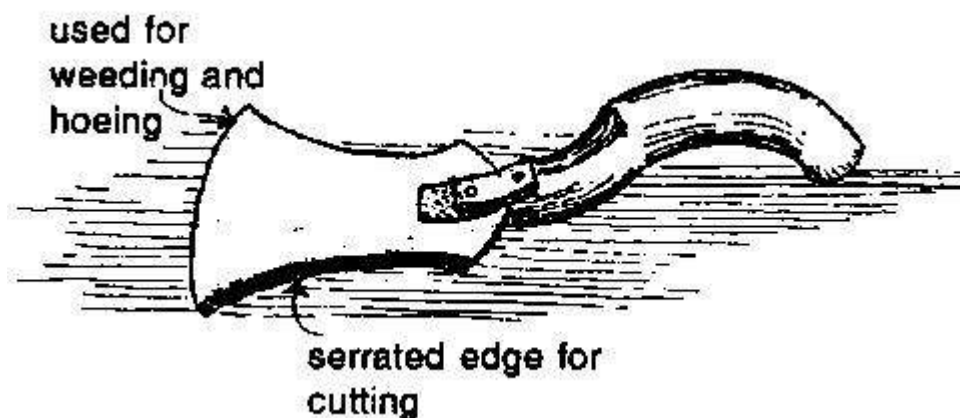
Suspend the cleaner from a sturdy tripod or beam.

Harvesting implements



Naveen sickle

This sickle is best suited for harvesting wheat and rice crops. It has a wooden handle with a special hand grip shaped to make harvesting easier. The sickle blade, made **of** serrated carbon steel, is riveted to a 12-mm wide, U-shaped strip which is fixed to the handle. Ten women using naveen sickles can harvest 1 ha **in** 10 hours.



Khurpa-cum-sickle

The khurpa-cum-sickle is a weeder, a hoe, and cutter all **in** one. The blade is made **of** carbon steel sheet. The front edge is used for weeding and hoeing, while the side edge is curved and serrated to cut like a sickle. The serrated edge has a curved length **of** 12 cm, which is about 60 percent **of** the length **of** a normal sickle. The handle is made **of** seasoned sesam wood. The tool weighs 300 g, light enough for continuous **use**.

Sources **of** drudgery-reducing implements

Comb-type groundnut stripper	Hand-operated grain cleaner
Draw weeder	Naveen sickle
Drum-type groundnut stripper	Tubular hand-held maize sheller
Dryland weeder	Central Institute of Agricultural
V-blade hand hoe	Engineering (ICAR)
College of Agricultural Engineering	Shri Guru Teg Bahadur Complex
Tamil Nadu Agricultural University	Bhopal 462003
Coimbatore 641003	Madhya Pradesh, India
Tamil Nadu, India	

Multipurpose weeder

Khurpa-cum-sickle

ICAR Research Complex

Division **of** Agri. Engineering

North-Eastern Hill Region

Indian Agricultural Research Institute

Shillong 793003

Pusa, New Delhi 110012, India

Meghalaya, India

Rotary paddy weeder

M.P. State Department **of** Agriculture

Putligarh

Bhopal 462001

Madhya Pradesh, India

Source: Centre **of** Science for Villages, Wardha, Dr. H. S. Biswas, and Dr. M. M. Pandey

Fuel-efficient chulhas

Advantages **of** fuel efficient chulhas

- **Use** less fuel
- Reduce fuel collection time
- Reduce cooking time
- Produce less smoke
- Conserve trees
- Allow more dung to be used as fertilizer instead **of** fuel
- Provide work for local chulha makers

Millions **of** women **in** developing countries spend hours each day gathering fuel and still more hours feeding inefficient, smokey chulhas. These ovens harm women's health, add to women's work load, and contribute to deforestation. To combat this problem, many fuel-efficient ovens have been designed and promoted over the years. These improved chulhas all have something **in** common: they are scientifically designed for better heat flow, which means that maximum heat is taken from the fuel and directed at the cooking pots.

Models

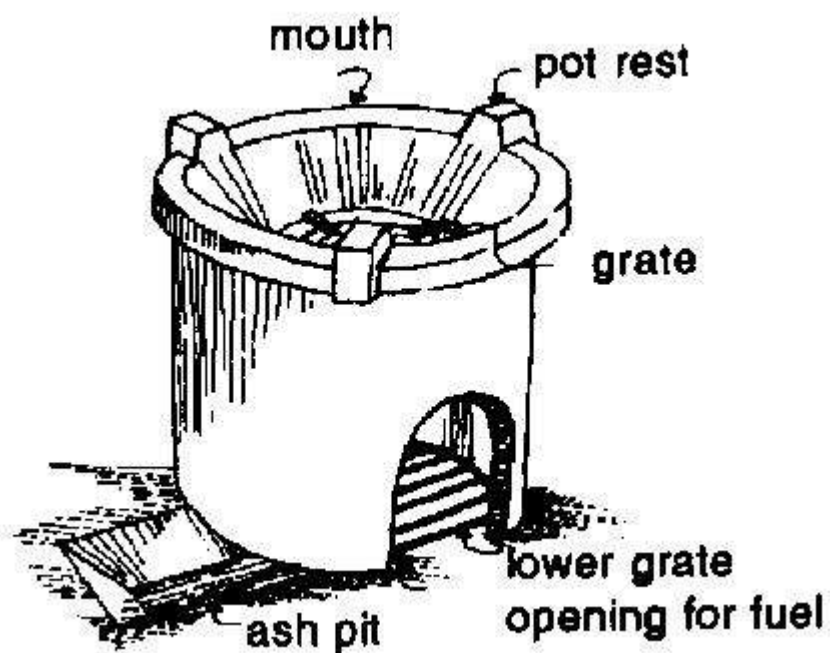
Many different models **of** improved chulhas are available:

- Pottery-lined mud chulha with or without chimney
- Portable metal chulha

- Portable ceramic-lined metal chulha
- Portable chulha with separate hood chimney
- Pottery-lined chulha without chimney



Portable metal chulha



Portable ceramic-lined metal chulha

Installation

Improved chulhas are installed by specially trained, selfemployed chulha makers. Customers are helped to choose the right chulha to meet their needs-depending on family size, kitchen location, type **of** fuel to be used. Normally, chimneys are recommended for closed, poorly ventilated areas.

Economies

Chulhas are normally made from locally available materials. But, depending on the chulha's size and design-whether the chulha includes a chimney pipe, smoke hood, ceramic or metal components-and taking into account installation charge and available subsidies, an improved chulha can cost from R15 to R150.

If you are interested **in** having a fuel-efficient improved chulha, contact the block development officer **in** your area.

Contributor: Mr. S. K. Jagwani

Solar cookers

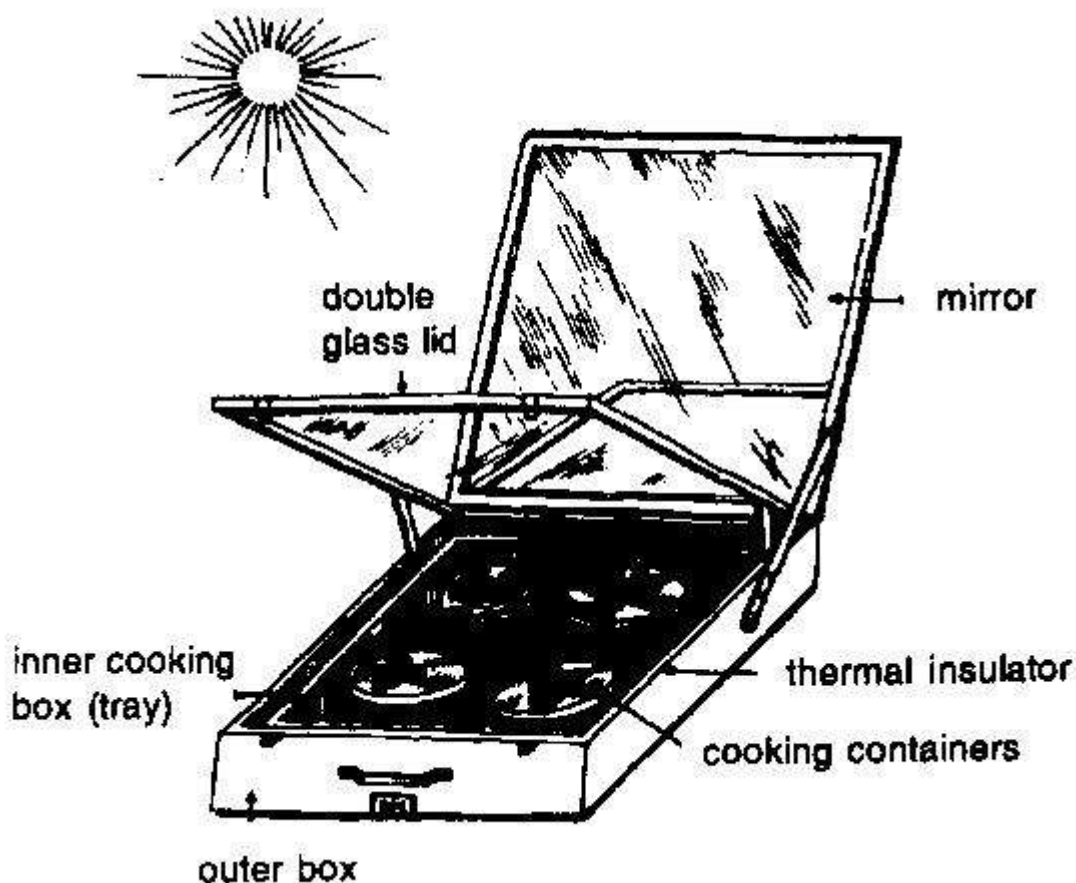
Households can save money, save labour, and preserve the environment by using the free energy **of** the sun to cook food. About 60 percent **of** energy used **in rural** areas **in** India is used for cooking. This comes from fuelwood, agricultural waste, animal dung, coal, and kerosene. Aside from the cost **of** these fuels and the long hours spent collecting them, there is also an environmental cost Demand for fuelwood, for instance, is causing deforestation which leads to floods and erosion.

Why buy a solar cooker?

- Savings-solar cookers **use** no fuel and are cheap to maintain
- Safety-no fires, no electric shocks, no gas leaks
- Time-saving-cook four items at a time
- Convenience-very little attention is required
- Simplicity-solar cookers are simple to **use**
- Nutrition-solar cooking preserves the nutritive value **of** food
- Flavour-food is cooked slowly so flavour is retained
- Cleanliness-no smoke and no soot

Note

Solar cookers do not work well **in** early morning, late afternoon, or on cloudy days.



Parts of the solar cooker

There are six main parts to a solar cooker

- 1 Outer box-made of galvanized iron or aluminium.
- 2 Inner cooking tray-made of sheet aluminium painted black to absorb the sun's radiation
- 3 Double glass lid-with a 1-cm air space between the sheets of glass for insulation and a rubber gasket to prevent heat leakage
- 4 Thermal insulating material- such as glass wool, packed between the outer box and the inner tray
- 5 Mirror-fixed on the inside of the outer box lid to focus the sun's rays on the cooking containers and cooking tray
- 6 Cooking containers (with covers)

-of aluminium or stainless steel, painted black on the outside to absorb the sun's radiation

How to use a solar cooker

- 1 Keep the solar cooker in the open in direct sunlight for at least 45 minutes before loading it with cooking pots. This will reduce the cooking time.
- 2 From time to time, adjust the position of the cooker and mirror to focus the sun's rays on the cooking pots and cooking tray.

3 Open the glass lid **of** the solar cooker, place the cooking pots inside and close the lid. As much as possible, keep the lid closed. Opening the lid will cause heat to escape and prolong cooking time.

Precautions

- When cooking is complete, leave the lid open for 10 to 15 minutes to allow the pots to cool down.
- **Use** cloth potholders when removing pots from the cooker.
- When opening the cooker's glass lid, keep your face and body away to avoid steam burn.

Maintenance

- The outside **of** the pots and the surface **of** the inner tray should be painted black from time to time. Avoid scratching the paint.
- When cooking is complete, clean the cooker with a dry cloth. Wipe both sides **of** the double glass lid and mirror with a soft clean duster before and after using the cooker.

Useful tips

- Cut vegetables into small pieces before cooking.
- Softer cereals and pulses **in** water before cooking.
- Do not overfill the pots (ingredients and cooking water combined should about reach the middle **of** the pot).
- Keep containers covered while cooking.
- Before roasting, grease the pot and smear the food with oil. Leave the pot lid off.
- Spices should be added before and after cooking, but not during cooking. Frequent opening **of** the glass cooker lid and pot lids will result **in** heat loss and prolonged cooking time.
- Keep the cooking tray and pots painted black.
- To avoid scratching the black paint, remove cooking pots before transporting the cooker.
- Store the cooker closed, **in** a safe, sheltered place.

Recipes for solar cooker

Alu Methi

Ingredients

250 g small potatoes	salt, chillies, and
(diced into small pieces)	turmeric powder to
100 g fresh methi	taste and 1 1/2 tbs
groundnut oil	

Method

- 1 Before cooking, clean and cut the methi leaves, apply salt, and leave for one hour.
- 2 Subsequently, squeeze the water from methi and wash it thoroughly **in** a strainer.
- 3 Heat oil and put turmeric powder and chillies **in** it.
- 4 Add potatoes and salt, place it **in** the pot and put it **in** solar cooker for about 30 minutes.
- 5 Add methi, uncover the pot, and leave for about 30 minutes.

Cauliflower

Ingredients

200 g cauliflower salt, turmeric, and
1/2 inch piece **of** ginger chillies to taste
1/2 tsp jeera 2 tbs oil
1 tomato

Method

- 1 Cut cauliflower into small pieces.
- 2 Heat oil and put **in** jeera, turmeric powder, chillies, salt, and cauliflower.
- 3 Pour it into a pot, cover, and place it **in** the cooker.
- 4 After about 30 minutes, cut the tomato and add it to the pot. Cook for another 30 minutes.

Chicken curry

Ingredients

250 g chicken
1 onion
1 tomato garlic, ginger, dhania powder, jeera powder, chillies, salt and pepper for seasoning
2 tbs oil
1/2 cup (lukewarm) water
1 peeled and finely cut potato
1 tomato either grated or blanched for seasoning and mashed.

Method

1 Mix all the ingredients, except the tomato, and place **in** a covered pot **in** the solar cooker for about 40 minutes.

2 Add the tomato.

3 Remove after 10-15 minutes. Mix thoroughly, pass through a sieve, and serve.

Chutney fish

Ingredients

1 pomfret 7-8 cloves garlic half lemon

1/4 tsp turmeric powder salt

2 green chillies coriander leaves, coconut, and roasted gram 1 tbs oil.

Method

1 Clean the fish and make gashes on both sides and smear with salt.

2 Grind garlic, coriander leaves, coconut, roasted gram, chillies, turmeric powder, and salt into a "chutney".

3 Add lemon juice.

4 Cover fish with this chutney and put it **in** a greased pot or on a greased griddle.

5 Do not cover the container. Place it **in** solar cooker for about 40 minutes

Note

Remember to preheat for at least 45 minutes.

Note

If mustard fish is to be made, the fish pieces should be marinated **in** a ground paste **of** 10 g mustard seeds, 6 green chillies, salt and oil. After marination for 30 minutes, the fish should be kept **in** the solar cooker uncovered for about 30 minutes.

Dal

Ingredients

150 g arhar dal

350 ml water

10 g ghee

1 1/4 tsp salt

1/4 tsp haldi powder

1/4 tsp red chill) powder

1/2 tsp garam masala

Method

- 1 Pick, wash, and soak for an hour a measured amount **of** dal.
- 2 Mix water, dal, ghee, salt, red chill), and haldi powder **in** the cooking pot.
- 3 Cover with a lid and keep it **in** the preheated solar cooker for 30 minutes.
- 4 When cooked, garnish with garam masala.

Masala chicken

Ingredients 500 g chicken (cut into eight pieces) 250 g onion 1 pod garlic 1/2 inch piece **of** ginger 3 tomatoes 1/2 tsp each **of** dhania powder and jeera powder, salt, turmeric powder and chillies to taste 2 the oil and 1 lemon

Method

- 1 Wash the chicken and smear it with salt, turmeric powder, and lemon juice. Leave aside for 30 minutes.
- 2 Grind onion, garlic, and ginger into a paste and fry **in** oil until the oil starts leaving the sides **of** the vessel.
- 3 Add jeera powder, dhania powder, salt, chillies, and turmeric powder.
- 4 Place chicken **in** the solar cooker container and pour the cooked masala on top.
- 5 Add sliced tomatoes.
- 6 Leave it **in** the solar cooker for about 40 minutes.

Plain rice

Ingredients

- 1 cup rice
- 2 cups lukewarm water

Method

- 1 Wash and soak the rice for 1 5 minutes.
- 2 Put the rice and water **in** the cooking pot.
- 3 Put the covered pot **in** the solar cooker for about 40 minutes.

Rice and Dal Khichri

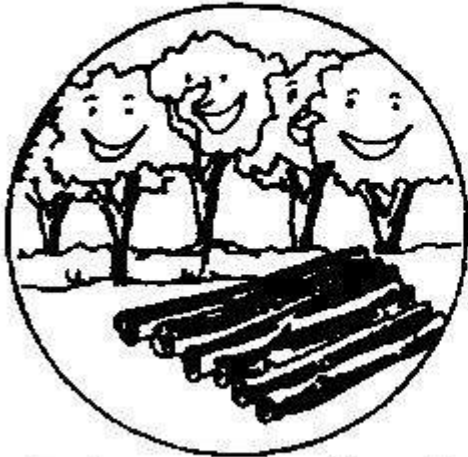
Ingredients	Method
1 cup rice	1 Wash and soak rice and dal together for 60 minutes. Drain.
3 cups water	2 Heat oil and fry ginger, pepper, and jeera lightly.
1/4 cups moong	3 Add rice and dal and put it into a dish. Add lukewarm water. Add salt to taste.
dal	4 Cover it and leave it in the cooker for about 30 minutes.
a small piece	5 Stir it and leave it in solar cooker for another 30 minutes.
of finely cut	
ginger, jera,	
salt, and	
pepper for	
seasoning	
1 tbs ghee	

Biogas as a rural energy source

Composition

Biogas contains 55-75 percent methane, plus hydrogen, carbon dioxide, and hydrogen sulphide. The percentage **of** inflammable methane gas depends on the raw material used to make the biogas.

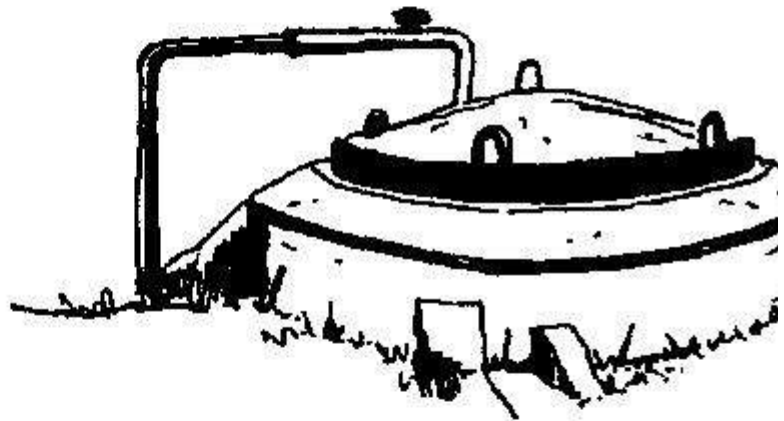
Biogas is a mixture **of** gases produced by the chemical decomposition **of organic** material such as animal dung. Consider installing a biogas plant. Animal dung, human waste, and waste plant material can be converted to clean, cheap fuel for cooking and lighting. And, the byproduct is good fertilizer. Biogas plants, also known as digesters or Gobar gas plants, can be installed to meet the needs **of** individual families on very small sites (3 m x 2 m), or for groups **of** several families.



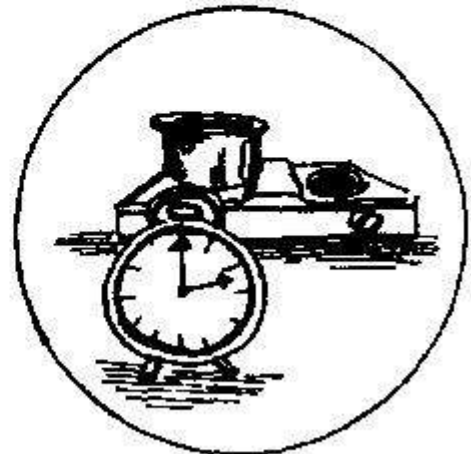
Reduce consumption of fuelwood and deforestation



Produce fuel and electricity



Make good fertilizer



Reduce cooking time

Benefits **of** biogas plants

Raw materials

- Animal wastes, such as dung **of** cows, elephants, horses, goats, poultry, and pigs
- Plant wastes, such as husks, straw, dry leaves, weeds, vegetable skins

- Human excrete
- Industrial and domestic wastes, such as billow dust, pulp mill effluent, fruit and vegetable wastes

How it works

The main parts **of** a biogas plant are the digester, mixing pit, inlet and outlet pipes, outlet tank, gas holder, and gas pipe.

- 1 **Organic** material and water are mixed thoroughly **in** a mixing pit.
- 2 The mixture flows through the inlet pipe into the digester tank.
- 3 As the **organic** material decomposes (**in** the absence **of** oxygen), biogas is produced.
- 4 Gas collects **in** the gas holder. This gas can be used for fuel.
- 5 Decomposed material **in** the digester becomes light. It passes through the outlet pipe to the outlet tank. The material is good quality manure, rich **in** nitrogen and phosphorus.

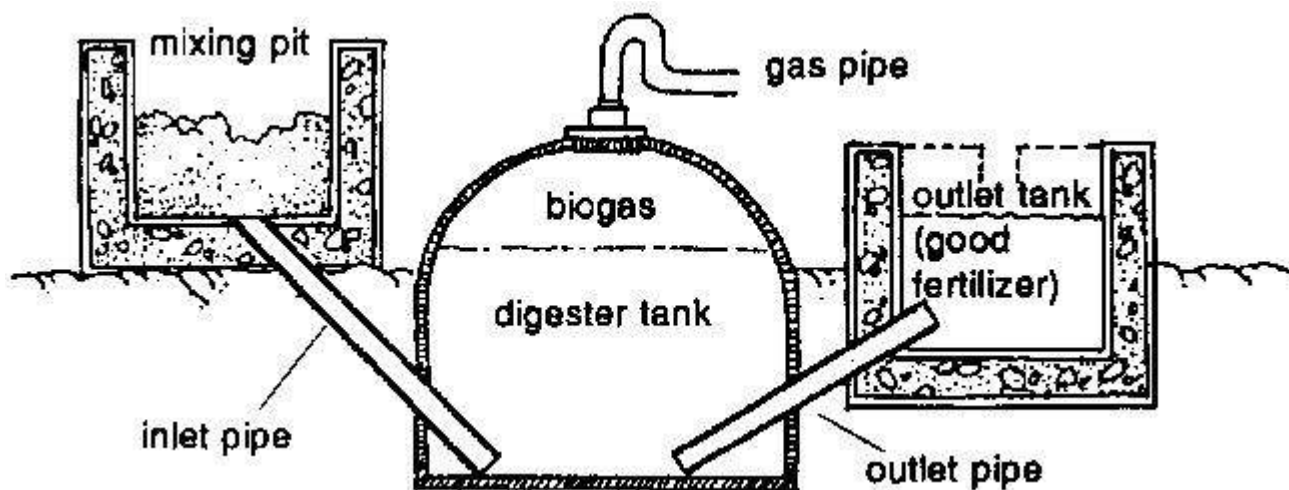


Diagram **of** biogas plant (not to scale), showing the main features.

Size

The size **of** your biogas plant should depend on your family's fuel requirements, and the availability **of** dung and other **organic** material. The table below will help determine the right size biogas plant for your homestead.

Capacity of plant (gas production per day in m ³)	Daily requirement of dung (kg)	Approximate number of cattle required for	Cooking for number of persons
1	25	2-3	3-4
2	50	4-5	5-8
3	75	6-7	8-12
4	100	8-9	12-16

Community-size biogas plants are also available which can serve the needs of several families.

Site selection

- Install the biogas plant on an elevated, open, and dry site which is exposed to sunshine most of the day.
- It should be near the kitchen and the animal sheds.
- The groundwater level should be at least two metres below the surface.
- The biogas plant must be at least 15 metres away from drinking water wells and hand pumps.
- Where the sanitary latrine is linked to the biogas plant, the water seal of the latrine must be at least 30 centimeters above the upper level of the biogas plant's slurry outlet pipe.

Cost of installation

The cost of installation depends on the type and size of plant installed. The table below shows the approximate cost of installation of various models at various capacities (assuming a 40-day retention period):

Capacity of plant (m ³)	KVIC ¹ model	Deenbandhu model	Pragati model
1	8,000	5,500	6,500
2	11,000	6,500	9,000
3	14,000	8,000	11,500
4	16,500	9,500	13,000

¹ Khadi and Village Industries Corporation

The national government provides facilities for promotion, construction, service, and repair of biogas plants. Substantial subsidies are also available through the National Programme on Biogas Development. As well, both commercial and cooperative banks provide credit, without land mortgage, for installation of family-size biogas plants. Repayment periods range between 5 and 7

years.

Installation

Biogas plants are installed by self-employed workers specially trained **in** the construction, installation, maintenance, and repair **of** biogas plants.

For more information contact the block development office **in** your area.

Contributor: Mr. S. K. Jagwani

Efficient fuel energy utilisation

Energy for cooking is a basic requirement **of** daily life. Women **in rural** areas must travel long distances to collect fuel for cooking. Then they spend long hours cooking **in** smoke-filled kitchens. Here are some ways to make best **use of** fuel and minimize cooking time.

Proper pots

- **Use** round-bottomed pots on wood-burning chulhas. More heat can be transferred to these as compared to flatbottomed pots.
- The diameter **of** the pot must be 1.5- to 2-times bigger than the diameter **of** the chulha opening.
- Clean the pot bottom before **use**.

Fuel-saving cooking techniques

- Cook with the minimum quantity **of** water. If more water is required during cooking, add hot water if possible.
- Keep the pot or pan covered with a plate or pot lid while cooking.
- Soak pulses, rice, etc., **in** water for at least half an hour before cooking. Hard-coated legumes, such as lima beans, gram, and cowpea, should be soaked overnight.
- Do not allow flames to come out the chulha's fire door.
- When cooking is complete, quickly remove unused fuel from the fire chamber and douse the fuel with water. This wet fuel can be sun-dried and used again.

Remember to cover your pot.

Smart fuel **use**

- Chop wood into small pieces, about 3 cm x 5 cm x 10 cm.
- Do not over-feed the fire. Flames should not escape the fire box. This is a waste **of** fuel.
- **Use** dry fuel. Otherwise, energy is wasted removing moisture when the fuel is burned.

Place wood pieces at angles across the grate (if the chulha has a grate) to allow air circulation.

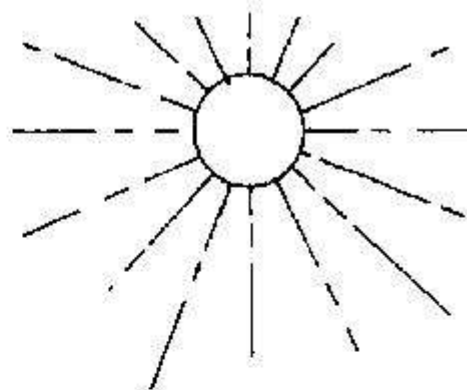
Stack wood pieces across each other for better circulation.

If you are using long fuel sticks which protrude from the fire box, keep them horizontal or tilted toward the centre **of** the grate by propping up their outside ends with a brick.

When using light fuels such as twigs and straw along with wood, bum the wood first to achieve a high temperature. Add the light fuels next for their good combustion.

Dung should be used for composting. However, if some part **of** your dung must be used for fuel, prepare fuel rods by coating dung over long sticks. After they are dried **in** the sun, these fuel rods burn more efficiently and produce less smoke than either wood or dung burned separately.

Producing fuel rods with dung and sticks



Producing fuel rods with dung and sticks

Water management for farm and home

Safe drinking water

Some 1.5 million children under the age **of** five die **in** India every year because **of** water-borne diseases. While most people know that bad water causes sickness, relatively few know that water carries diarrhoea, cholera, and stomach disorders. **Rural** women are the principal collectors, storekeepers, and users **of** water at home and **in communities**. Therefore, they must know how to ensure that the water they **use** is safe.

What is safe water?

Water is safe when there is nothing **in** it that can cause a disease. Safe drinking water must be:

- Free from harmful germs (bacteria, parasites, viruses, etc.)
- Free from harmful chemicals (such as pesticides) and foreign matter (such as dirt)
- Pleasant to taste or tasteless
- Colourless or crystal clear
- Odourless

Importance **of** safe water

Not all water is safe for human **use**-drinking and cooking. Contaminated water can be dangerous to health. It is a source **of** deadly diseases such as cholera, diarrhoea, dysentery, gastroenteritis, typhoid, jaundice, polio, guinea worm infestation, worm infection, and other health problems.

What causes contamination **in** water sources?

Human excreta-faeces and urine
Animal excreta-dung and urine
Bathing, washing, and cleaning activities
Industrial effluent from mines, mills, refineries, etc. (Dead fish seen frequently **in** water might indicate the presence **of** chemicals.)
Wastes from cities
Improper garbage and waste disposal
Pesticides and fertilizers washed into rivers and groundwater
Dead and decaying animals and plants, especially **in** stagnant water
Soil erosion

Due to these pollutants, water becomes unsafe for domestic **use** and, therefore, unsafe for drinking.

How to recognize unsafe water

Unsafe water has various harmful chemicals (such as iron and fluorides), germs, and waste materials. Harmful chemicals and germs cannot be seen with the naked eye but can cause unpleasant odour or taste.

Note

To be sure, get your water tested. Take a sample **of** water for testing to your local water-testing laboratory.

Note

Wells should be situated away from sources **of** contamination.

Water from hand pumps can become contaminated **in** the rainy season.

Prevent surface water from entering wells.

Keep washing areas and sources **of** contamination downstream from your water source.

Unsafe water has:

- unpleasant, bitter or salty taste might be due to excess **of** iron and various salts like chlorides.

- foul smell-might be due to gases, germs, sewage, and/or algae.
- cloudy or turbid appearance might be due to excess **of** mud, clay, salt, iron, decaying **organic** matter, dyes, etc.

In general:

- running water is safer than stagnant water.
- groundwater is safer than surface water.
- covered wells and hand pumps are safer than open wells, tanks, and ponds.
- tubewells are safer than open wells.
- deep wells are safer than shallow wells.



Can you identify the sources **of** contamination **In** this picture?

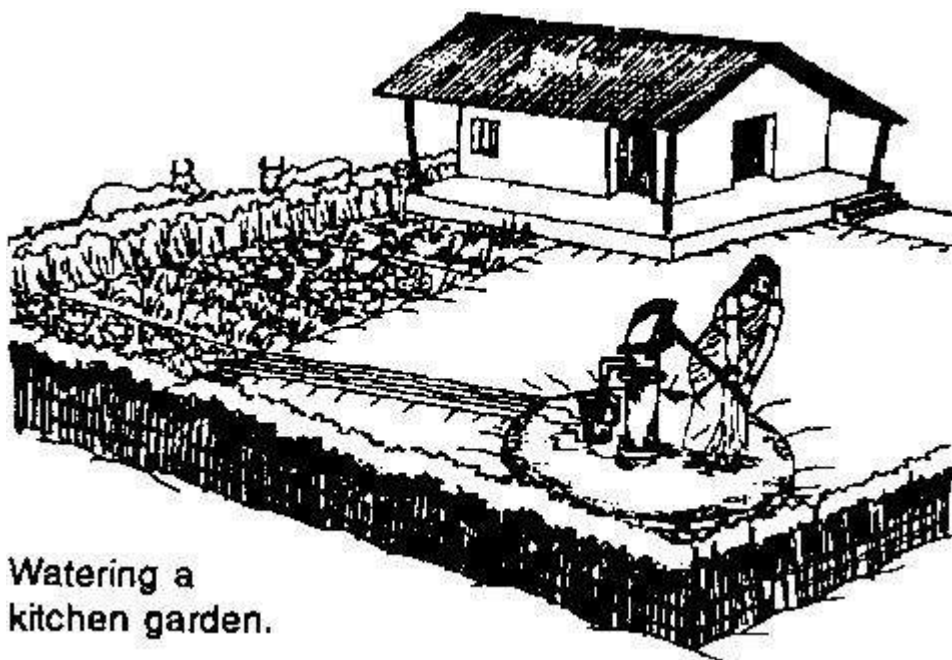
Source: Notional Drinking Water Mission, Government **of** India

Maintenance of community water sources

Any water source is a valuable property **of** the entire village. Therefore, it is everyone's responsibility to guard the water source from contamination.

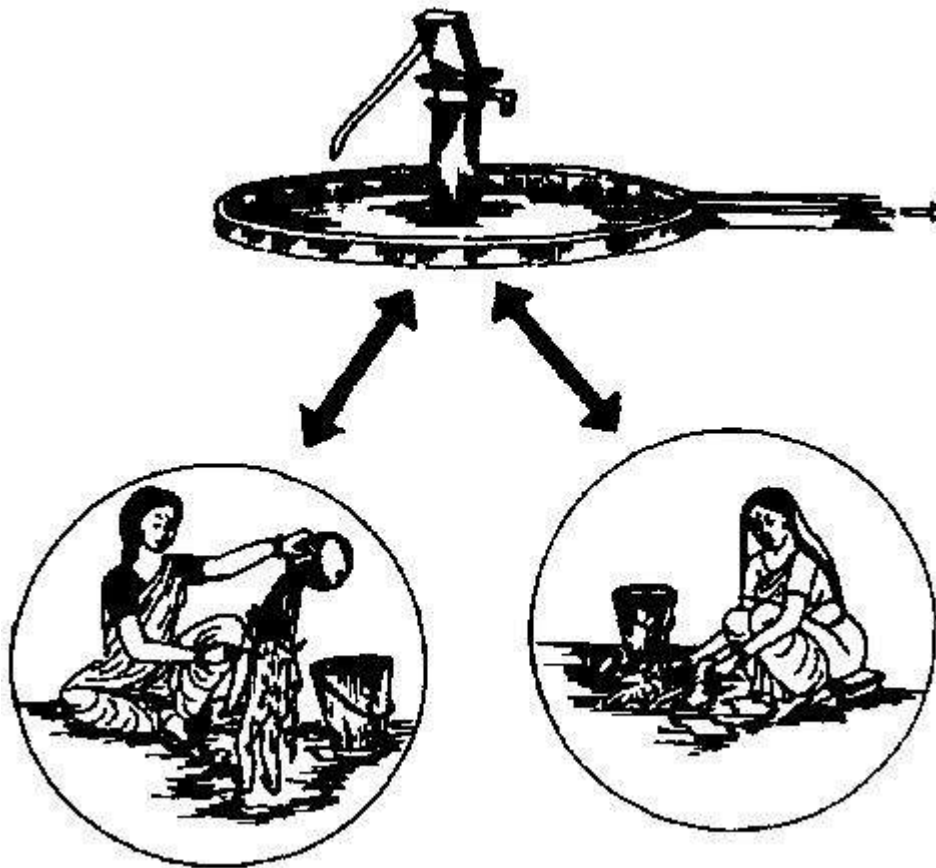
Taps and water pumps

- Keep the tap and pump and the surrounding area clean.
- Make a drain to lead excess water away from the tap or pump.
- Excess water can be used to water a field or kitchen garden, or can be drained into a soakage pit. This prevents the surrounding area from getting muddy.
- Clean drains regularly.
- Repair cracks **in** concrete. Repair cracked or damaged pipes promptly.
- Protect the water source, piping system, and storage tank from contamination by people, animals, agricultural and industrial waste.
- Prevent children from putting their lips on the tap or pump when drinking water.
- Bathe and wash clothes at least 15 m away from the tap or hand pump.
- Make a fence around the tap or hand pump to keep cattle and other animals away.
- If it is necessary to water cattle from the pump, make a special cemented trough some distance (about 15 m) away from the pump.
- Turn off taps after **use**. Do not waste water.



Watering a kitchen garden.

Watering a kitchen garden.



Bathe and wash clothes at least 15 m away from the tap or hand pump.

Wells

- Sink wells **in** good soil at least 15 m away from possible sources **of** contamination, such as cesspools or insanitary privies.
- Fill **in** all hollows, rat holes, foul tanks, cesspits, etc., near the well.
- The site should be sufficiently high to prevent water from flowing toward and seeping into the well.
- Provide a parapet wall around the top **of** the well about 1 m high to prevent surface water from entering the well. The top **of** the well wall should slope (should not be horizontal) to discourage people from sitting or washing clothes on it, and thereby contaminating the water.
- Cut down or trim trees and vegetation close by so that leaves and bird droppings do not fall into the well. Tree roots should not be allowed to sprout from the lining **of** the well.
- Cover the well to prevent leaves and dust from blowing inside.

Prevent sparrows and pigeons from making their nests **in** the lining **of** the well.

Provide a proper washing and bathing place at a distance from the well and preferably at a lower level than the well so that waste water flows away. Waste water seeping into the ground close to the well can contaminate the well water.

- Provide a cemented area around the well at least 2 m **in** diameter. Make it slope away from the well

so that surface washings flow away from the well and not into it.

- The buckets **of** individual users might be dirty and contaminate the well water. So, discourage users from lowering their own buckets into the well.
- Attach a strong bucket with a chain or rope to the well permanently for public **use**. Keep this bucket clean.

Tanks and ponds

If possible, do not **use** water from tanks and ponds for drinking. **Use** well water instead. If you must **use** water from tanks or ponds, try to follow these guidelines.

Select sites with good surroundings with no insanitary conditions or bore-hole latrines **in** the vicinity.

Ensure that banks are properly sloped and planted with grass.

The tank or pond should be ringed by an embankment to prevent water from flowing **in**.

Do not allow surface drains to empty into the tank or pond.

Fence the tank or pond to keep away cattle.

Keep one tank for drinking water and another for other activities, such as washing, bathing, and watering animals.

Draw water without going into the tank. Draw water from the steps or by means **of** a hand pump.

Plant trees only at a distance so as not to attract cattle and bird droppings.

Remove weeds and algae regularly.

Clean the tank or pond regularly and re-excavate when dry.

This will increase its capacity as well.

Do not allow any commercial activities, such as jute steeping **in** the tank.

Source: National Drinking Water Mission, Government **of** India, Mr. Yash Pal Bedi and Directorate **of** Advertising and Visual Publicity, Government **of** India

Management of drinking water for the household

You must ensure that the water you **use** is safe. Take care to prevent contamination from the time water is collected to the time it is used.

Hands are a major source **of** water contamination. So, do not put your hands **in** the drinking water and do not let drinking water splash or pour over your hands during collection, transportation, or storage.

Water container

- Clean your water containers with ash or cleaning powder. Do not **use** mud as it contains harmful bacteria which can contaminate your water.

- Do not **use** containers which previously contained pesticides, chemicals, petrol, or other poisonous substances.

Collecting water

- Avoid collecting stagnant water from ponds. Collect water from wells rather than from surface sources. If, however, this cannot be avoided, strain the water through two layers **of** cloth. Allow the water to stand for a short while. The water can then be purified with bleaching powder or by boiling. (See Safe drinking water and Some simple ways to purify drinking water.)

Clean your hands thoroughly before filling the water container.

- Do not lower your container into the well. **Use** the community bucket fixed to the well for this purpose.
- Do not place this community bucket on the ground.
- Do not walk down the steps **of** the well (**in** the case **of** a step well) to collect water. This spreads guinea worm. (See Maintenance **of** community water sources.)

Transporting water

- Carry drinking water **in** a covered container.
- Make sure that the cover is clean.

Storing water at home

- Keep the water container covered.
- Keep the water container on a high platform out **of** reach **of** children and animals. Clay pots and other porous containers must be raised slightly off the ground to prevent contamination.
- If possible, **use** a container with a tap near the base. This prevents contamination from hands and utensils dipping into the container. It also allows sediment to settle to the bottom.
- If possible, empty and clean household water storage containers daily.
- **Use** some simple methods to purify your water before **use**. (See Some simple ways to purify drinking water.)
- **Use** a clean, long-handled ladle to take water from the container.

Sources: National Drinking Water Mission, Government **of** India, Mr. Yash Pal Bedi and Directorate **of** Advertising and Visual Publicity, Government **of** India

Some simple ways to purify drinking water

Drinking water is not always safe. Sometimes it can carry debilitating diseases, even death. To prevent infection by waterborne diseases, follow the simple techniques given below.

Boiling

Boil all drinking water for at least 10 minutes. Boiling kills most **of** the harmful organisms present **in** water. **In** case boiling is a problem-because **of** high fuel costs or lack **of** fuel-boil at least the water for children, older people, and sick people, especially during the rainy season. To improve the taste **of** boiled water, stir it vigorously with a clean spoon or pour the water from a height, from one container to another several times.

Container	Water quality
Brass, copper	very good
Plastic, glass	good
Steel, iron	not good
Tin, hindalium	bad
Mud, aluminium	very bad

Copper or brass vessels

If possible, store water **in** copper or brass vessels.

Copper and brass inhibit the growth **of** bacteria.

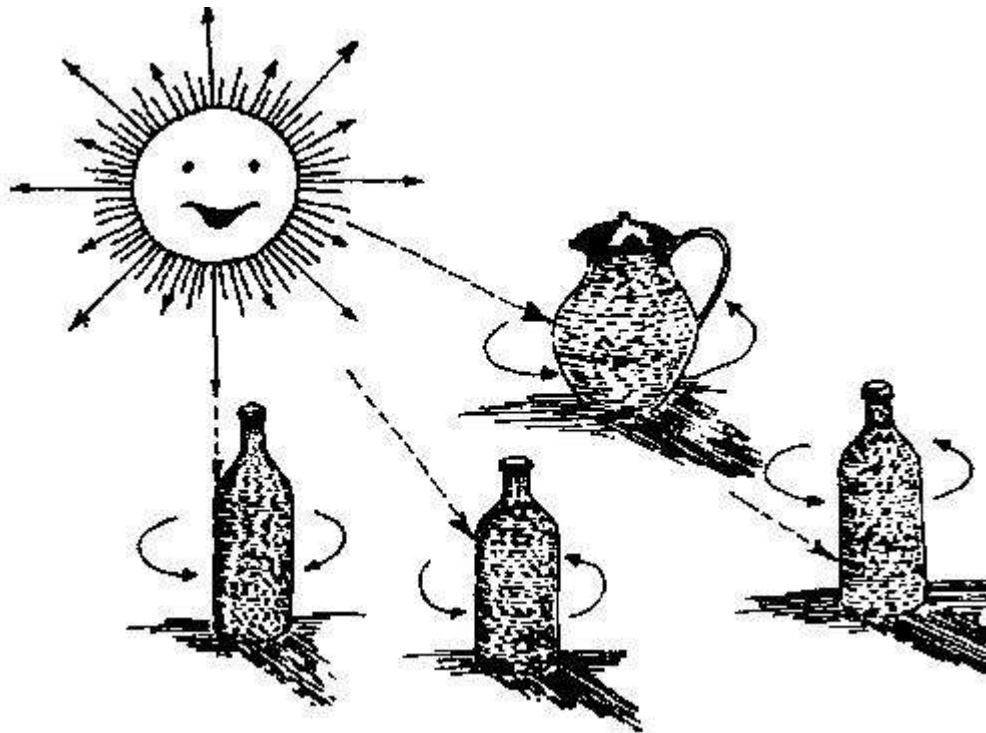
Solar disinfection

1 Leave water containers for some time so that heavy dust and dirt particles settle to the bottom.

2 Pour the water into transparent plastic, coloured glass, or blue-tinted glass vessels or bottles. As you pour, be very careful not to disturb the sediment.

3 Cover the vessels and cap the bottles.

4 Expose them to strong direct sunlight for at least 90 minutes. If possible, put the vessels **in** the sun early **in** the morning and leave them out until late afternoon. This destroys bacteria that cause several common diseases. Keep the vessels slightly away from each other for direct radiation.



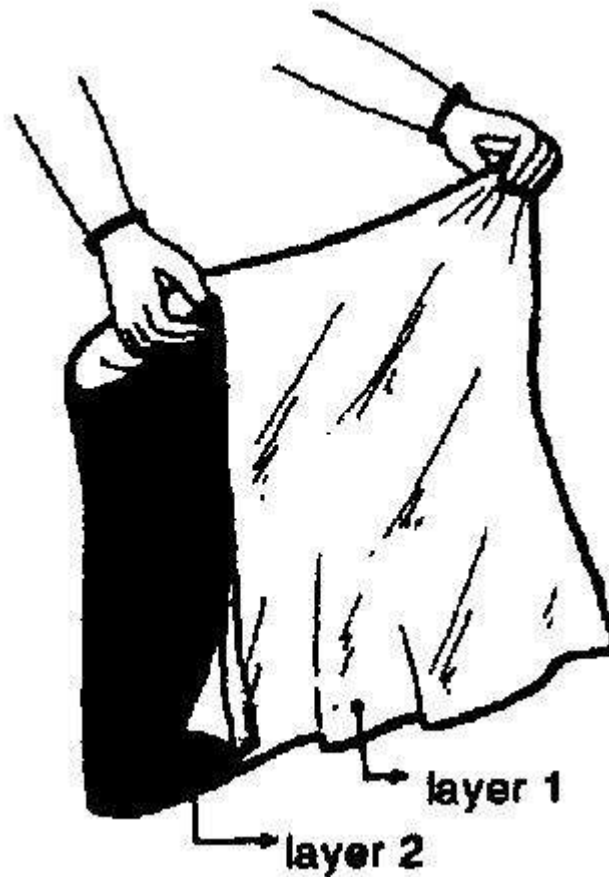
Transparent plastic and colored glass vessels

This solar-disinfected water can be used directly or kept overnight to cool.

Three-pot system

Unsafe, dirty water can be made much safer simply by storing it for at least 24 hours. Within that time most **of** the dirt will sink to the bottom.

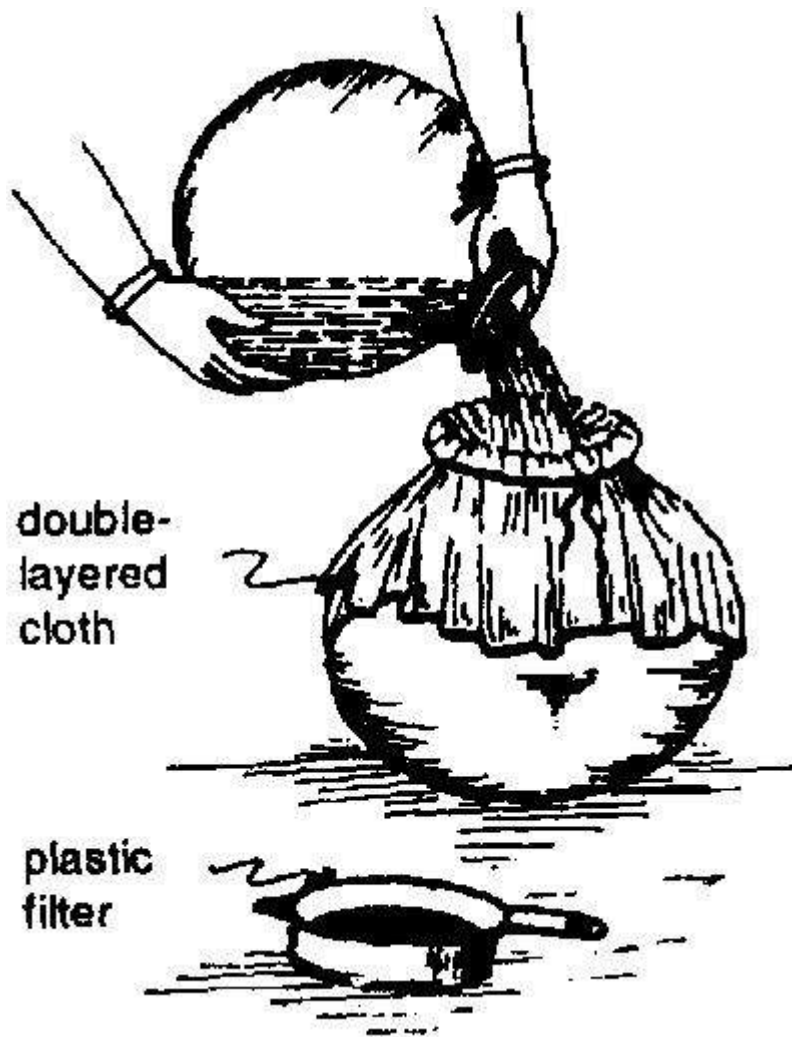
- 1 Take two big pots and one small pot. **Use** the big pots for fetching water on alternate days.
- 2 Allow the water **in** the first pot to stand for 24 hours.
- 3 Then, pour the clear top water into the small Pot for drinking.
- 4 **Use** the remaining water for washing.
- 5 Clean and refill the first pot when it is empty.
- 6 Again, allow it to stand for 24 hours.
- 7 **Use** the second pot **in** the same way as the first. **In** this way, each day's drinking water has been left to stand for at least 24 hours.



Double-layered cloth

Cloth filters

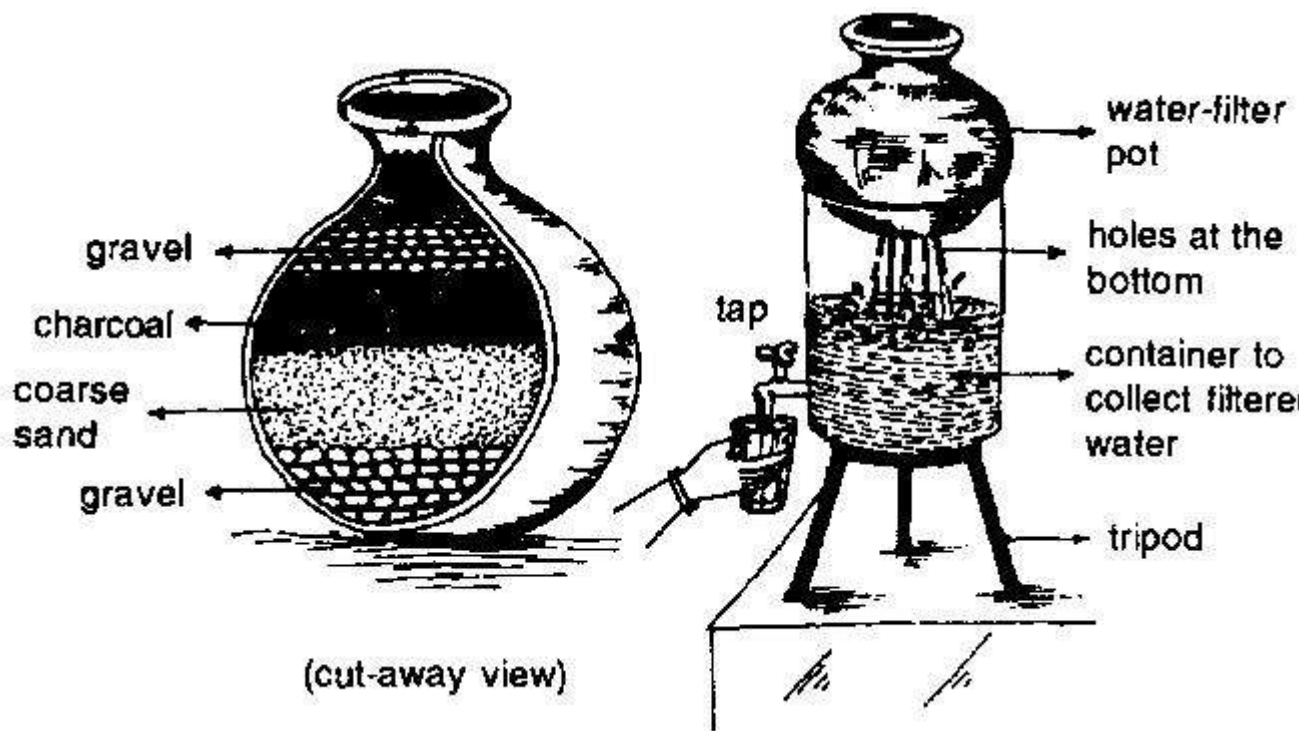
Cloth water filters can be used to strain insects, worm larvae and other comparatively large particles from water. Make a simple two-layer filter using cloth **of** two different colours so that you know which side to place on top (to receive unclean water). **Use** tightly woven cloth. Wash the filters after each **use**. This prevents organisms and debris caught **in** the filter from recontaminating the water. You can also buy readymade, cheap plastic filters.



Cloth filters

Charcoal filters

Charcoal water filters can be used to remove suspended material and harmful bacteria in polluted water to a level satisfactory for human consumption.



Water-filter pot

Materials

- Gravel and sand for filtration.
- Charcoal to remove colour, odour, taste, and certain dissolved impurities

Construction

- 1 Make a number **of** small holes **in** the bottom **of** a galvanized iron or steel drum, clay pitcher, or ordinary steel drum. This will be the water-filter container.
- 2 Fill the pitcher or drum with a 25-cm layer **of** gravel.
- 3 Place a layer **of** coarse sand on top **of** the gravel, up to a height **of** about 25 cm.
- 4 Cover with charcoal.
- 5 Cover the charcoal with a 510-cm thick layer **of** gravel to prevent the charcoal pieces from floating **in** the water.

Chemical disinfection

Chlorine **in** one form or another is the most common chemical used for disinfection **of** water. It is normally effective against bacteria commonly associated with water-borne diseases. It is, however, less effective against certain cysts, ova, and viruses.

Chlorine is supplied as a gas, **in** solution, or as a solid. Probably the easiest form **of** sterilization **of** emergency water supplies is by **use of** either calcium hypochlorite (ordinary bleaching powder) or sodium hypochlorite (available as a liquid).

Notes

- Wash the materials before filling the filter container.
- About three-quarters **of** the drum should be filled with the filter material. Place this water-filter container on top **of** another iron or steel drum or clay pitcher, fitted with a tap. Pour water **in** the top. Filtered water is obtained through the tap at the bottom. The charcoal should be replaced after six months. The sand and gravel can be washed and reused.
- You are advised to add a few drops **of** chlorine solution (5.25 percent) to disinfect each jug **of** water.

Chlorination at home

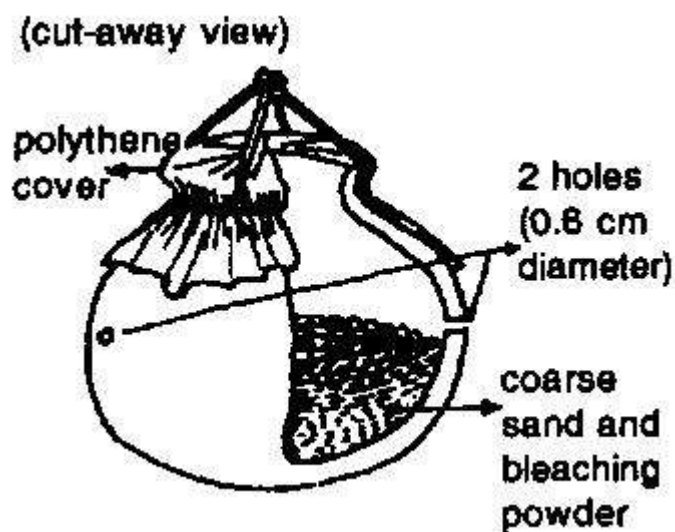
Make a chlorine solution by mixing 1 cup **of** laundry bleach **in** 3 cups **of** water. Add 3 drops **of** this solution to 1 litre **of** water and allow the water to sit for 30 minutes. Alternatively, you can treat water using chlorine tablets which are available **in** the market.

Chlorination **of** community wells

Continuous disinfection **of** well water can be done using low-cost devices called "pot chlorination "

Single-pot chlorinator-for larger wells

- 1 Take a 12- 15 litre earthen pot.
- 2 Make two holes 0.6 cm **in** diameter **in** the middle **of** the pot.
- 3 Pour into the pot a moist mixture **of** 1.5 kg bleaching powder and 3 kg coarse sand. (The mixture should occupy the volume **of** the pot below the level **of** the holes).
- 4 Cover the mouth **of** the pot with polythene.
- 5 Lower the pot into the well with a rope so that it remains 60 cm below the surface **of** the water.



Single-pot chlorinator

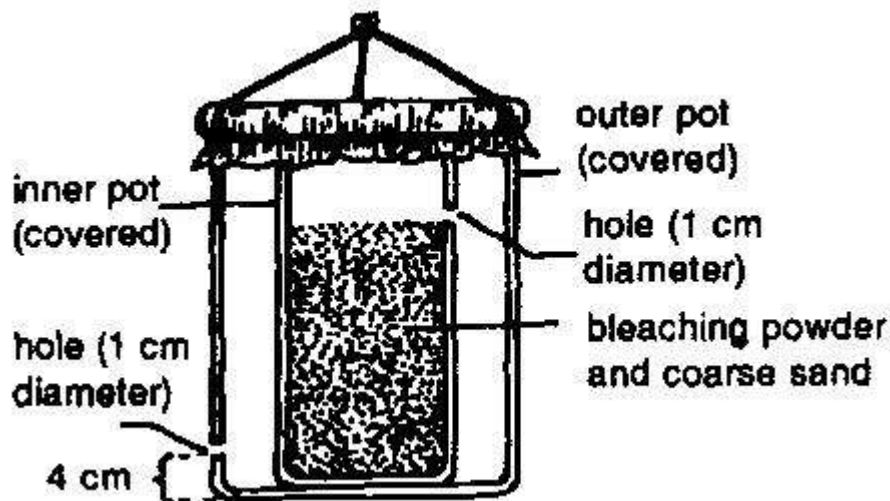
This unit can chlorinate wells holding 9,000-13,000 litres **of** water with a withdrawal rate **of** 900-1,300 litres per day (sufficient for 40-60 people per day) for a period **of** at least one week. The

treated water has a chlorine content **of** 0.2-0.8 parts per million.

Double-pot chlorinator-for small household wells

Use of a single-pot chlorinator **in** a small well (4,000 litres **of** water with a withdrawal rate **of** 360-450 litres per day) will result **in** over-chlorination. Instead, **use** a double-pot chlorinator.

1 Take two cylindrical pots-one to fit inside the other.



Double-pot chlorinator (cutaway view)

Make a 1 cm diameter hole **in** the side **of** the smaller pot, about 8 cm below the rim.

3 Fill this pot to just below the hole with a moist mixture **of** 1 kg bleaching powder and 2 kg coarse sand.

4 Make a hole 1 cm **in** diameter, about 4 cm from the bottom **of** the big pot.

5 Put the small pot inside the big pot.

6 Cover the mouth **of** both pots with polythene.

7 Lower the unit into the well with a rope so that it hangs 1 m below the water level. This chlorinator gives 0.3-0.5 parts per million **of** chlorine over a period **of** 2-3 weeks.

Sources: National Drinking Water

Mission, Government **of** India, Mr.

Yas Pal Bedi, and Directorate **of**

Advertising and Visual Publicity,

Government **of** India

Calculating volume

Use this formula to calculate the volume **of** water **in** your well:

3 x radius **of** the well (cm) x radius **of** the well (cm) x depth **of** water (cm) = cubic cm

Use of indigenous plants for cleaning water

Farm women **in** India possess a wealth **of** indigenous knowledge. Women **in** some parts **of** India, for instance, **use** various plants to make muddy water clear.

Moringa oleifera drumstick, sainjana, sahjana

Moringa oleifera can make muddy water clear **in** 1-2 hours.

Dosage

Use about 30 seeds **in** 40 litres **of** water. **Use** more seeds to clear very muddy water. Dosage can also depend upon the condition **of** the water source and the season. (1 1/2 seeds per litre **of** water for very muddy water and 1/4 **of** a seed **in** one litre **of** water for less turbid water.)

Method **of** preparation

- 1 Remove the wing and coat **of** the seed.
- 2 Crush the white kernel **in** a mortar.
- 3 Mix the powdered kernel with a small amount **of** potable water **in** a glass and stir vigorously for 5 minutes.
- 4 Pour this suspension through a tea strainer or muslin cloth into turbid water.
- 5 Keep stirring the water slowly for about 10 minutes.

Strychnos potatorum nirmall The ripened seeds **of** Strychnos potatorum can be used to make a natural flocculent for cleaning muddy water-dirt particles flock together, creating larger clumps which can be easily removed.

Dosage

Use about 1.5 mg **of** seed extract per litre **of** muddy water.

Method

- 1 Crush ripened seeds into a thick paste using clean water.
- 2 Add the paste to muddy water and stir.
- 3 Let it stand.
- 4 Strain through muslin or pour off the clear water into a clean vessel. Be careful not to disturb the sediment.

(The same results can be achieved by rubbing the seed on the inner surface **of** an earthen water vessel before filling.)

Semecarpus anacardium bhela, bhilawa

This seed is used **in** Central India as a substitute for *Strychnos potatorum*. Rub the seeds on a stone and make a thick paste. Mix it with muddy water. Follow the same procedure as for *Strychnos potatorum*.

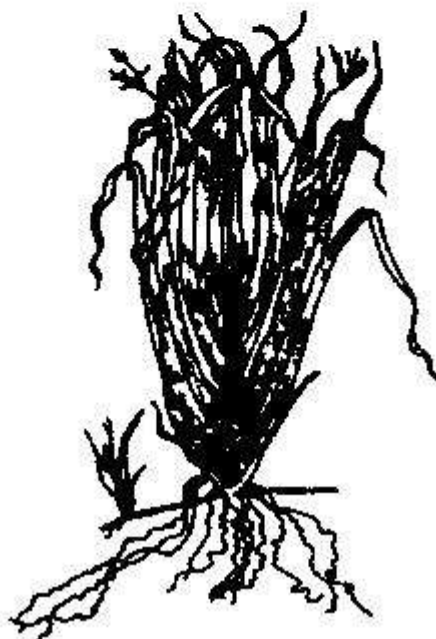
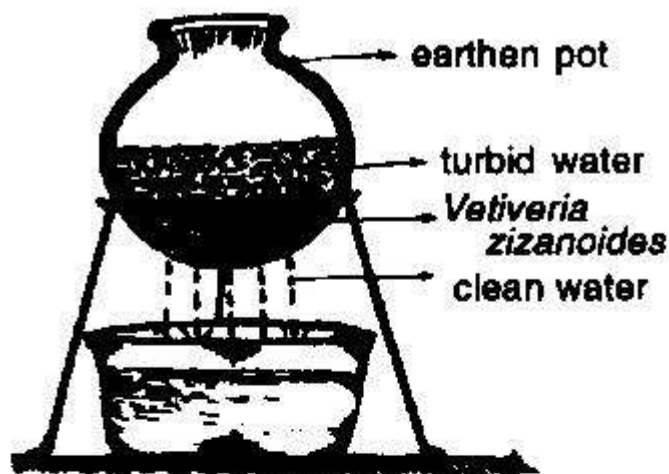
Vetiveria zizanoides khus, vetiver grass

Take a clay jar with a few tiny holes **in** the bottom. Lay wiry roots **of** the rhizome at the bottom **of** the jar. Water filtered through this layer **of** roots is not only cleaner but also has a pleasant smell. (Practiced **in** South Kerala.)

Tylophora indica jangli-pikvan

The dry roots **of** this plant improve the quality **of** drinking water. The roots can be placed directly **in** water or powdered and stirred **in**.

Limnanthemum cristatum This herb is grown **in** rainwater harvesting tanks **in** some parts **of** Rajasthan for cleaner water and pleasant taste.



Vetiveria zizanoides

Source: Consortium for **Rural** Technologies (CORT)

Soakage pit for proper disposal **of** waste water

Note

Do not **use** your soak pit for disposing **of** waste water from latrines.

Day-to-day household tasks, such as cleaning, bathing, and washing clothes, produce waste water. Stagnant pools **of** water around houses, **in** the streets, and **in** choked drains are a health hazard.

Besides producing bad odour and making areas muddy, stagnant pools become breeding places for mosquitoes.

Kitchen gardens are a good place to dispose **of** waste water. However, if you don't have space for a garden, building a soak pit is a practical, effective alternative.

Soak pits work like this: waste water gets dispersed **in** the specially designed pit and is absorbed **in** the subsoil, while pieces **of** solid waste naturally decompose. Since decomposition takes place **in** a sealed pit, no foul smell is produced.

Materials required Stones (large, medium, small): 1 cart load Plastic or metal perforated plate (15 cm diameter): 1 PVC pipe (30 mm diameter) 75 cm - 1 m Cement: 2 kg Bricks: 12 Polythene or gunny bags: 4 Sand: 2 cubic ft Masonry and labour charges (digging, fitting, and finishing construction **of** the pit): 1 day

Construction

Select a 1 sq m area close to the drain outlet, and 30 to 60 cm away from the nearest wall **of** the house.

- Dig a pit 1m x 1m x 1m x.

- Fill the pit with big stones (coconut size) up to 30 cm, followed by medium stones (guava size), from 30 to 60 cm, and small stones (wainut size) from 60 to 90 cm.

Note

In case the distance between the drain outlet and the soak pit is greater than the recommended distance **of** 30 to 60 cm, the length **of** the drain pipe has to be increased accordingly.

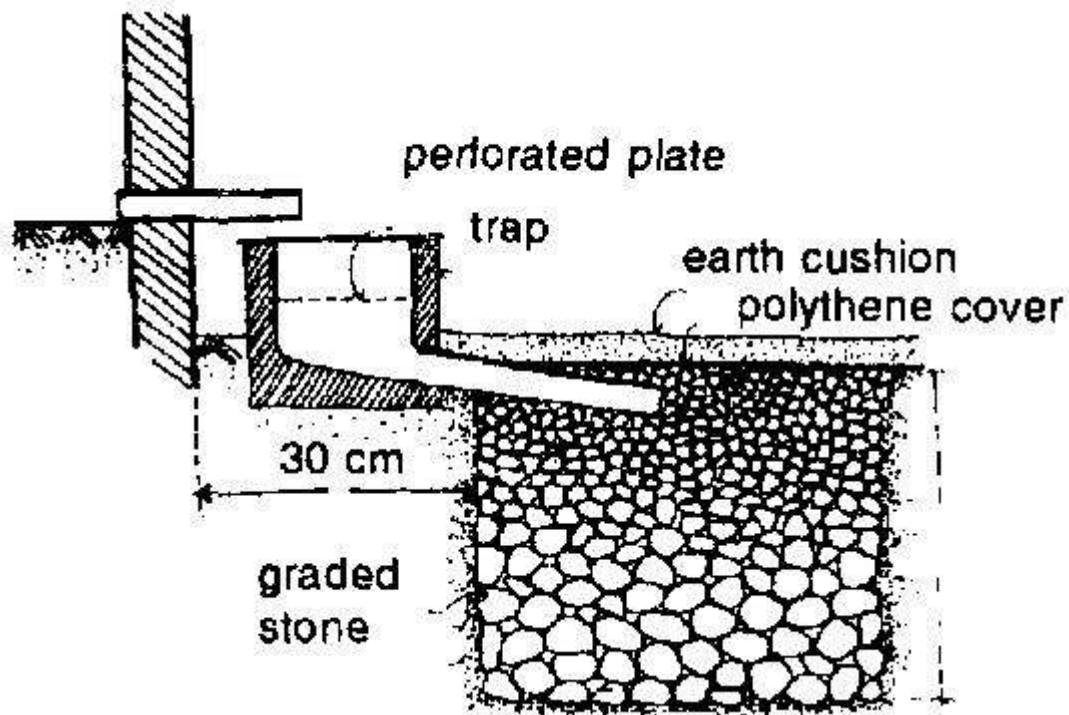
Note

During heavy rains, cover the trap with a plastic sheet to stop the rainwater from draining **in**.

Choose a drain pipe (PVC, bamboo or any used rubber tube or hose) 5 mm **in** diameter. Cut it to a length **of** about 75 cm

Make a hole 3 cm **in** diameter at one end **of** this pipe.

Construct a brick-lined trap below the drain outlet **of** the house, install a perforated plate and a drain pipe running down to the soak pit.



Construct a brick-lined trap

The principal/function **of** the trap is to keep solid deposits, rainwater, and mud out **of** the soak pit. You can also **use** a clay pot with holes **in** the bottom as a trap.

- Install the drain pipe so that the end with the 3 cm hole reaches the centre **of** the pit and the perforation faces downwards.

- Cover the pit with a polythene sheet (fertilizer bags or cement bags). Make sure that the cover stretches at least 15 cm beyond the sides **of** the pit. Spread earth on this cover and pack it until the surface **of** the pit is level with the ground. Make the finished surface look the same as the surrounding area.

Maintenance

Daily-Remove solid deposits held **in** the trap and flush a litre **of** water through the trap to clear any blockage.

Periodic-**In** time, your soak pit might become choked. Excess moisture on top **of** the soak pit is - an indication **of** choking. When choking occurs, dig out the soak pit and remove the stones and debris. Wash the stones and refill them **in** the pit.

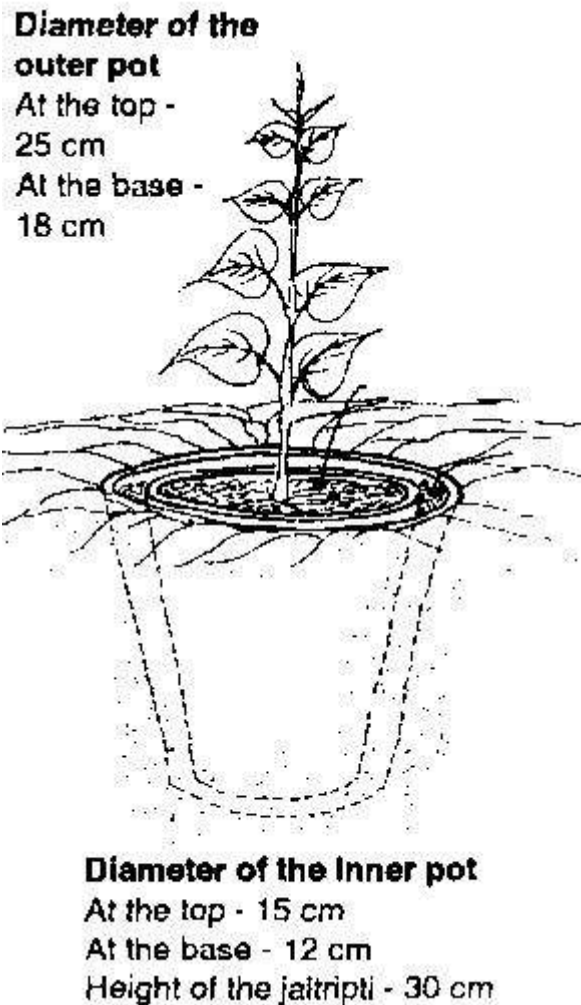
For an average family, a well maintained soak pit will last for at least five years.

Contributor: Dr. N. Kamalammo

Efficient use of irrigation water

Note

Different size jaltriptis can be made to suit your needs.



Plant

Rural women travel long distances for fuel, food, and fodder. This work can pose great hardship, especially **in** arid and semiarid regions where trees and crops are scarce. Irrigation is an obvious solution, but providing enough water to nurture crops and trees on dry, sandy soils is difficult. There are techniques and tools, however, which can help.

Jaltripti

Growing trees is difficult **in** arid and semi-arid regions, especially **in** high percolation sandy soils. A simple device called a Jaltripti can reduce the frequency **of** waterings and reduce the total amount **of** water needed, while ensuring a constant regulated supply **of** moisture to young trees.

Construction

The jaltripti consists **of** a double-walled earthen pot. It is made by placing one pot inside a larger pot. See box at left.

The base (but not the sides) **of** the inner pot is coated with paint, cement, or coal tar to keep water from passing through.

Method

- Dig a hole and bury the jaltripti up to the rim **of** its outer pot.

- Fill the inner pot with good soil.
- Transplant the sapling into the inner pot.
- Fill the space between the two pots with water.
- Cover this circular water reservoir with polythene sheet to reduce evaporation. Do not cover the sapling.
- Fill the jaltipiti with water every week or so, depending on the season and the size **of** the pot.

Pitcher method

The pitcher method makes good **use of** water. It is best suited to dry areas with light soils, but can be adapted for **use** anywhere. It is particularly useful for growing melons, gourds, pumpkins, and other trailing plants.

- Dig holes 70 cm wide and 70 cm deep.
- Add 18 kg **of** composted manure to each hole.
- Add 18 kg **of** soil to each hole and mix well.
- Bury an earthen pot with the mouth **of** the pot at ground level **in** the middle **of** the bed.
- Fill the pot with water up to the brim.
- Cover the pot.
- Plant four seeds around the pot.
- Refill with water whenever the water level decreases.

Circular gardens

Circular gardens are best suited to drought areas and where land is scarce. They **use** little water.

Method

- Dig holes 30 cm **in** diameter and 30 cm deep.
- Build bunds around the rims **of** the holes.
- Plant seedlings inside the holes.
- Water close to the stem **of** the plant.

Sprinkler irrigation

This method is used for medium and large farms. It is more efficient on coarse texture soils, such as sand and sandy loams, which have low moisture-holding capacity. It is especially useful on undulating land and sand dunes.

The water is sprayed on the crop at a controlled rate. It can be used for almost all crops and is very

popular for cash crops and some orchard crops.

Spray irrigation is advantageous on some soils with salinity problems. It leaches salt effectively, and promotes seedling emergence and growth.

The spray cools the crops during high temperatures and controls frosts during freezing temperatures.

Some sprinkler systems are portable. A system costing Rs 1520,000 to install can irrigate 5-10 ha **in** one crop season.

Drip irrigation

Drip irrigation involves the slow application **of** water, drop by drop, to the root-zone **of** a crop.

Water is used very economically, since losses due to deep percolation and surface evaporation are reduced to the minimum.

This system is suited to arid regions. Growing orchards on saline soil is possible using the drip system.

Sources: Ms. Chitra Mani, Mr C. V. Sheshadri, and CDRT Allahabad

Fish production

Integrated fish farming

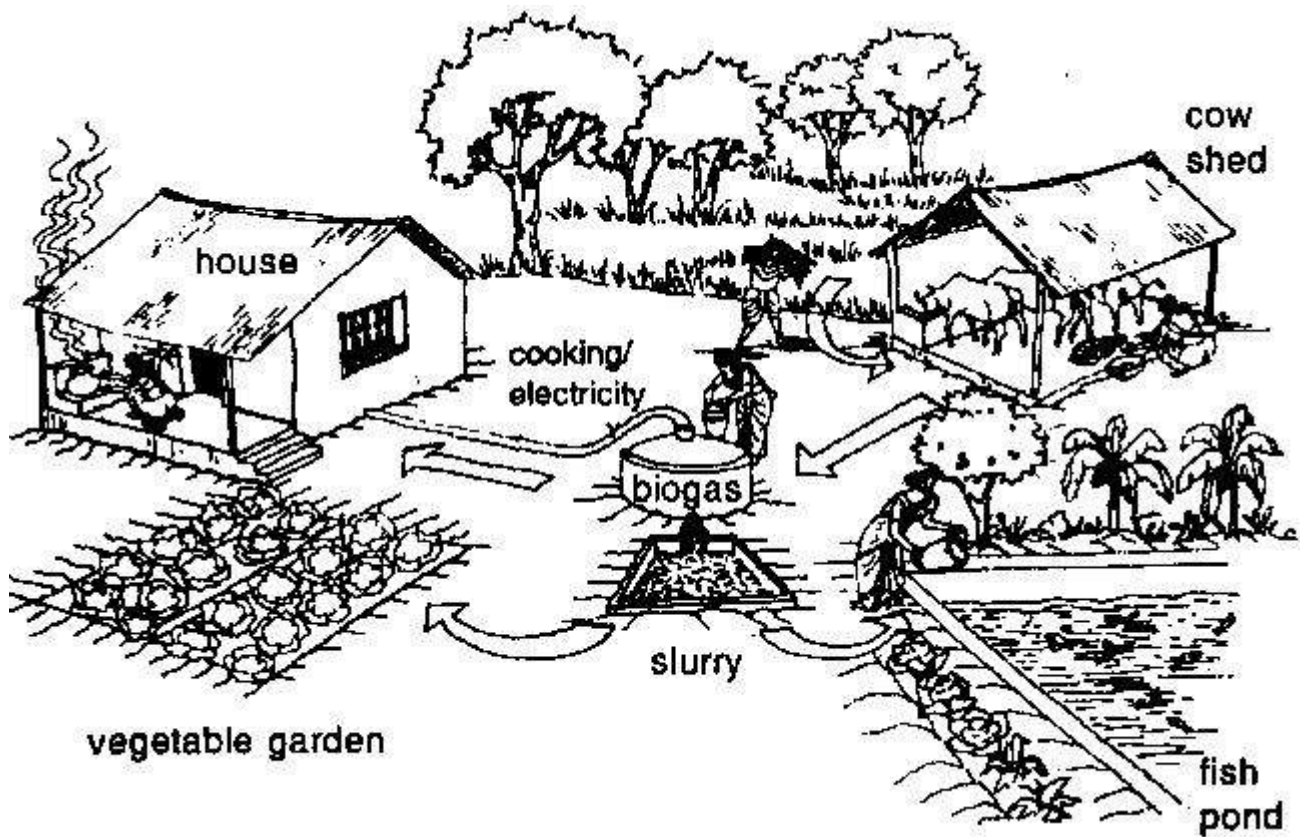
Raising fish **in** combination with pigs, poultry, cattle, or ducks can raise family income.

Since animal waste makes good fertilizer for fish ponds, and since 60 percent **of** the cost **of** fish farming goes for feed, integrating livestock and fish farming makes sense. Try a combination **of** different animals and crops that best suit your area. Grow vegetables and other crops on the pond dykes. **Use** animal waste to run a biogas plant and then feed the biogas slurry to fish-it is better than raw waste as fish-pond fertilizer. The goal is efficiency and higher profits.

Possible combinations include:

- Fish-cattle
- Fish-duck
- Fish-poultry
- Fish-pig
- Fish-goat or -sheep
- A combination **of** fish with two or more types **of** livestock (e.g., poultry pigfish)

Poultry- fish culture

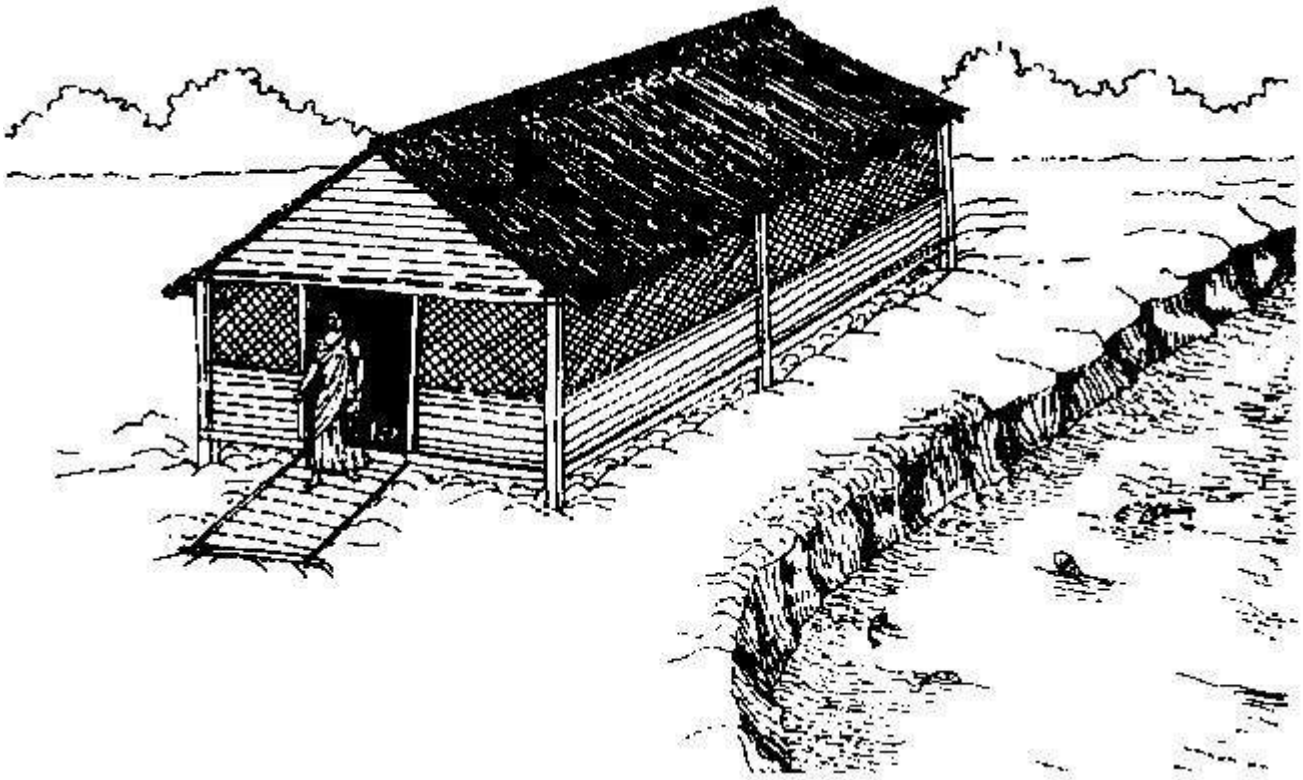


Poultry- fish culture

Deep litter system

Between 500 and 600 birds will produce enough litter for a 1 ha fish pond. Using this system, 4,000-5,000 kg of fish 60,000 eggs and 1,200 kg of chicken can be produced annually.

- Locate the poultry house near the fish pond.
- Construct the poultry house floor out of brick, concrete, or hard soil.



Deep litter system

Cover the floor to a depth **of** 15 cm with chopped straw, dry leaves, hay, groundnut shells, broken maize stocks, or sawdust.

Provide 0.3 to 0.4 sq m per bird.

Keep the birds on the litter to collect their droppings.

Stir the bed regularly.

Keep adding more **organic** matter to maintain the required depth **of** 15 cm.

If the litter becomes damp, add superphosphate or lime to keep it dry.

After 10-12 months, the litter is fully built up and its nitrogen content has reached about 3 percent. This litter can be used as fertilizer for your fish pond.

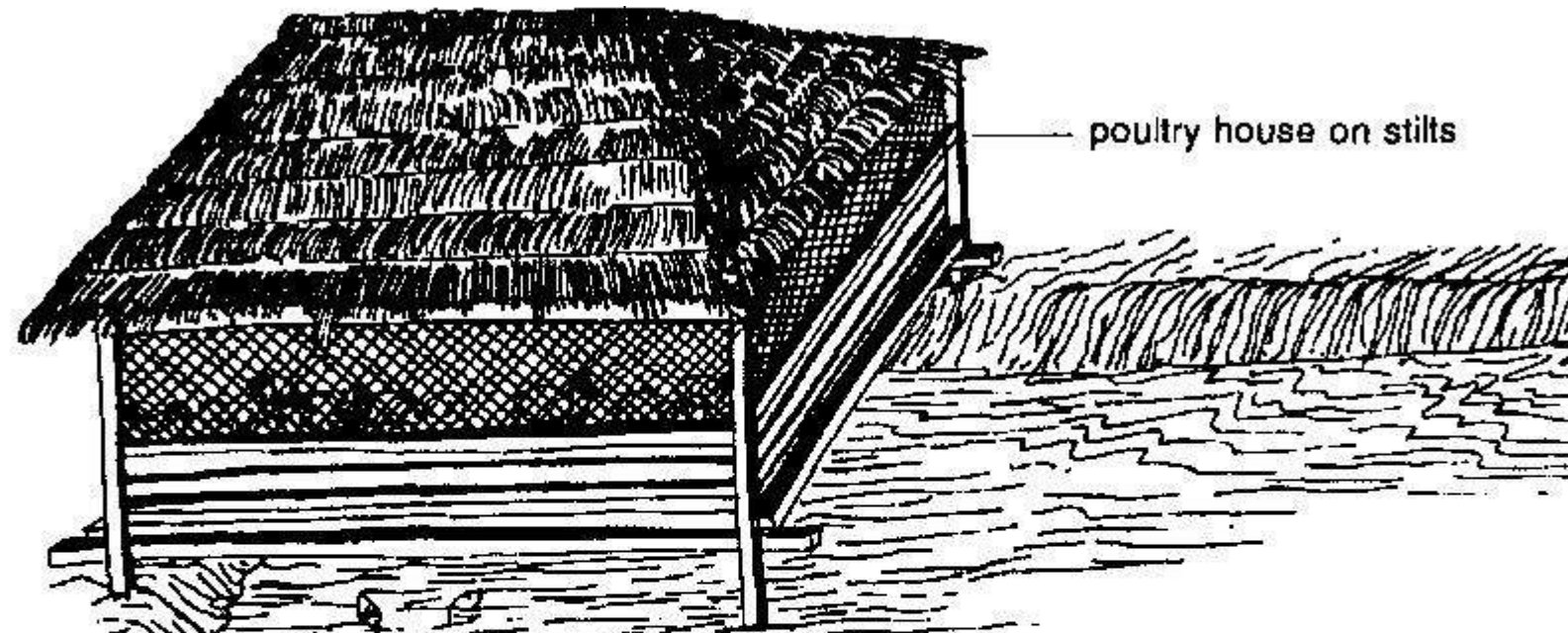
Store the litter **in** a dry place and apply it to the pond at the rate **of** 15-20 kg/ha per day.

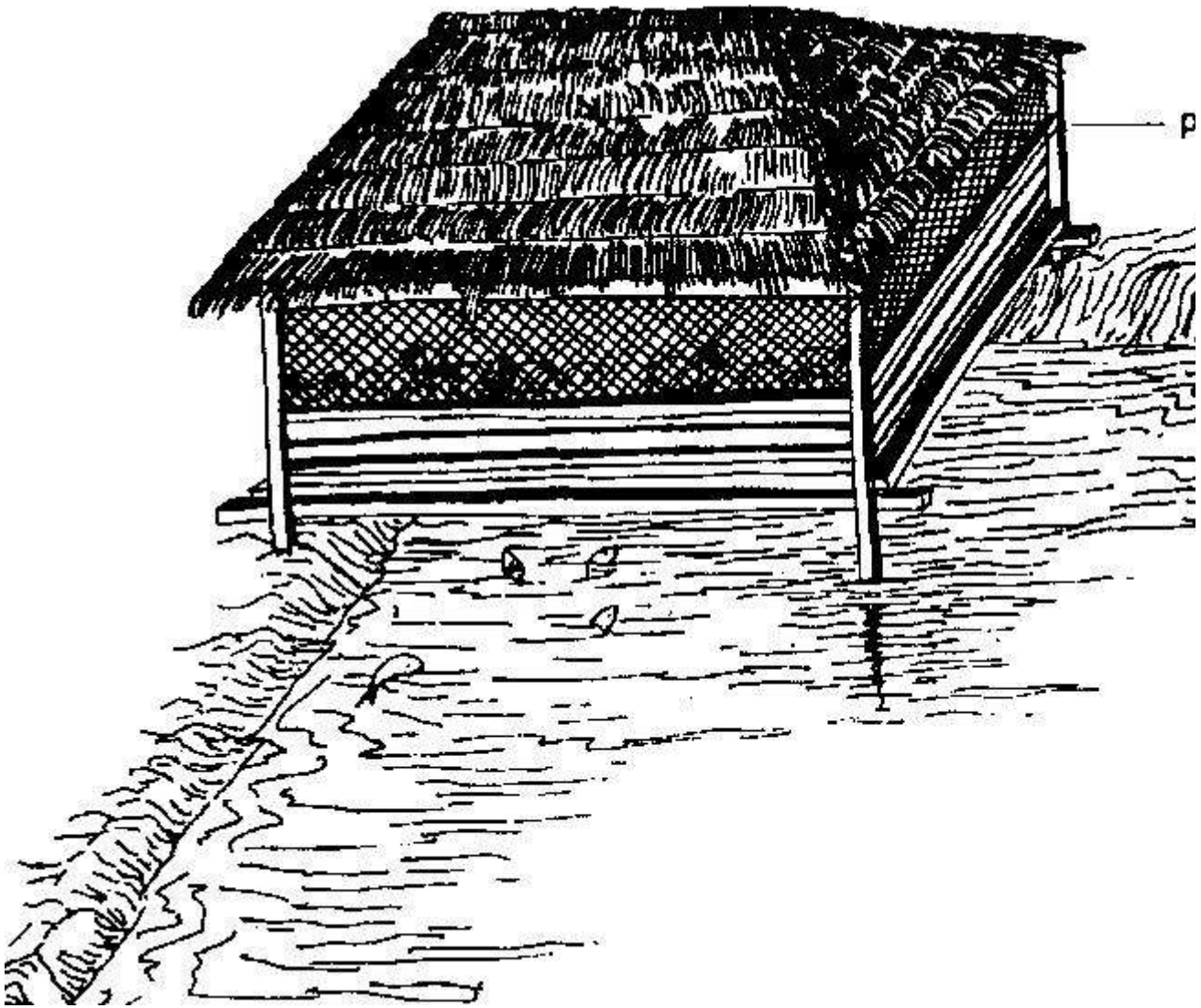
Slatted floor system

Build a poultry house on stilts over the pond. Build the floor out **of** slatted bamboo or slatted wood so that the bird droppings fall directly into the pond. The birds can be kept **in** cages or allowed to move freely inside the poultry house. pond

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Pond

Note

Do not apply litter when algal blooms appear at the surface **of** the pond.

Composite fish culture

Fish ponds are a valuable source **of** protein and ready cash. Maximize production from your fish pond by raising combinations **of** between 3 and 6 complementary fish species which make best **use of** your pond's resources.

Pond preparation New ponds should be dug from clay loam soils. Avoid digging the pond on sandy soil.

- Narrow, rectangular ponds are easiest to manage. Allow for 0.2-0.4 ha **in** surface area and sloping **in** depth from 1.5 m to 2.5 m.
- Build the pond where it will be exposed to direct sunlight. Shade will reduce the pond's productivity.
- Apply lime to prevent fish diseases and parasites.

Manuring

Use raw cow dung at the rate **of** 10-15 tonnes per ha per year.

Add about 2.5 tonnes to the pond 15 days before stocking and the remaining quantity **in** 10-11 monthly instalments. (If mahua has been applied to exterminate weed fish, forego the first application **of** cow dung.)

- Construct a bamboo crib to hold cow dung. Keep the crib filled with cow dung up to the water line.
- Defer application **of** cow dung for a few days if algal blooms appear and water becomes green.
- Add enough cow dung to make the water greenish-brown. This colour indicates there is plenty **of** natural food **in** the water.

Cow dung required (tonnes/ha/year)

Newly constructed pond	5.6 to 6.6
Pond which has been in use for some time	5.0 to 5.6
Old pond	0.7 to 0.5

Lime dosage

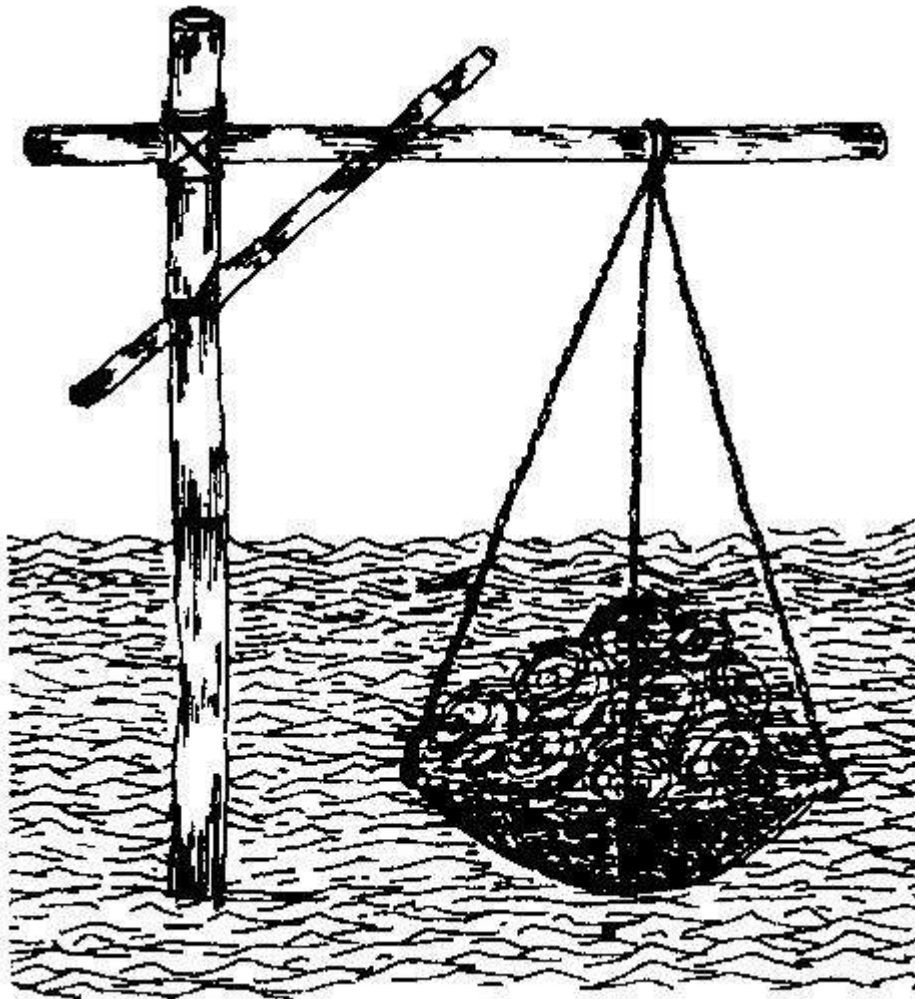
Highly acidic	2,000 kg/ha
Near neutral	500 kg/ha
Mildly alkaline	200 kg/ha
Highly alkaline	no lime

Use litmus paper to test your pond's acidity.

Stocking

Note

Variation **in** pH is harmful to fish. Lime your pond one week before manuring.



Crib to hold cow dung

Fish fingerlings for stocking can be purchased from government fish farms or from private growers. Stock **in** October-November.

About 10-cm-long fingerlings should be used for stocking. A pond with 2-3 m depth should be stocked at 6,000-10,000 fingerlings per ha. Depending upon the availability **of** fingerlings, the pond can be stocked with 3, 4, or 6 species **in** the following ratios:

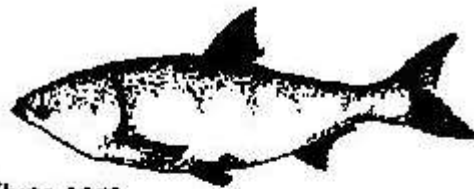
Note

Fingerlings should be transported **in** cool weather. **In** hot weather, transport **in** the early morning or evening.

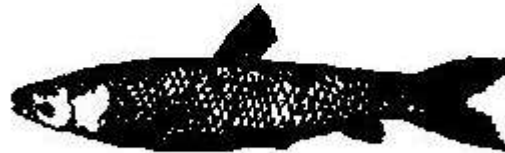
Species combinations and their stocking ratios

	3-species	4-species	6-species
Catla	4	3	1.5
Rohu	3	3	2.0
Mrigal	3	2	1.5
Common carp		2	2.0
Silver carp			1.5
Grass carp			1.5

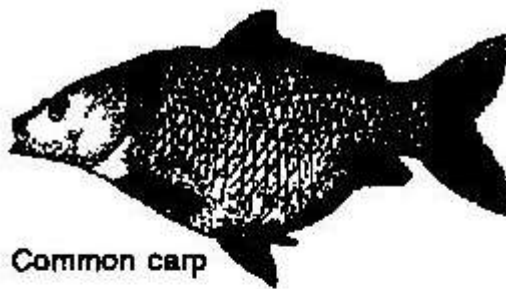
Introduction of fingerlings



Silver carp



Grass carp

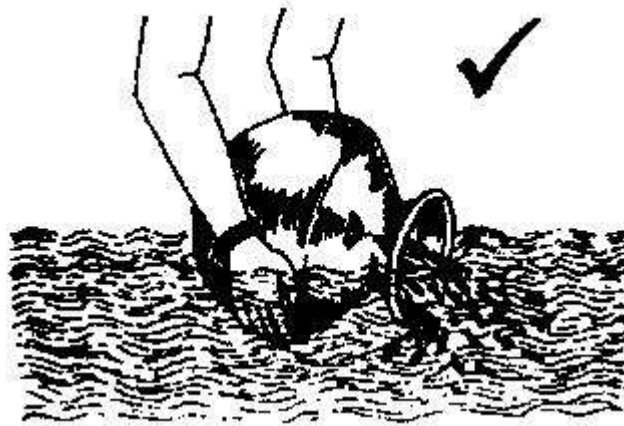


Common carp

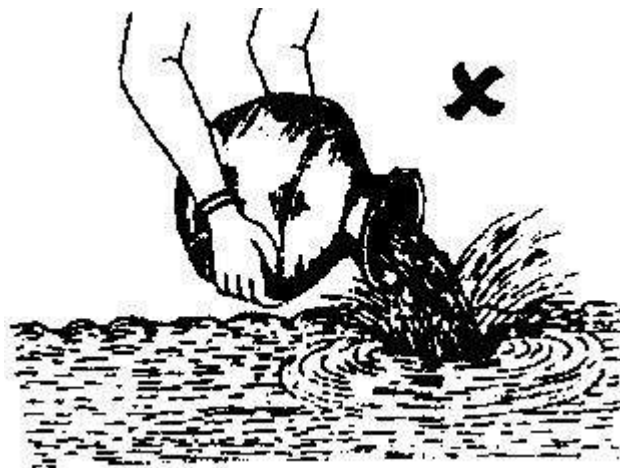


Catla

Fish



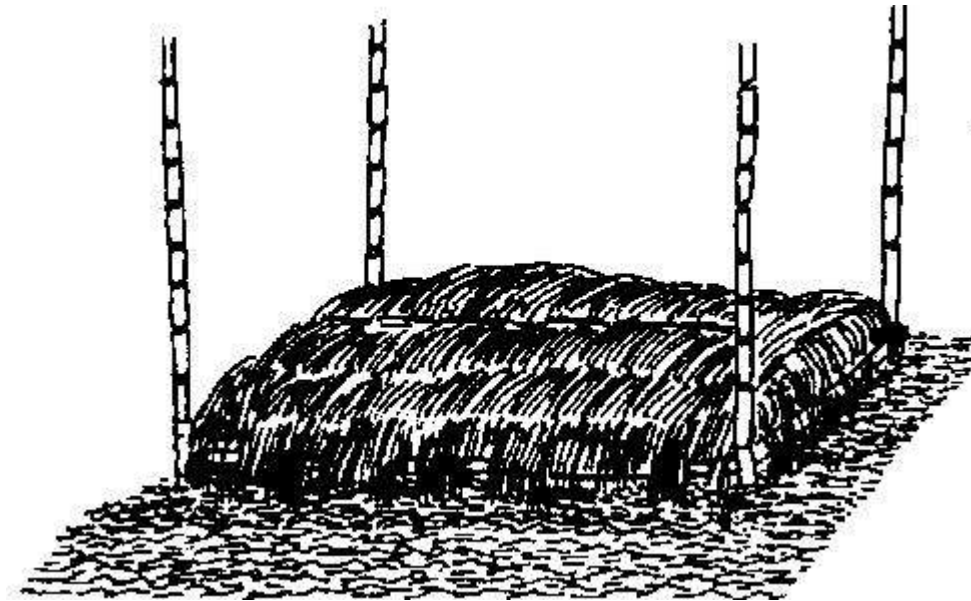
Right way-Release the fingerlings by gently tipping the plastic bag or container into the water.



Wrong way-Fingerlings should not be poured into the pond.

Feeding

Fish eat tiny plants and animals zooplankton and phytoplankton-which float **in** the water. Your goal is to maximize the growth **of** this natural food through proper management, which includes fertilizing the pond. Your fish will also need food supplements **of** oil cake (e.g., mustard or groundnut oil cake)



Frame filled with aquatic weeds to feed grass carp and rice bran.

Grass-eating fish, such as grass carp, will need a regular supply **of** weeds.

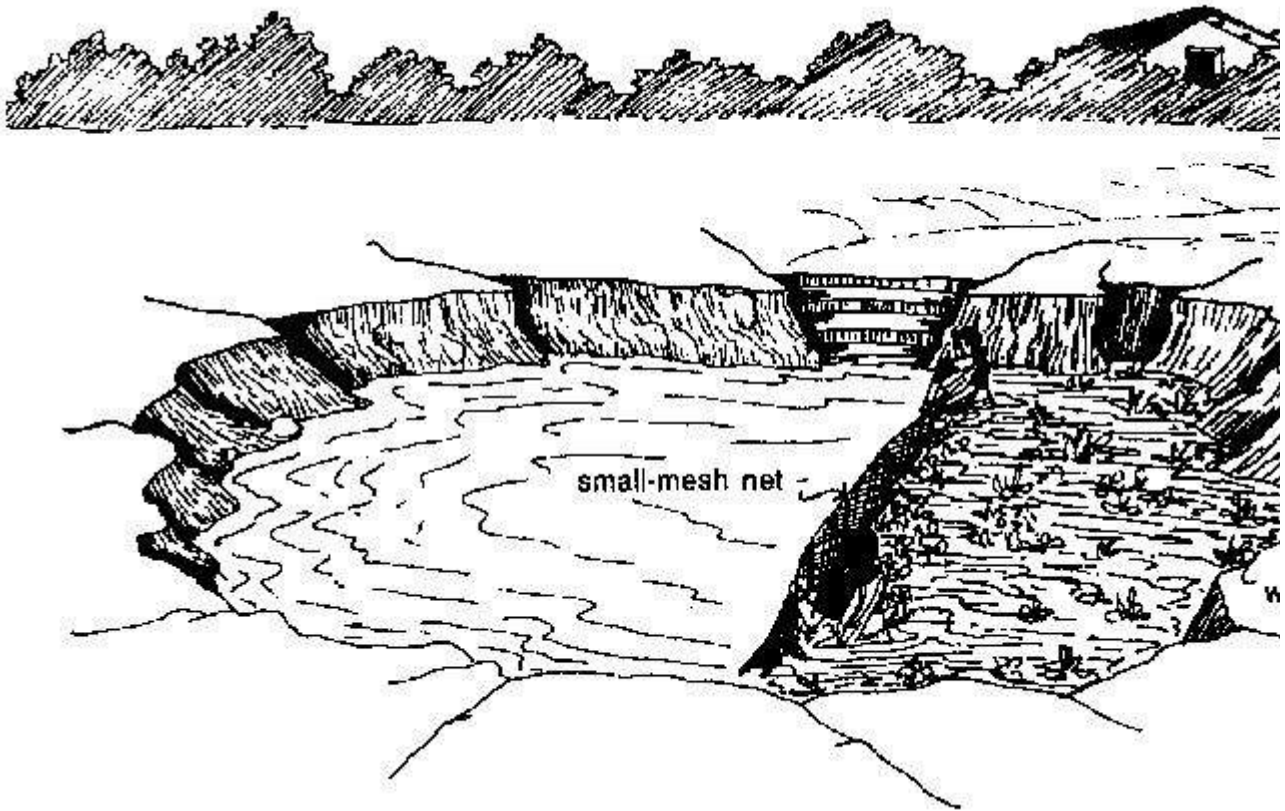
Part **of** the feed mixture can be broadcast at a fixed place. The rest **of** the feed can be made into a dough ball suspended **in** the water just below the surface.

To feed grass carp, suspend aquatic weeds on a frame made **of** bamboo and rope.

Weed clearing

Weeds take up nutrients, harbour harmful insects, consume oxygen, and block sunlight. They must be removed from the pond.

- Floating weeds, such as water hyacinth and pistia, can be removed by hand.
- Lighter floating weeds, such as spirodella, lemna and wolfia, can be removed by dragging a rope or small-mesh net across the pond surface.



Removing surface weeds

- Underwater weeds can be pulled up by dragging a length **of** weighted barbed wire Gr chain along the bottom **of** the pond

Rake your pond

Rake the bottom **of** your pond periodically to release nutrients. This can be done by dragging bricks along the bottom.

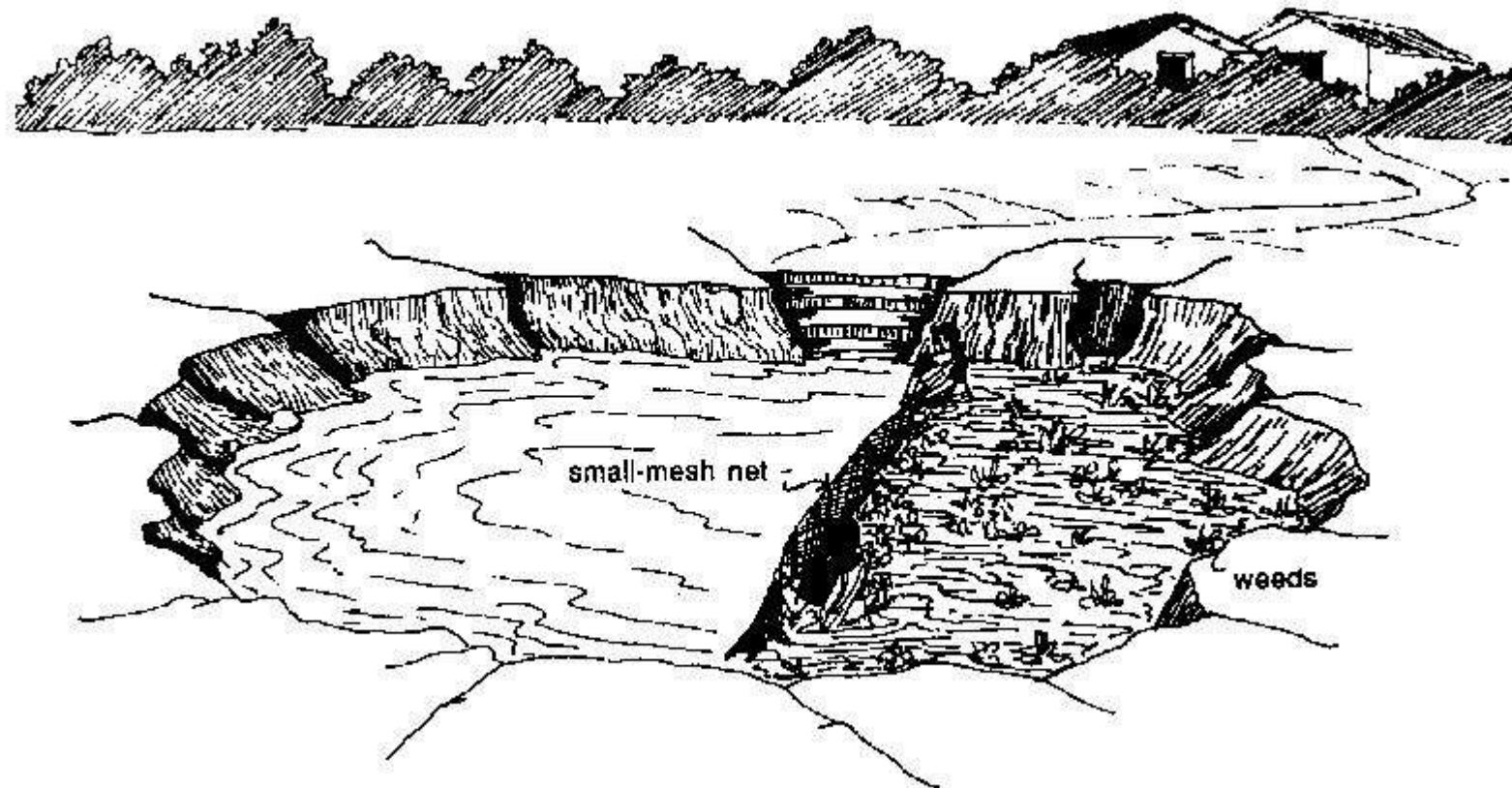
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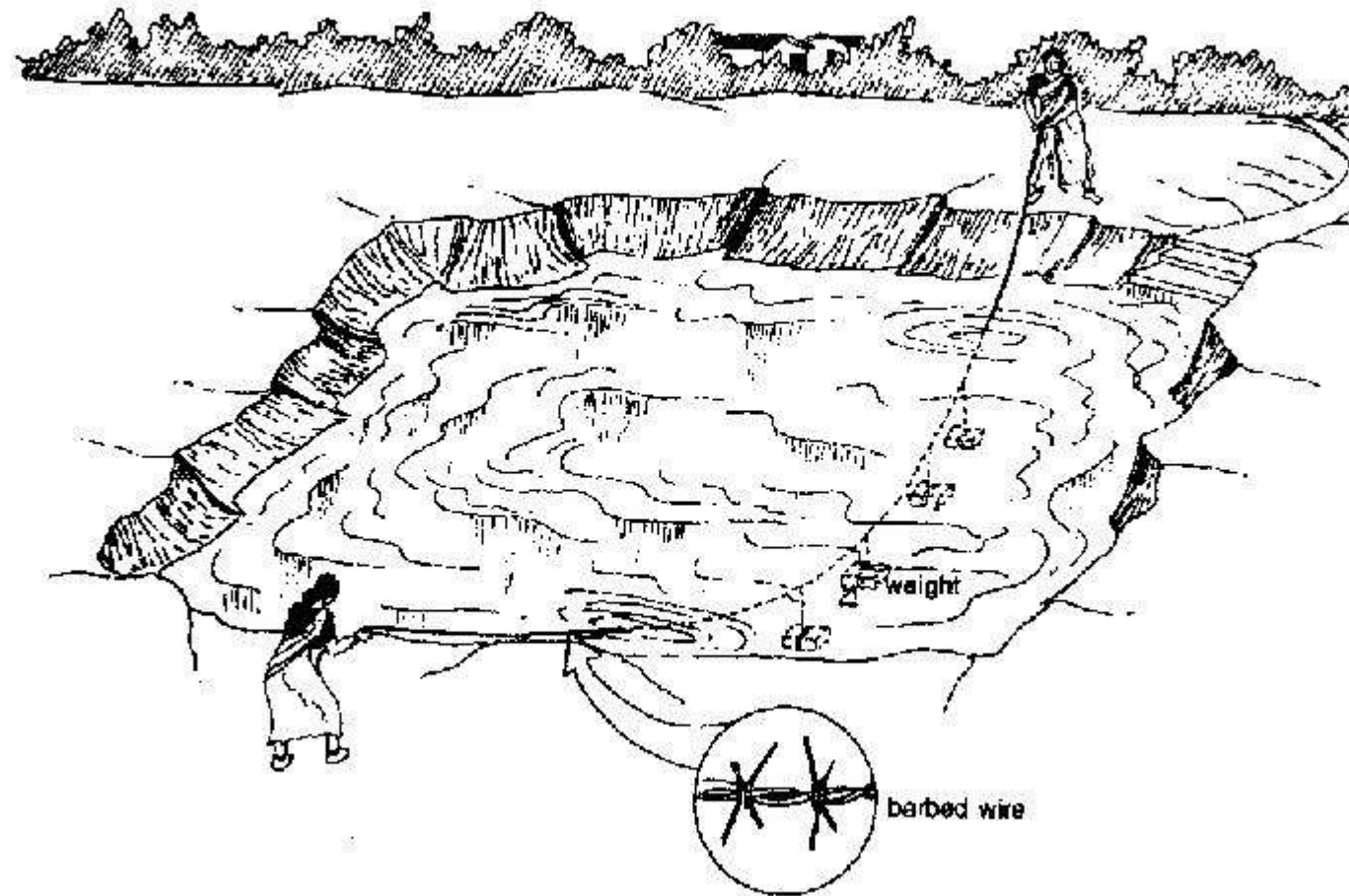


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Dragging weighted barbed wire to remove underwater weeds

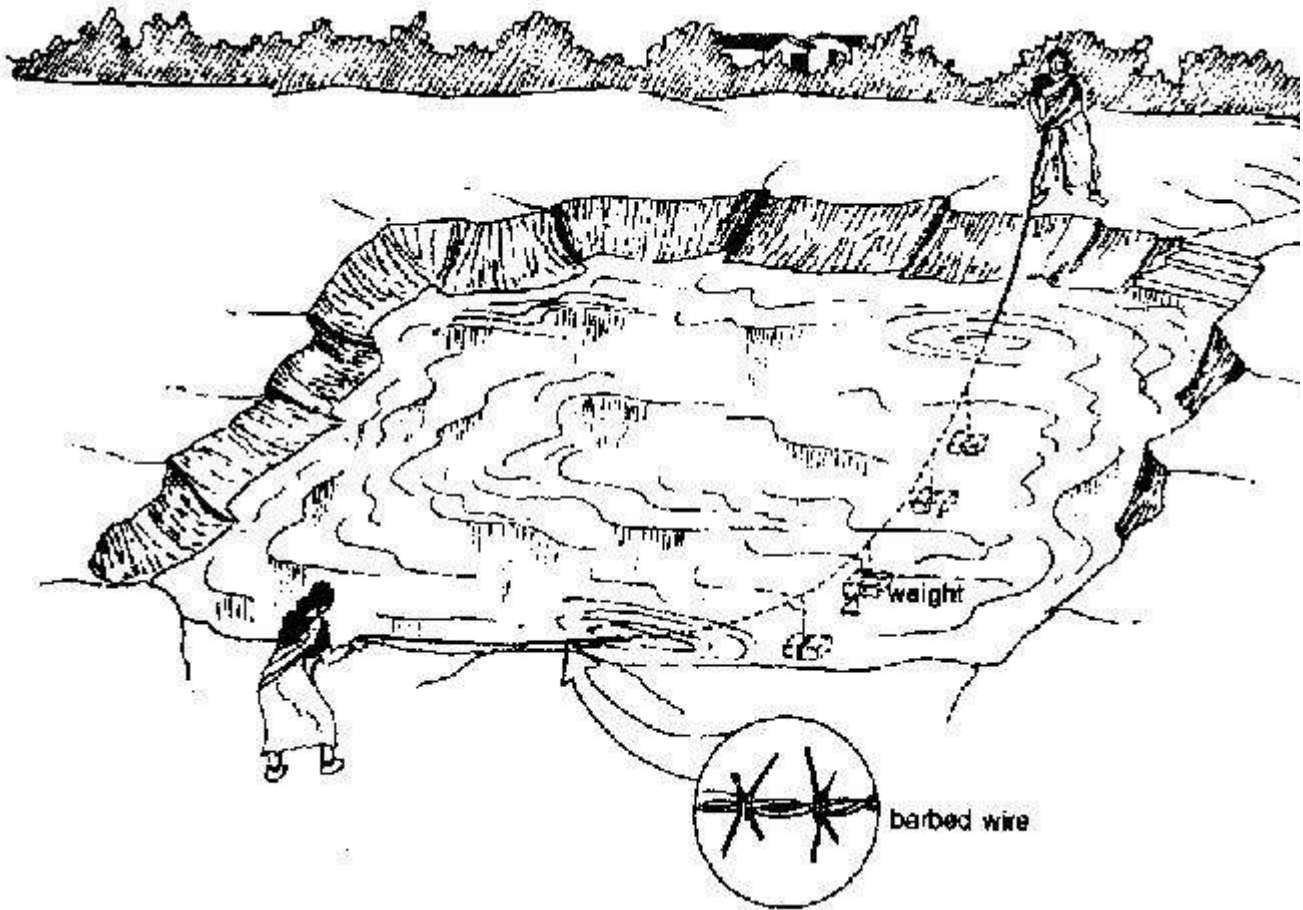
Note

After applying mahua, wait before introducing your new species. Wait longer if a heavy dose of mahua cake is given. The minimum waiting period is 24 hours.

Undesirable fish

Eradicate predatory or "weed" fish with mahua oil cake. Broadcast soaked mahua oil cake uniformly over the pond at the rate of 2-2.5 tonnes per hectare of pond surface, with a pond depth of 1 metre. Mahua oil cake is available in the market. Fish killed by mahua oil cake can be eaten.

Problems and solutions



Dragging weighted barbed wire to remove underwater weeds

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Problems and solutions

If water level drops due to excessive evaporation	- add water to the pond.
If fish come to the surface with their snouts protruding for air (moat obvious	- stop applying manure and stop supplementary feeding.
	- add fresh water to the pond. ing from the water, gulp
	- beat the surface of the water with bamboo poles.
In the early morning)	- cut banana trunks into small bits and scatter them on the hand surface to help reduce acidity.
	- pull a drag-net through the pond several times for aeration.
	- apply potassium permanganate at 1 to 2 mg per litre.
	- apply lime at 300 to 500 kg per ha of pond surface.
If algal bloom forms	- release silver carp yn the pond, 500 per ha of pond surface.
	(Average weight of silver carp should be 100 9.)
If birds are eating your fish	- install scarecrows or other bird-scaring devices.
If your fish are being taken	- watch your pond more closely.
	- float branches in the pond. This will prevent netting.
If fish become diseased	- net out the diseased fish and have them examined at the nearest government fisheries office for possible remedial measures.

Harvesting

Harvest the fish after one year when they have reached a marketable size **of** 0.6-1 kg If

the pond is threatened by flood, drought, or disease, consider harvesting early When netting, start from the deep end **of** the pond and drag the net slowly toward the shallow end

Cost and return from a one-hectare pond

Oil cake (3,000 kg @ Rs 5/kg)	15,000
Rice bran (3,500 kg @ Rs 2 50 /kg)	8,750
Labour (2 people) 360 person-days	7,200
	30,950
Interest 15%	4,642
	Rs 35,592
Income	
Sales of 4,000 kg of fish @ Rs 22/kg	Rs 88,000
Net Profit	
(Rs 88,000 - Rs 35,600)	Rs 52,400

Sources: Central Institute **of** Fisheries Education, Bombay and Dr. V. R. P. Sinha and Nirmal K Thakur

Paddy - fish culture

Fish raising and paddy growing make a profitable on-farm combination. The system described here produces two crops **of** paddy tall variety **in** the wet season and a higher yielding variety **in** the dry season and a single crop **of** fish.

Fish species mix and stocking rate

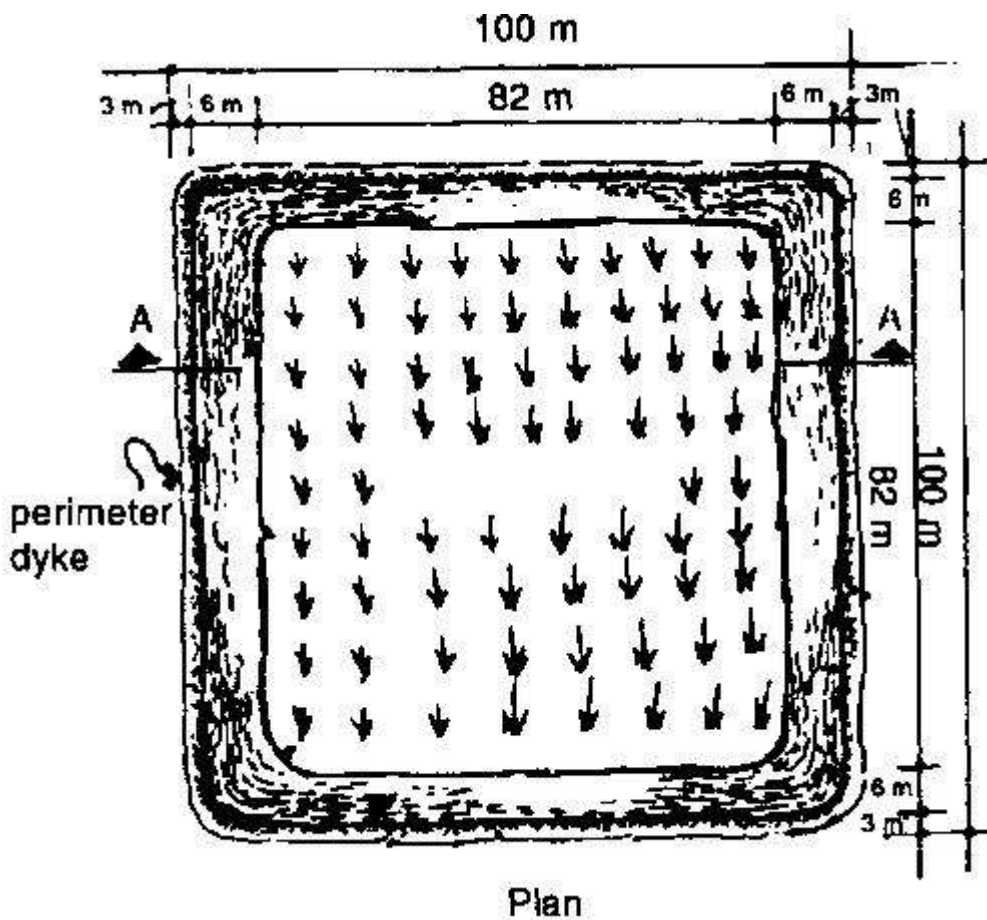
Stock rohu, catla, mrigal, or minor carp at the rate **of** 4,000/ha per ha. The species mix should include 25 percent surface feeders, preferably catla, which are readily available; 30 percent column feeders, such as rohu; and 45 percent bottom feeders, such as mrigal or beta. Prawns also grow well **in** paddy-fish culture plots.

Fingerlings can be obtained from government fish centres or from local private dealers. Stock the fish when the water level rises over the paddy growing area (July-August).

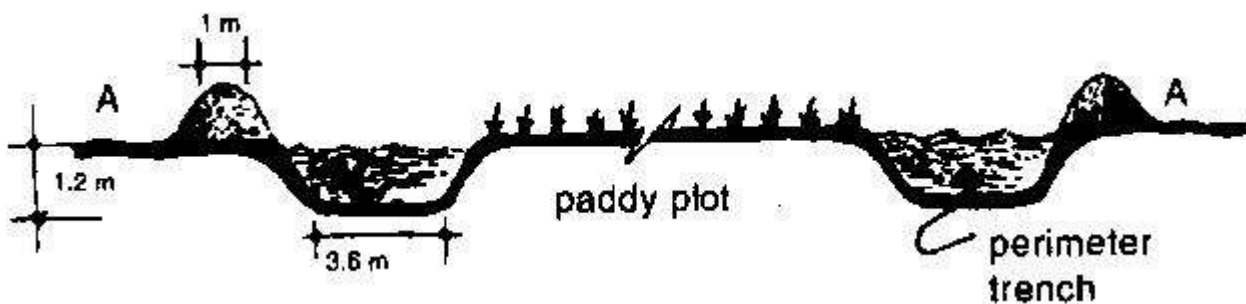
Selection **of** site

Low-lying areas with high rainfall (above 800 mm) are well suited to paddy-fish culture.

Trench design and construction



Top view



Cross-section view

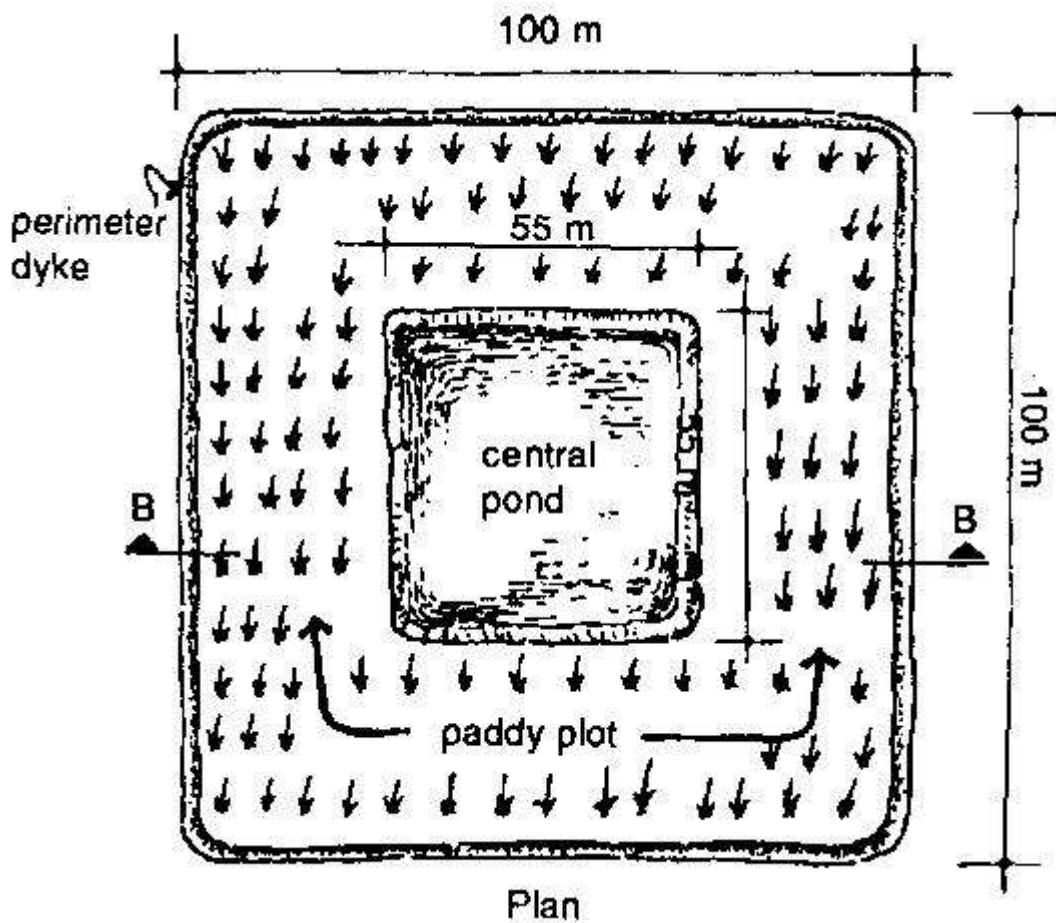
Perimeter type

Place the paddy growing area **in** the centre. The paddy growing area should slightly slope on all sides toward a perimeter trench.

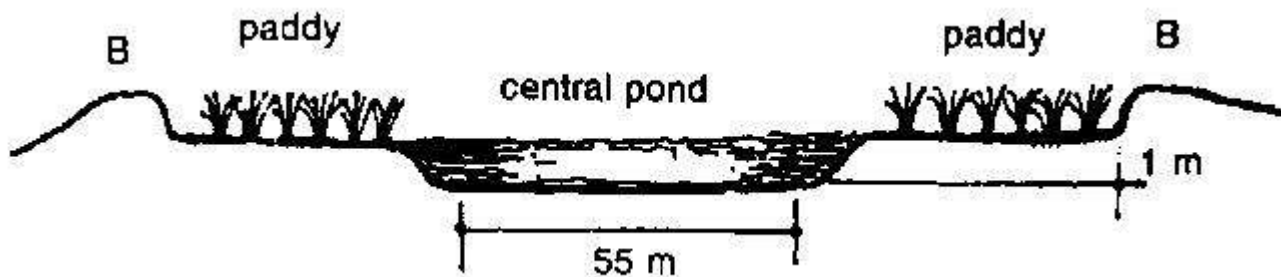
Central pond type

In this design, the paddy growing area drains into a central pond.

Lateral trench type



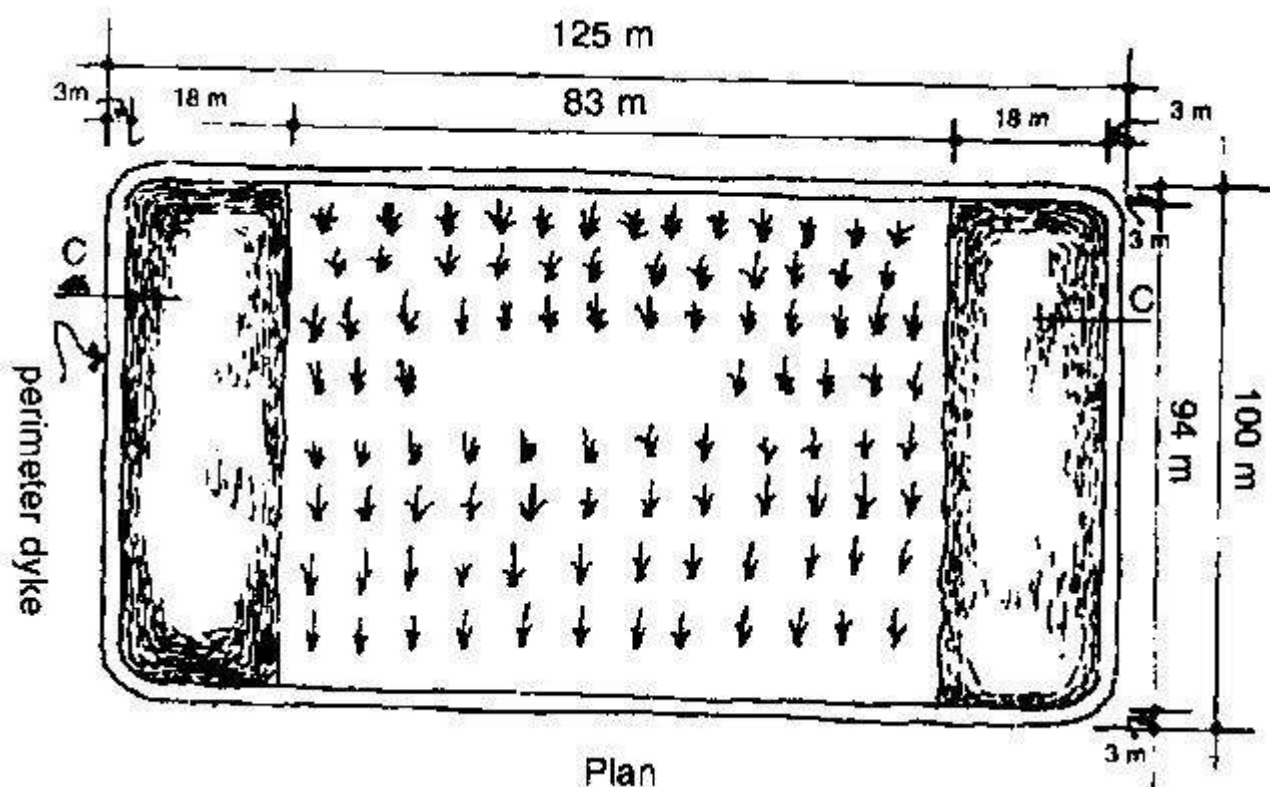
Top view



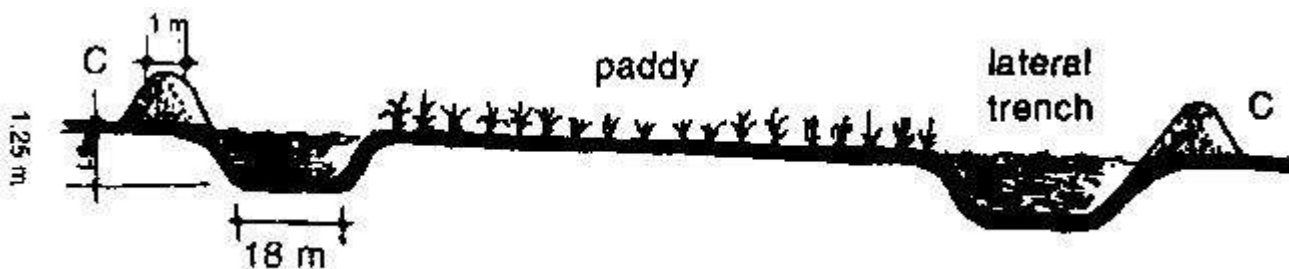
Cross-section view

Dig a trench at one end **of** a moderately sloping paddy field. Or dig two trenches or ponds at opposing ends **of** the paddy growing area. The total water area should be about one-third the land area.

The actual shape **of** plots can vary according to land contours and topography.



Top view



Cross-section view

Note

High yielding varieties should not be grown **in** the wet season. The water level maintained for the high yielding varieties is too low for fish cultivation (2.5-3.0 cm).

Note

To protect your new rice plants, **use** bamboo traps to remove crabs.

Fish feeding and management

For better growth, feed the fish mustard oil cake and rice bran (one part oil cake to one part rice bran) at the rate **of** 2-3 per cent **of** fish body weight.

- Feed from bamboo trays each day.
- If available, feed shelled mollusc meat to your prawns.

- Periodically catch fish to monitor their health and growth.
- Test the pond water with litmus paper. If it is acidic, add lime at the rate **of** 100 kg per hectare to the trenches or ponds only (not to the paddy growing area).

Fish weigh 2-3 g at the time **of** stocking and 200-500 g at harvest.

Paddy varieties

- Choose a deep-water paddy variety for the wet season.
- Choose a short-duration, higher-yielding variety for the dry season crop.

Paddy preparation

Wet season crop

- Clean the plot.
- Add cow-dung (4,000-5,000 kg/ha). **Use** sewage water if available.
- Plough the plot thoroughly.
- After first rain (May-June), sow deep-water paddy seed.

Dry season crop

- After harvest (December-January), clean the plot once again for the second crop.
- Plough the plot repeatedly.
- Apply basal fertilizer during final harrowing at the rate **of** 10 kg N, 30 kg P₂O₅, and 30 kg K₂O per ha. If available, apply sewage water **in** place **of** NPK.
- Transplant 2-3 seedlings per hill. Keep 20-30 cm space between hills and 20 cm space between the rows.
- Irrigate with freshwater from adjacent ponds or trenches or with sewage water.
- Keep 5-7 cm **of** water **in** the paddy plot.
- Remove weeds at the time **of** tillering.
- Apply the second dose **of** fertilizer at tillering stage (30 kg N/ha) and the third dose before panicle initiation (development) stage (15 kg N/ha) or add sewage water, if available, from tillering to panicle development (booting) stage.
- Irrigate the plot as needed.

Fish harvesting

Around the time **of** the deep-water paddy harvest, when the plot gradually dries up (December-January), the fish take shelter **in** the trench or pond. Fish harvesting should start shortly after the first paddy harvest. Fish that have reached 200-500 g should be taken out at fortnightly

intervals by drag netting. **In** time, the water **in** the trenches and ponds will be used up to irrigate the second paddy crop. Remove the remaining fish by hand.

Note

Build an earthen ridge between the pond and paddy growing area to prevent pesticide from getting into the pond water.

Cattle fish culture

Two for one

A one-hectare fish pond needs about 10-15 tonnes **of** dung and urine per year to maintain its fertility. New ponds need higher doses **of** dung and urine. **In** general, the dung and urine **of** two cattle are sufficient to maintain a one-hectare pond.

Caution

Your pond water should be brown. If the water suddenly turns dark green because **of** algal growth, stop the inflow **of** dung and urine until the water turns brown again. Stop the flow **of** dung and urine during persistent cloudy weather (2-3 days **of** continuous cloudiness). You do not have to stop the flow **of** dung and urine during rain.

Raising fish and cattle together is quite profitable. Although wastes from cattle are not as rich as wastes from poultry and pigs, cattle farmers can still **use** cattle dung and urine to maintain a fish pond.

Cattle waste as pond fertilizer If you own cattle, construct a shed close to your pond. The shed should have a bricklined floor with good drainage toward the

Dung and urine slurry

As a better alternative, mix dung and urine thoroughly, dilute with water and, using a bucket, evenly broadcast the mixture into your fish pond. Dung **in** the form **of** biogas slurry is even better. Apply 80-120 kg **of** fresh slurry per hectare **of** pond each day. (See Biogas as a **rural** energy source.)

Production

About 2,500-3,000 kg **of** fish can be produced from one hectare **of** pond each year. The cattle provide milk and labour. Buffaloes can also be raised instead **of** cattle.

Duck - fish culture

Benefits **of** ducks

- Ducks contribute to high fish production while producing valuable eggs and meat.
- Ducks loosen the pond bottom, releasing nutrients which increase pond productivity.
- No additional land is required to raise ducks.
- Ducks get 50 to 75 percent **of** their feed from the pond **in** the form **of** aquatic weeds, insects, and molluscs.

- Ducks spread their droppings over the whole pond. This reduces the labour associated with pond manuring.

Ducks and fish make a great combination. Just build a simple duck shelter next to the fish pond and reap the results. Your fish will grow large on duck manure, spilled duck feed, and microscopic animals and plants made plentiful by the presence **of** the ducks. You will harvest fish, duck eggs, and meat while saving on pond fertilizers and supplementary fish feed.

Pond management

- Six- to eight-week-old ducklings should be stocked on the pond.
- Vaccinate them prior to stocking.
- The ducks are likely to prey on small fingerlings. To avoid this, stock the pond with fingerlings more than 10 cm **in** length.

Selection **of** ducks

Indian runner, styles, mete, and megaswari are suitable breeds.

Construction **of** duck house

- Construct a house on the pond embankment to shelter the ducks at night and during egg laying.
- Allow the ducks free access to the pond during the day. It is not necessary to build a fence around the pond.
- Provide about 0.3 0. 5 sq m **of** floor space per bird.

Duck droppings as manure

- Droppings should be collected from the duck house at night and applied to the pond every morning.
- 200-300 ducks are sufficient to manure a 1 ha fish pond.

Feed supplements for ducks.

Supplementary food at the rate **of** 100 g per bird per day can come from household wastes such as kitchen leftovers, rice bran, and broken rice. Put this feed inside the duck house. Do not give ducks spoiled food.

Fish, eggs, and meat

Ducks start layers eggs at the age **of** 24 weeks and continue to lay until the age **of** two years. After this, sell them.

About 3,000 kg **of** fish, 12,000 eggs, and 500 kg **of** duck meat can be produced per hectare **of** pond each year.

Pig - fish culture

Productive combination

A pig attains slaughter size after 5-6 months. Fish culture is normally done for 10-12 months. Therefore, two lots **of** piglets can be raised along with one harvest **of** fish.

A total **of** 4,200 kg **of** pig meat and 5,000-6,000 kg **of** fish per hectare **of** pond can be produced each year. Pigs are fed grasses and other green fodder and kitchen wastes at the rate **of** 1.5 kg per pig per day.

Pigs efficiently convert farm and kitchen refuse into manure which can be used to fertilize fish ponds. Indigenous breeds are hardy and well adapted to local conditions. Exotic breeds are more productive and gain weight faster, but require more care than indigenous breeds.

Housing

Build a pig pen with 1 to 1.5 sq m **of** floor space per animal on the pond embankment. The floor should be cemented with drainage toward the pond. About 30-40 pigs should be raised per hectare **of** pond area.

Selection **of** breeds

Quick growers and prolific exotic breeds, such as Large White, Yorkshire, Landrace, etc., are preferred. Do not allow exotic breeds outside their pen. Indigenous breeds can be allowed to forage outside, around the pond during the day. If pig rearing begins before fish stocking, it is not necessary to apply basal manure to the pond. (See Composite fish culture.)

Note

Do not allow the pig excrete into the pond if the water turns dark green.

Poultry, pigs, and fish

You can combine poultry and pig raising by housing poultry above the pig pens. The poultry droppings and spilled feed fall through a slatted floor into the pig pen. The pig droppings can be washed into the pond.

Sources: Dr. S. D. Tripathi, Dr. B.K. Sharma and Dr. Manak K. Das

Horticulture on dykes

Dykes cover a large area on many farms. Despite its potential for production, dyke land is most often underutilized. The following are some suggestions for making **use of** dykes.

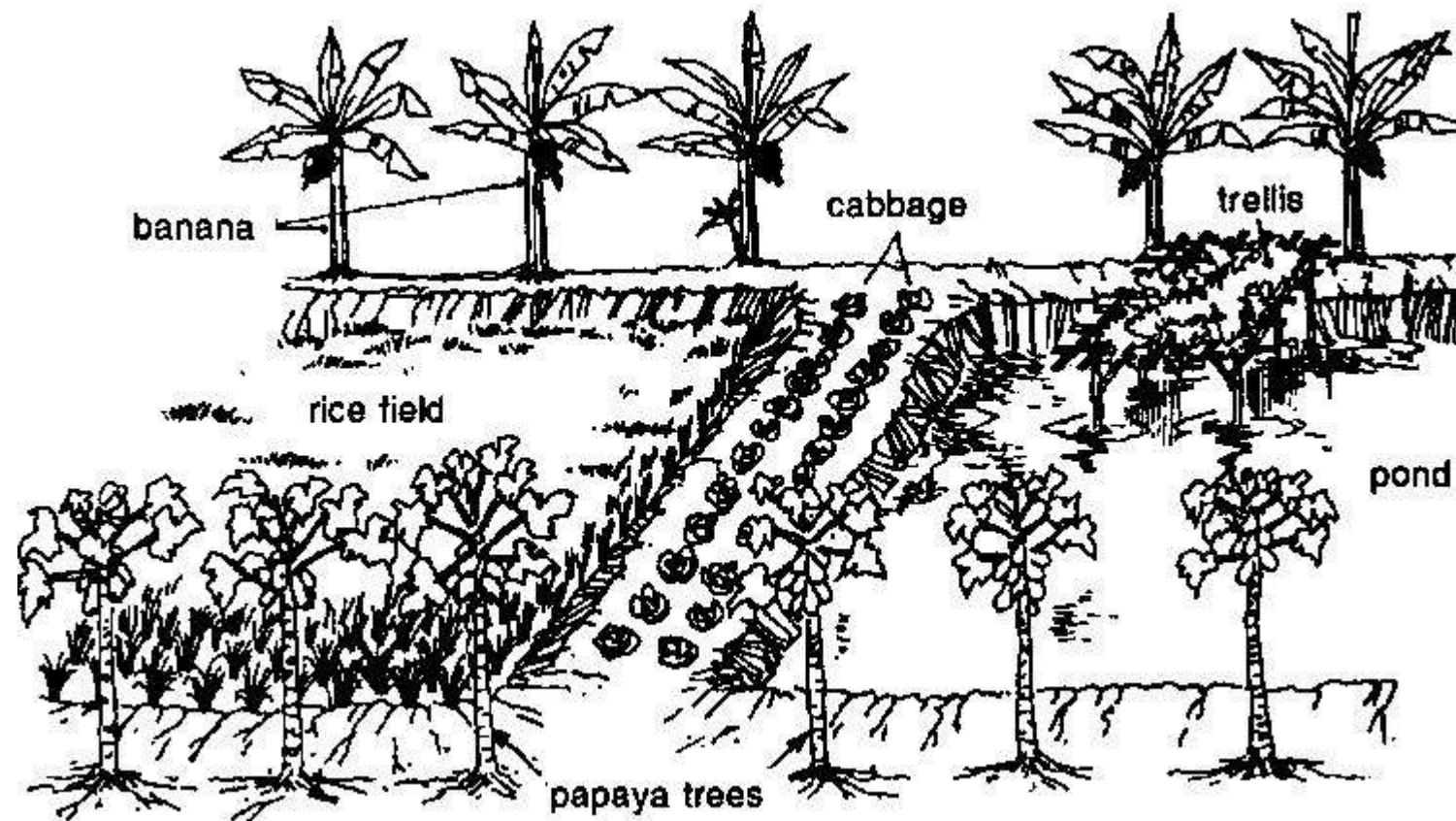
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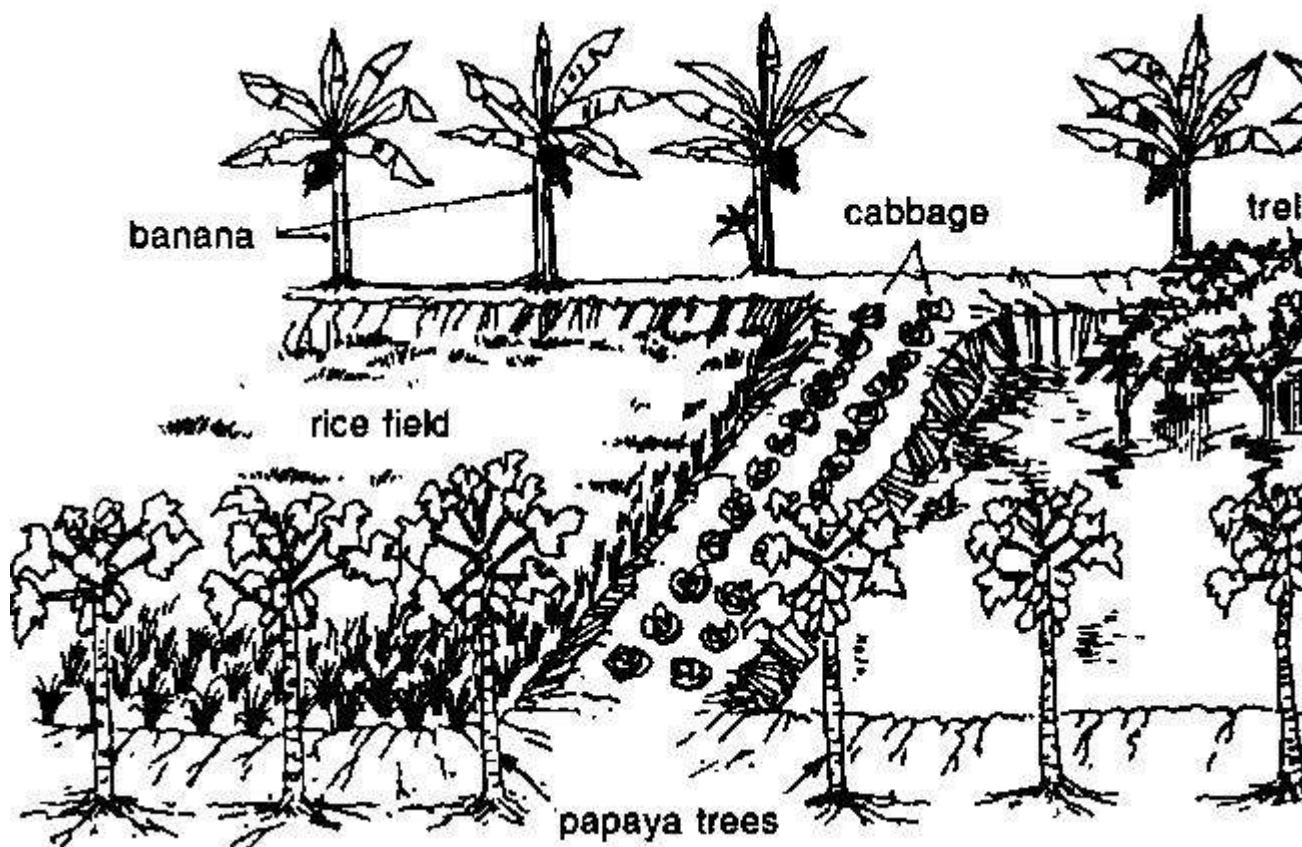
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Dyke planted with cabbage

Fruit trees

Dig pits (50 cm in diameter x 30 cm deep) and fill them with compost and soil. Plant papaya saplings (April-May) and banana and citrus (June-July). Water regularly. Maintain 3 banana plants in one pit. Harvest papaya after 6 months.



Dyke planted with cabbage

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Dig pits (50 cm **in** diameter x 30 cm deep) and fill them with compost and soil. Plant papaya saplings (April-May) and banana and citrus (June-July). Water regularly. Maintain 3 banana plants **in** one pit. Harvest papaya after 6 months.

Creeper plants

Dig small pits (25 cm **in** diameter x 10-15 cm deep) and add compost. Plant gourd seeds (2-3 **in** each pit) **in** March. Build a bamboo trellis for creepers over your pond. Harvest from May onwards.

Leafy vegetables

Cultivate leafy vegetables like amaranthus, water bindweed, and Indian spinach during summer.

Winter crops

Cultivate and dress the top soil with compost. Build small mounds spaced 40-cm apart. Transplant early varieties **of** cabbage and cauliflower **in** late August or early September. Add water as needed. When plants reach 15-20 cm, apply fertilizer (Sufala, 20-25 g to each plant). Repeat 25-30 days after transplanting. Begin harvesting 65-70 days after transplanting.

Part way through harvesting the first crop, transplant cabbage and cauliflower on the intermediate harvested space. Manure and water the same as for the first crop. The second crop will be ready by February. Intercrop with spinach and tomato.

Fish culture with waste leaves

Use waste leaves **of** horticultural crops and banana leaves as feed for grass carp. (See related topics **in** this manual.)

Contributor. Dr. A. K Dutta

Solar drying of fish

Village used to sun-drying clothes, fruit, vegetables, or cow dung cakes, can easily learn to dry fish for home consumption and sale.

Fish are more difficult to dry than fruits and vegetables. However, with the proper technique and some practice, fish can be dried with little effort and at low cost. Dried fish usually fetch a good price **in** the market.

Preparation Fish can be divided into two categories:

Small fish white baits, silver bellies, small sardines, prawns, soles, etc.

Medium and large fish mackerels, jew fish, croaker fish, pomfrets, seer, catfish, tuna, shark, etc. The process for drying small fish is different from drying medium- and large-size fish. However, all sizes **of** fish must be fresh and odour-free. Sundrying takes two to three days for an average 8 to 10 hours a day, with a maximum temperature **of** 38°C. Properly dried fish should contain 12 to 15 percent moisture.

Small fish

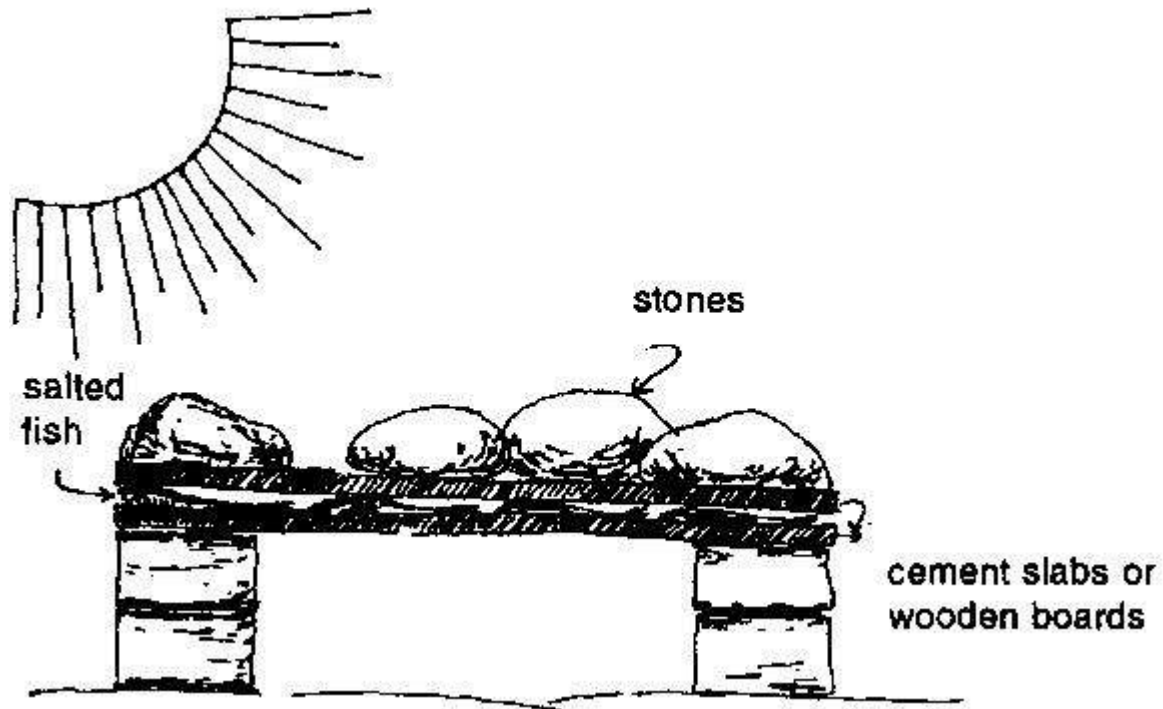
- 1 Wash **in** clean water to remove dirt and sand.
- 2 Allow excess water to drain out for 30 minutes.
- 3 Spread washed fish on mats, split bamboo, or gunny bags, hang them from a line to dry.
- 4 Allow the fish to dry **in** the sun.
- 5 Occasionally, turn the fish so that both sides dry.
- 6 Pack the dried fish **in** polythene bags.
- 7 Put the bags **in** plastic or wooden containers.
- 8 Store dried fish **in** a cool, dry place.

Medium and large fish

- 1 Cut off the head.
- 2 Slit open the belly and remove the guts.
- 3 Wash the fish **in** water and remove the blood.
- 4 Make a mixture **of** common salt using 1/3 fine salt and 2/3 coarse salt.
- 5 Salt the fish-one part salt to four parts fish (1:4) for large fish and one Part salt large fish and one

part salt to eight parts fish (1:8) for medium fish.

6 Leave the fish to absorb the salt for about on hours.



Solar drying of fish

7 Sandwich the fish between slabs of cement or wooden boards piled with weights.

8 After one day, turn the fish.

9 Wash the salted fish in 3.5 percent salt solution.

10 Dry the fish by spreading them on mats.

11 Pack the dried fish in polythene bags and store them in a cool, dry place.

Contributor: Dr. D. R. Rao

Appendices

Glossary of local terms

General

Local terms English

bidi local cigarette, cheroot

chapaties thin, unleavened wheat

bread

chulha stove

chutney paste

dal pulse

dhania powdered coriander

seeds

garam masala whole spice

ghee butter oil

godown storage

gunny cloth coarse cloth made from

jute

haldi turmeric

jaggery brown sugar

jeera powder cumin powder

khichiri cooked mixture

khurpi hand glove

mahua *Bassia latifolia*masaa mixture **of** spicesmegaswari name **of** Indian breed **of** duck

murreh Indian buffalo breed

pucca cemented floor, or any solid construction usually **of** manufactured materials

sutli string

tulsi basil

Multipurpose trees

Local terms	English name	Botanical name
anjan		Hardwickia binata
aonla		Embllica officinalis
ardu		Ailanthus excelsa
arvi	colocasia	
babul	Israeli babul	Acacia tortilis
ber	Indian jujube, Chinese date	Zizyphus mauritiana
brij babul		Dichrostachys cinerea
casuarina	sea oak	Casuarina equisetifolia
desi babul		Acacia nilotica
gliricidia	gliricidia	Gliricidia septum
kathal	jack fruit	Artocarpus heterophyllus
margosa	neem	Azadiracta indica
seesam, shisham	rosewood	Dalbarpta sissoo
sejana, sainjana	drum stick, horseradish tree	Moringa oleifera
siris, desi serfs, kala siris		Albizia lebbek
shahtut	mulberry	Morus alba
subabui	leucaena	Leucaena leucocephala
vilayati babul	mesquite	Prosopis juliflora

Fruits, vegetables, and grasses

amla		Phyllanthus emblica
amrapalli	mango variety	
arhar	pigeon pea	
bajra	pearl millet	

bakla	broadbean	
berseem	Egyptian clover	Trifolium alexandrinum
bhel		Semcarpus anacardium
bhindi	lady finger	Abelmoschus esculentus
brinjel	eggplant	Solanum melongera
chana	Bengal gram	
doob grass	Bermuda grass	Cynodon dactylon
guar	Cluster bean	Cyamopsis tetragonloba
Jangli pikvan		Tylophora indica
jowar	sorghum or great millet	
karanj		Pongamia pinnate
khas		Vetiveria indica
knol khol	type of cabbage	
kulfa	portulaca	Portulaca oleracea L.
Iobia	cowpea	Vigna sinensis
lucerne	bur clover	Medicago hispida
methi	fenugreek	
mung	green gram	Phaseolus aureus
palak	spinach	
poi	Indian spinach	
ragi		Brassica juncea
raima	lima bean	
sem	carpet legume	Dolichos lablab
Sudan grass		Sorghum sudanense
toria	Indian rape	Brassica compestris

		var
tulsi	basil	
urad	black gram	Phaseolus mungo

Banned and not approved pesticides

S. No.	Name <u>of</u> pesticide not approved for <u>use</u> (as <u>of</u> Feb. 28,1994)
1	Calcium Arsonate
2	EPM
3	Azinphos-Methyl
4	Lead Arsonate
5	Mevinphos (Phosdrin)
6	2, 4,5-T
7	Carbophenothion
8	Vamidothion
9	Mephosfolan
10	Azinphos Ethyl
1 1	Binapacryl
1 2	Dicrotophos
1 3	Thiodemeton/Disulfoton
14	Fentin Acetate
15	Fentin Hydroxide
1 6	Chinomethionate(Morestan)
17	Ammonium Sulphamate
18	Leptophos (Phosvel)

S. No.	Name of pesticide banned for use (as of Feb. 28, 1994)
1	Dibromochloropropane (DBCP)
2	Endrin
3	Pentachloronitrobenzene (PCNB)
4	Pentachlorophenol (PCP)
5	Toxaphene
6	Ethyl Parathion
7	Chlordane
8	Heptachlor
9	Aldrin
10	Paraquat-di-methyl Sulphate
11	Nitrofen
12	Tetradifon
13	PMA
14	Nicotine Sulphate

These pesticides are under fresh review as per the directions **of** the Honorable High Court **of** Rajasthan.

Improved varieties of grasses and legumes in different regions

Species	Variety	Region	Yield lover(green forage <u>In</u> t/ha)
Grasses			
Anjan grass	IGFRI-3108	Dry parts of Maharashtra,	20-30
Cenchrus ciliaris		Rajasthan, Haryana,	
		Bihar and UP	
	IGFRI-3813	Gujarat, Rajasthan	25-30
		Haryana, AP and Bihar	

	CAZRI-75	Extreme dry areas of Rajasthan	10-20
Marvel grass	S-32	Gujarat, UP, Haryana	20-25
Dichanthium		and Maharashtra	
annulatum	S-65	Bihar	15-20
	IGFRI-495-1	Gujarat, Rajasthan	20-25
		AP and Maharashtra	
Orchard grass	S-37 & S-143	High hills of J & K	60-70
Dactylis glomerata		HP and UP. Also in eastern highlands.	
Fescue grass	Delta and	High hills of J & K	40-45
Festuca arundinacea	Kentaki 31	HP and UP. Also in eastern highlands.	
Doob grass	NK-37	Hill and plains of UP	10-15
Cynodon dactylon		Punjab, Haryana, MP and Bihar	
	Bermuda	Coastal regions of	15-20
	coastal	Tamil Nadu, Gujarat	
		Kamataka and Maharashtra	
Nandi grass	Kanjguia	Eastern plains	30-35
Setaria sphacelata			
Denanath grass	IGFRI-2808	Low hills of J & K, HP	50-100
Pennisetum pedicellatum	and PP-47	UP, eastern low hills and eastern plains	
Bahia grass	Common	UP, Haryana, Punjab	20-40
Papsalum notatum	Wallace and Tampa	and coastal Maharashtra Tamil Nadu, Kamataka and Andhra Pradesh	
Guinea grass	PGG 14	In moist places of Gujarat, 50-70	
Panicum maximum	PGG 19	Maharashtra, Tamil	

		Nadu,	
	and Hamil	Kamataka, AP, Haryana,	
		Punjab and UP	
Napier grass	Pusa giant	Whole of India	100-150
Pennisetum	NB-21	Whole of tropical	120-150
purpureum		humid part of India	
	IGFRI	UP, MP, NE hills	110-150
	AP, Punjab and hills of		
	North India		
Legumes			
Red clover	Kenland	High hills of J 8 K,	50-60
Trifolium pretense		HP and UP	
White clover	Kavulchus	High hills of J & K,	60-70
Trifolium repens	and Nordic	HP and UP	
Birdsfoot trifial	Grainger	High hills of J & K,	30-40
Lotus corniculatus highlands		HP, UP and eastern	
Carribbean stylo	Perennial	southern plateau and	15-20
Stylosanthes hamata		dry regions of	
		Rajasthan, Gujarat,	
		Haryana and HP	
Stylo	Shefield,	Eastern low hills and	15-20
Stylosanthes guianensis	Cook and Invader	coastal regions	

Improved varieties of vegetables for nutrition garden

- Vegetable Improved varieties
- Asparagus Perfection and other exotic varieties

Beetroot	Pusa Dark Red, Crimson Globe
Bitter gourd	Pusa Do Mausami, Pusa Vishesh, Coimbatore Long, Arka Harit
Bottle gourd	Pusa Naveen, Pusa Summer Prolific Long, Pusa Hybrid No. 1
Brinjal	Pusa Purple Long, Pusa Kranti, Pusa Purple Cluster, Punjab Bahar
Broccoli	Futura, Premium Crop, Topper, Sparten Early and other exotic vegetables
Brussels sprouts	Hilid's Ideal and other exotic varieties
Cabbage	Golden Acre, Pusa Mukta, Pusa Drumhead, Pride <u>of</u> India, August, September
Capsicum	California Wonder, Yolo Wonder
Carrot	Pusa Kesar, Pusa Meghali, Nantes, Pusa Yamdagi
Cauliflower	Pusa Deepali, Improved Japanese, D 96, Dania, Pusa Snowball 1, Snowball 16
Celery	Clean cut, Golden Self blending, Ford flock and other exotic varieties
Chilli	Pusa Jwala, Pusa Sadabahar, N.P.
Chinese cabbage	Crispy Choy, Pea Choy, Wongbok and other exotic varieties
Clusterbean	Pusa Sadabahar, Pusa Navbahar
Coriander	Local varieties
Cowpea	Pusa Do Fasli, Pusa Komal, Pusa Phalguni
Cucumber	Poinsette, Japanese Long Green, Pusa Sanyog, Poona Khira
French bean	Contender, Pusa Parvati, Kentucky Wonder
Garden bean	Pusa Early Prolific, Rajani, Lal Sem
Garlic	Local varieties
Kale	Exotic varieties
Knol-kohl	White Vienna, Purple Vienna
Leek	Broad London, Large American Flag, Elephant and other exotic varieties
Luffa	Pusa Chikni, Pusa Basdar, Satputia, Cal
Mint	Local varieties
Onion	Pusa Red, Pusa Ratnar, Pusa White Flat, Pusa Madhvi
Okra	Pusa Sawani, Parbhani Kranti, Punjab Padmi ni, Vaishali Vadu
Palak	Pusa Jyoti, All Green

Parsley	Moss curled, Hamburg, Curled leaf and other exotic varieties
Potato	Kufri Chandermukhi, Kufri Chamatkar, Kufri Badshah, Kufri Sheetman, Kufri
Kissan, Kufri Sinduri	
Pumpkin	Pusa Vishwas, Solan Badami, Arka Chandan, Pusa Hybrid No. 1
Radish	Pusa Desi, Pusa Reshmi, Japanese White, Pusa Himani, Pusa Chetaki, White Icicle, Rapid Red-White Tipped
Round melon (Tinda)	Punjab Tinda, Local varieties
Spinach	Virginia Savoy
Summer squash	Australian Green, Pusa Alankar
Tomato	Pusa 120, Pusa Ruby, Pusa Gaurav, Pusa Sheetal, Pusa Early Dwarf
Turnip	Pusa Sweti, Pusa Chandrima, Purple Top White Globe, Snow-ball, Golder ball,
Pusa swami ma	
Watermelon	Sugar Baby, Ashai Yamato, New Hampshire, Midget, Improved Shipper

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