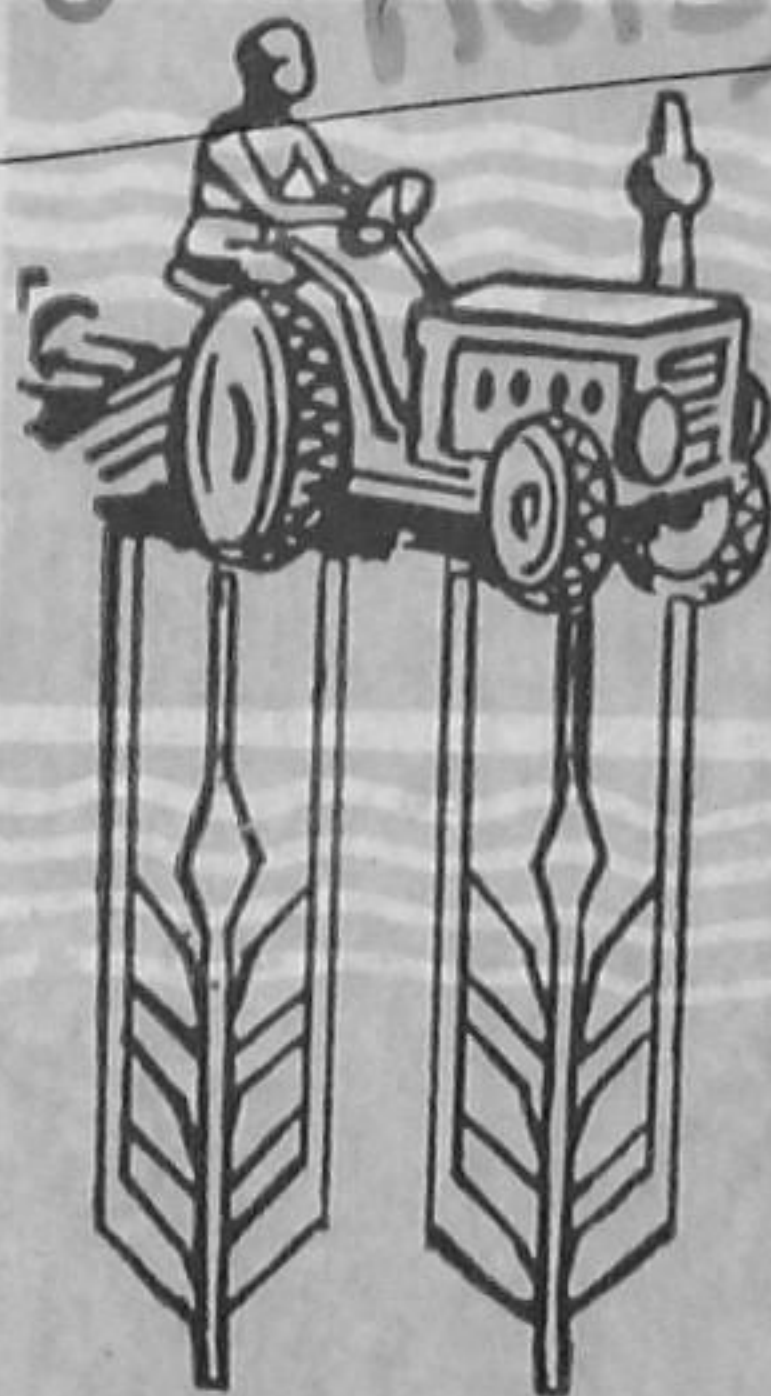
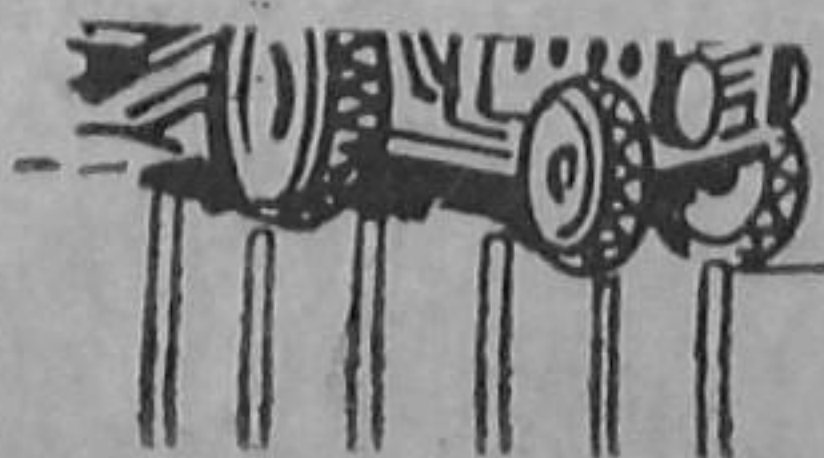


LET US GROW

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LET US GROW CROPS

HIRANMAY BANERJEE

WITH A FOREWORD

By

S. K. Dey



Issued on behalf of

MINISTRY OF COMMUNITY DEVELOPMENT AND CO-OPERATION
GOVERNMENT OF INDIA

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*(Translation from the original in Bengali,
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FOREWORD

It was a happy accident that I came across a book written in Bengali entitled "Amara Fasal Falai". Normally, I would perhaps have skipped it over. I did not do so in this particular instance because the author, I found, was my friend Hiranmay Banerjee, Development Commissioner, Government of West Bengal. I knew the author as a seasoned administrator, the very definition of a gentleman and a philosopher by education, temperament and outlook. I was naturally intrigued how he could take upon himself the responsibility of writing a book on the rugged subject of crops.

Experts are taught by experts. Our experts in India usually write for themselves or for a readership in the wider horizon. Until a few years ago, these experts rarely had any contact with the people who pay for their education, training and maintenance. Even now they feel shy at the thought of the illiterate masses, much more so of working and living amongst them. That in such circumstances what they write would go far above the head and heart of the common folk is no wonder. We have been struggling with our experts to get them to face our illiterate paymasters and write for them in the language which they would understand and assimilate. We have hardly yet made a beginning. My curiosity naturally was very great when I came across this title under the pen of my friend Hiranmay Banerjee. I read the original book written in Bengali for the UNESCO. I felt, for the first time, that I had come across a book written by a layman meant for laymen.

I have been meeting thousands of farmers from different parts of India at my residence in Delhi every year in the course of "Bharat Darshan" by them. I have been talking to them on the supreme importance of agriculture as the foundation for life in India. Soon I discovered that this way I was only adding to the surfeit of talking in this country. I realised that I should begin talking through deeds rather than words if I desired to make an impression. I started practising agriculture, horticulture, poultry and fishery on the scale I possibly could manage within the confines of my residence and my time at Delhi. In these pursuits I came face to face with the experts as also the real problems of agriculture in India. I was longing for a book which could tell me in the language of a layman the basic facts of agriculture such as I could understand. I could discover none in the market. The book "Amara Fasal Falai" came in as a most welcome gift. I relished every page. I found that here was something written by someone from out of the whole experience of his life, which did not require

an expert to understand or interpret. I had the text checked up by technical experts who happily confirmed that there was no technical flaw.

My next move was a request to the author to allow the Ministry to publish it in different languages. I wished to push this out in sufficiently large quantity to enable our cultivators in all parts of India to share the thrill I had while reading the book. I am confident that readers will derive benefit from a perusal of the book as I did. It is also my hope that others will emulate the example of Hiranmay Banerjee and write not merely on agriculture but also on other technical subjects dealing with the rugged needs of our people on which we have perforce to continue our uphill efforts for years to come, if we are to catch up with the centuries that have bypassed us. I am grateful to Hiranmay Banerjee for the pains he took to write the original Bengali version of this book and more so for the English translation which he has done at my request. We greatly appreciate this labour of love and the willingness to share its fruit with his fellow citizens throughout this sub-continent.

New Delhi
March 30, 1960

S. K. DEY
*Minister for Community
Development and Co-operation*

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I. WHY SHOULD WE TILL ?

We are acquainted with brick-built houses in towns. They have strong underground foundations. Over these is built the ground floor, then the first storey, the second and so on. Had there been no foundations, there could have been no ground floor, no first storey, in fact no house at all.

In our society people earn their livelihood in different ways. Some cultivate lands, others weave, others, again, work in offices or are engaged in trade. It is not without reason that the society is organised this way. Man's first necessity is food. None can live without food. Next to food in importance is clothing. A man thinks of other necessities only after his demands for food and clothing have been met.

If a cultivator can grow a good crop, first of all he lays by his own requirements and that of his family for the whole year. He then sells the surplus in the market. With the money he thus gets he buys his cloth. If the crop happens to be exceedingly good he will have some money left over after the purchase of cloth. With that he buys an umbrella and a pair of shoes for himself, *churies* (bangles) for his wife, a shirt for his baby son and a printed frock for his baby daughter.

We call the men who make clothing, shoes, umbrellas and *churies* artisans. The weaver weaves cloth, the cobbler makes shoes, the goldsmith makes *churies*. They are all artisans. They do not cultivate land themselves. Consequently, they have to depend for their food on those who cultivate land. But a cultivator will not part with foodgrains for nothing. He does not weave the cloth he needs. For that he depends entirely on the weaver. That is why the weaver supplies cloth to the cultivator in exchange for foodgrains.

But who is going to establish contact between the weaver and the cultivator ? The cultivator lives in one part of the country and the artisan in another. That is where the trader comes in. He pays for the surplus produce of the cultivator and takes over the stocks. Then he opens a shop in the market. The weaver comes to that shop to buy foodgrains. Elsewhere he finds a different shopkeeper who deals in cloth. He sells to him the cloth he has woven. He pays for the foodgrain from the money he gets by such sale. In carrying on such transactions for purchase and sale the shopkeeper gets involved in increasingly complicated work. He has to keep accounts of these transactions, he has to attend the customers, he has to replenish his stock, he has to do so many other things. He

hardly finds it possible to attend to so much work single-handed. So he has to engage a salaried employee. Such employees maintain themselves with the pay they receive for the service they give to their masters.

This is how society has evolved. It is like a house where the ground floor stands on the foundations, the first storey stands on the ground floor and the second storey on the first. The crop the cultivator produces by tilling the land is like the foundations. The consumer-goods produced by the artisans are like the ground floor. The trade which makes contact between the two possible is like the first storey. This is how society has been built up. We have to bear in mind the basic truth that cultivation is the base of our social structure. Where cultivation is done well, the economic foundation of the society is sound. Where cultivation is not carried on properly, the economy is weak. Such society can never prosper. The prosperity of a country depends on proper cultivation of land.

In the olden days people used to be fully conscious of this fact. That is why their leaders would advise them that the growing of food crops should be considered a sacred duty. Even today women in our country observe vows called *Vratas*. Wishing to assure a long life for her husband, a woman practises the *Savitri-Vrata*. To observe such a vow one has to conform to numerous rules of conduct, one has to subject oneself to considerable pain. Even so, women would readily submit to such rigours. The reason is that the value of what they wish to achieve is so high that all this subjection to pain, all this compliance with special codes of conduct appears justified. That is why wise men in olden times wanted people to realise that the growing of food was such an important assignment that all the effort necessary for it should be ungrudgingly made and all the rules for good cultivation should be scrupulously complied with. That was why they said that land should be cultivated in the spirit of a *Vrata* (vow). Have they not given us the correct advice?

II. DUTY AS FREE CITIZENS

The status of our country has changed. Every one of us who is grown up knows about it. Not long ago—only thirteen years back—conditions obtaining in our country were different. The British people were then the rulers. Their home country lies beyond many rivers and seas. They loved only their own country. They had no particular reason to love our country. Our welfare was none of their concern. They would come to India to earn money and to remit it to their own country. No wonder our country became extremely poor. Crops were poor and the goods produced by the weaver, the potter, the blacksmith would not sell in the market. Famine was a frequent visitation. Hundreds of thousands died of starvation.

Our people could not stand such extreme impoverishment of the country. That is why such of us as loved our country started working heart and soul to wrest freedom from the British. Some of the freedom fighters were hanged by the British, some were put in jail, while others were deported. But oppression could not break those who had dedicated themselves to the cause of the country. Mahatma Gandhi accepted the leadership. He asked the British to 'Quit India'. Eventually the British did really leave our country. That was for us a day of great rejoicing. That is why we celebrate August 15 as Independence Day.

But the mere withdrawal of the British would not lead to an automatic improvement of our lot. The winning of freedom will not place the gifts of paradise on the palm of our hand. Freedom only gives us an opportunity to build our country as we desire. It is nothing more than that. Now our country can only take the shape we want to give it. But a mere desire to build up is not enough. Everybody has to play a part in the constructive effort, every one has to work for it. Thus alone can we make our country great. Our vast country had gone down to such a depth of poverty that it had no wealth to call its own. There was countrywide distress and despondency. To build it up properly, endeavour of a high order on the part of our people is necessary. Just to undertake an ordinary *Vrata* one has to subject oneself to considerable suffering and observe an elaborate code of conduct. To make a country great, how much more pain has to be suffered, how much harder work has to be done. Indeed, developing the country is the most important of all *Vratas* (vows) !

After the British left, our leaders decided that the country

should be developed. The duty of a free citizen is to help develop the country. There are many countries in the world. The people of these countries have opportunities to shape their future. That is why their countries have developed well. In their countries, even the village roads are metalled. There are brick-houses in the villages. These houses are electrified. The farmers in these lands do not depend on rainfall for irrigation. If there is timely rainfall it is availed of. If there is none there is an alternative. These countries have a net-work of canals. If water is required for irrigation it is drawn from canals. These countries have good hospitals for the treatment of the diseased. There every girl and boy must receive education. In short, for those who live in these countries there is provision for all kinds of welfare.

The leaders want our country to develop along similar lines. For this purpose they have drawn up schemes of development. Together these schemes are known as a plan. Our country is a very big one. It is difficult to prepare a complete list of all the works necessary for its development. Nor is it possible to take up all these works together. So it is necessary to decide which works should be taken up first. These should be taken in hand immediately. Others which can wait should be taken up later. That is why a fixed period has been assigned for each plan. The work assigned for the period of the first two Five Year Plans has been almost completed. We are now engaged in drawing up the work programmes for the next five years, *i.e.*, for the Third Five Year Plan.

Now, to develop the country, we have to put up factories. But the equipment and machines that are necessary to build up such factories are not made in our country. These have to be imported from countries which are more advanced than ours. Money is required to buy them from foreign countries. Where shall we find that money? A considerable part of that money comes from the export of our crops.

Food is essential to sustain life. If the demand for food can be met from the yield of the land it is well and good and no complications follow. But if the crop is bad there is difficulty. The price of foodgrains rises. Also, there is not enough to go round. We are then compelled to import wheat or rice from outside. There is no other way out. One cannot leave men to die without food. If all the foreign money available is spent on the purchase of rice or wheat abroad then no money is left over for purchase of machines and equipment. We fail to buy them. We cannot complete our work of development which gets delayed.

There is a way to get over this difficulty. The remedy lies in taking such steps as would ensure good crops. If we can grow good crops there will be no shortage of foodgrains. If we can produce

more paddy the price of rice will not go up. Everybody will get his food. We will not have to import rice or wheat from foreign countries. The money thus saved can buy machines and equipment from abroad. Our Five Year Plan can thus progress smoothly. The key to success lies in the hands of the cultivators of our country.

It is apparent that a heavy responsibility rests on the shoulders of our cultivators. If only they can grow enough food the economic system would function well. What is more important, our Plans will progress according to schedule only if the yield of crops is satisfactory. To make this possible we have to learn improved farming methods from other countries. Also, we have to re-learn the sound practices which were evolved in our own country but have been forgotten. The cultivator has to take the *Vrata* (vow) of growing more food. He has to practise cultivation as a joyful duty. He has also an important duty to do his bit in developing the country. The role of the cultivator is a very significant one. He has been entrusted with the duty of laying strong foundations for the economic development of his country. He has the capacity to make a success of the Five Year Plan. So our motto should be : LET US GROW CROPS !

III. BASIC FACTS ABOUT PLANTS

To bring up a healthy and strong baby, it is not enough to have love and affection for him. To be a good mother one has to know, in addition, everything about child welfare. A baby is a delicate being. He needs constant attention. He must be so kept that he does not catch cold. He must be given the food that he can easily digest and that will nourish his body. He has no teeth and so cannot take solid food. So, whatever nourishment is to be given should be given in liquid form. This is not enough. To bring up a healthy and strong baby it will not do to pay attention to him alone. His mother should also be well looked after. A baby will be born strong and healthy only if his mother is healthy and strong. It is also necessary to protect the baby from danger. A child is helpless and lacks the capacity to look after himself. So his mother has to look after him. It is necessary to be watchful to prevent a poisonous insect from biting him, or a jackal dragging him away. It is only by constant and elaborate attention that a child is properly brought up because the child is a helpless being.

The crops we grow in the fields are also living beings. When we grow paddy we first sow its seed in the soil. That seed grows into a seedling. We then till the land and transplant the seedling. There it grows. Then one day it flowers. Then it ripens into corn. When the corn matures its green colour turns golden. Finally, the plant dies. A plant, too, is a living being. To begin with, it is born like a human being. Then it grows. And after that even as a man dies and leaves behind children, a plant grows old and dies leaving behind children in the form of seeds. We in India call the plant *udbhid* as it sprouts from the soil.

Since a plant is, like man, a living being, we have to attend to its many needs to keep it alive. When it is helpless like a baby it needs special attention. It has to be kept in a place where it will keep well. It must be given its proper food and in a manner that can impart vigour to it. It has to be protected from harm by insects, by goats and by cattle. It is also necessary to ascertain whether the parent plant yielded good crops. Just as the mere affection of the mother cannot make a baby strong, so also the attention of the cultivator alone will not make a plant grow vigorously. Just as it is necessary for the mother to know how to bring up a child, it is also necessary for the cultivator to know how the plant grows well. To be a good cultivator one should not only love plants but also know the basic facts about their life.

The basic facts of plant life in respect of which we should acquire knowledge are the following :

The right kind of soil,
The right kind of food, and
The enemies of plants.

The Right Kind of Soil

A plant cannot go about as a man can. It stays where it is born. But a plant cannot grow on every kind of soil. For instance, a plant cannot grow where the soil consists only of sand. Nor can it grow on rock. A plant grows on earth. So the earth is its hearth and home.

Earth, sand and rock are not, however, intrinsically different things. From the same paddy is produced *muri* (parched rice), *khai* (puffed rice) and rice proper. They are different forms of husked paddy. In the same manner both earth and sand originate from rock. The entire crust of the earth is made of rock. This rock is exposed to the sun and gets heated. Again when it is cold, the rock gets cooled. By this alternate subjection to heat and cold the rock disintegrates. Then the action of wind and rain transforms it into earth. Floods caused by rain wash that earth into the river. That is why during the rains the water of the river becomes muddy. When the river spills over the banks this earth-mixed water enters the fields. After that the earth settles on the field. We call that depositing of silt.

The soil that can grow plants is composed mainly of sand and clay. There is little difference between sand and clay. When wheat is crushed into coarse grains we call it flour. When wheat is crushed into fine grains we call it *maida* (powdered wheat). Similarly, when rock disintegrates into coarse grains we call it sand. When it disintegrates into fine grains we call it clay. Sand lacks cohesion. As its grains are coarse it cannot be compressed into a ball. It cannot retain moisture. If it is moistened with water, it dries up quickly. As the grains of clay are fine it can be easily compressed into a ball. It can retain a good deal of moisture and when mixed with water gets sticky.

All soil is a mixture of clay and sand. If the soil has more sand in it, we call it sandy soil. If it has more clay in it, we call it clayey soil. Sandy soil has the qualities of sand. It is light. It turns easily. It does not get damp as it does not retain moisture.

On the other hand, clayey soil has the qualities of clay. It can retain considerable water. So it does not need much irrigation. When it dries it cracks up. The grains being fine they adhere closely to one another. That is why it is very difficult to break or plough such soil.

Where the proportion of sand and clay is more or less equal, it is called 'loamy soil'. Loam is midway between sand and clay. It is neither light nor sticky. It retains moisture but does not get damp.

Apart from sand and clay the soil contains some other elements. One of these elements is lime and the other is organic matter. Limestone produces lime by disintegration. If lime is present in the soil manure decomposes well, and the crop thrives.

It is necessary to have a clear idea of what organic matter is. Whatever thing has life is a living being. The cow and the goat are living beings. We know plants are called children of the soil. Plants are endowed with life. So they are also living beings. Whatever is produced from a living body is organic matter. It is called organic matter because it comes from an organism which is another name for a living body. When cattle, goats and buffaloes die, they rot on the field. Their flesh is eaten by vultures. Their bones are left on the field to decompose. After decomposition they get mixed up with the soil. Cattle graze on the field. They drop their dung on the field. That also decomposes and mixes with the soil. Leaves grow on plants. They are ultimately shed and fall on the land. They rot and mix with the soil. These bones, this cowdung, these leaves, all mix with the soil and become part of it. This component of the soil is organic matter.

So we have now learnt that the soil that grows plants contains four elements—sand, clay, lime and organic matter. There is considerable deficiency of lime and organic matter in the soil of our country. To make a good soil all the components should be present. The ideal soil has these components in the following proportion :

Sand—eight to nine parts.

Clay—four to five parts.

Lime—one part.

Organic matter—one part.

Plants react very much like men. The climate of a man's own country suits him best. If another country has a similar climate he will keep very well there. But he will feel uncomfortable in an alien climate and his health may suffer.

The same rule holds for plants. Wheat is a native of cold countries. The Punjab is severely cold during winter. It grows wheat well. Bengal is much warmer. Wheat does not grow well there. The people of the Punjab belong to a dry climate. They cannot stand the humid heat of Bengal. Water-melon likes a hot climate. It grows well in a hot country. It does not grow in cold countries. Again paddy loves water-logged areas. That is why it grows well in Bengal. Uttar Pradesh is a dry country. Paddy will not grow well there. Paddy is like the man from East Bengal. It thrives in water and mud. It cannot stand dry climate.

For this reason, the same soil will not be suitable for every kind of crop. Different soils go with different kinds of crops.

The Right Kind of Food

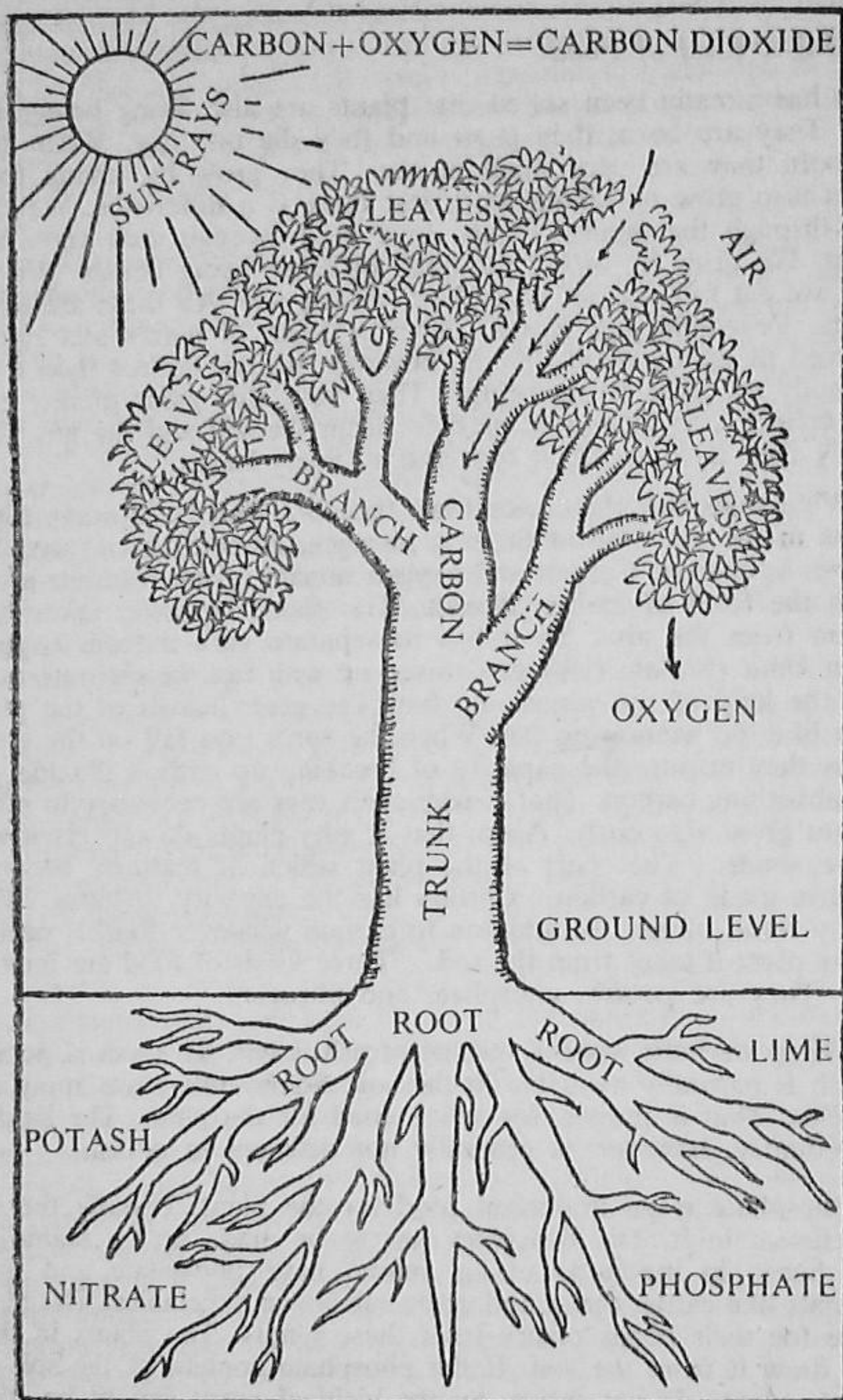
It has already been stated that plants are also living beings like men. They are born, they grow and they die one day. When they are born they are very small in size. They grow by taking food. Plants also grow by taking food. But there is a difference. We take food through the mouth. Plants draw food through their roots and leaves. We grow by eating the body of other living beings. We eat flesh, we eat fish, we eat vegetables, we eat rice. All these are living beings. Vegetables are leaves, stems or fruits of plants and rice is the seed of paddy plant. Plants, however, do not collect food from the body of other living beings. They have this great quality that they collect food in minute particles from the soil and the air. That is why they have so much root and so many leaves.

What does the plant take from the air? There are many kinds of gas in the air. One of these is nitrogen. Another is oxygen. Yet another is carbon. Carbon and oxygen remain mixed together in the air in the form of carbon dioxide. The plant, however, takes only carbon from the air. So it has to separate carbon from oxygen. When *khud* (broken rice) gets mixed up with rice we separate them with the help of the winnowing fan. The green leaves of the plant work like the winnowing fan. When the sun's rays fall on the green leaves they acquire the capacity of breaking up carbon dioxide gas and absorbing carbon. That is why sun's rays are necessary to make a plant grow vigorously. Again that is why plants do not grow well in the shade. That part of the plant which at maturity becomes wood is made of carbon. Carbon has the capacity to burn. That is why wood burns. In addition to carbon whatever food is needed by the plant it takes from the soil. Three kinds of food are important. They are potash, phosphate and nitrogen.

When we burn wood a residue of ash is left. This ash is potash. Potash is naturally available in the soil. Some cultivators apply ash to fields. That is proper, for ash is food for the plant. The land in our country, however, is generally not deficient in potash.

Phosphate is an important food for the plant. Usually the soil is deficient in it. The deficiency has to be made up by manuring. The bones in the body of an animal have phosphate and lime. Animals like cattle, sheep and goats subsist on vegetables. The phosphate for their bones comes from these plants. The plants in their turn draw it from the soil. If the phosphate content of the soil decreases plants do not thrive. So the yield of crops cannot be good.

Process of Separating Carbon from Air
Through Leaves



Nitrogen is another important food for the plant. If the nitrogen content of the soil goes down, plants do not grow well. The deep green colour of the leaves we see in healthy plants disappears if there is deficiency of nitrogen. Plants then turn light yellow. It has already been stated before that nitrogen is found in air in the form of gas. Carbon is also mixed up with air. The plant takes carbon through its leaves. But it cannot take nitrogen through the leaves. It takes nitrogen through the roots.

Nitrogen remains in the air above the soil and the roots of the plants remain under the surface of the earth. How does the plant get its supply of nitrogen? Its method of obtaining nitrogen is rather interesting. There are innumerable bacteria in the soil. The soil that can be placed on a rupee contains nearly 30 million bacteria. We can guess from this how small the bacteria are. Now even in the soil there are interspaces. Through them air gets into the soil. The function of these bacteria is to extract the nitrogen in this air and then fix it in the form of nodules. After that the nitrogen contained in the nodule mixes with other food and is drawn into the body of the plant through its roots. The plant is then in a position to assimilate it. When the soil is turned, air can penetrate well into the soil. The bacteria can then function better. That is why the wise cultivator loosens the soil at the roots of the crop from time to time.

It is possible to verify with eyes the truth of the statement that bacteria draw nitrogen from the air and fix it in the form of nodules inside the soil. These bacteria establish colonies at the root of what are called leguminous plants. That is why nodules are found adhering to the roots of such plants. These nodules are solidified nitrogen. If we uproot pea or *kalai* (*Phasiolus radiatus*) or *dhaincha* (*Sesbania aculeata*) plants we can find such nodules attached to their roots. These plants help the fixation of nitrogen in the soil and thereby make it more fertile.

It will thus be seen that there are four important kinds of food for plants. Of them carbon comes directly from the air through the leaves. The other kinds of food are drawn by the plant from the soil through its roots. But the plant cannot feed on them if they are just in the soil. A baby or an old man without teeth cannot take solid food. They will take the food if it is mixed with a liquid. In this respect the plant is like the baby or the old man. It draws food from the soil with roots as fine as thread. That is possible only when the food in the soil mixes with water and becomes liquid. After being fixed in the soil nitrogen turns into ammonium and nitrate. These substances together with phosphate and potash mix with water to form a juicy substance, which is drawn by the roots of the plant.

This explains why irrigation is necessary for the growth of

plants. Without water no food can reach the body of the plant. That is why a plant dries up and dies if the soil is very dry. Cultivators know that a plant dries up if there is excessive salt in the soil. The reason is that salt draws moisture. When salt is present in the soil it draws away the water from near the roots. The result is that the plant does not get enough water to turn the food into liquid.

IV. THE ENEMIES OF PLANTS

Plants have many kinds of enemies which can be divided into two groups. Firstly, other kinds of plants; secondly, insects.

If four or five pups are born to a bitch it will be seen that the stronger ones alone suck the milk of the mother. The pup that is not strong in the body goes without milk. As a result, it loses weight and even dies. Food is available in the soil. In the soil are sown a variety of seeds. A regular struggle ensues among the plants for the sap. The plant that is hardy and vigorous wins, while the plant that is weak dies out and is eliminated. Once the *san* grass (*Imperata arundinacea*) gets a foothold in a field of *dub* grass (Dog grass, *Cynodon Dactylon*) it completely destroys the *dub*. This is common knowledge.

WEEDS

The crop that is grown by man is extremely delicate. It is like a new born babe. It cannot compete with plants that grow up themselves. We call the latter weeds.

Weeds harm a crop in many other ways. They take a share of the manure that has been put into the soil for the crop. They draw the water from the soil. That is not all. If the weed is allowed to spread out, the crop gets neither light nor space to grow. Its condition becomes similar to that of the weak pup. Some of it dies. Whatever survives fails to yield a good harvest. That is why a good cultivator tries to eliminate weeds.

Weeds are of two kinds. There is one kind that germinates afresh from seed every year. The seed of the weed of the previous year remains broadcast on the land. After ploughing, with the first showers it germinates into seedlings. If these can be destroyed when young they cannot spread seeds and the mischief is kept under control.

The other kind of weeds does not germinate from seed. Their bulb or root remains inside the soil. After cultivation fresh weeds sprout from them. *Mutha* (*Cyprus roeindas*) or *Ulu* grass (*Imperata arundinacea*) represent this class of weed. In their case there is no point in uprooting the plant. Unless the root or the bulb lying deep in the soil is dug out the weed will sprout again. That is why it becomes extremely difficult to raise crops on land overgrown with *Kash* (*Saccharum officinatum*) or *Ulu*.

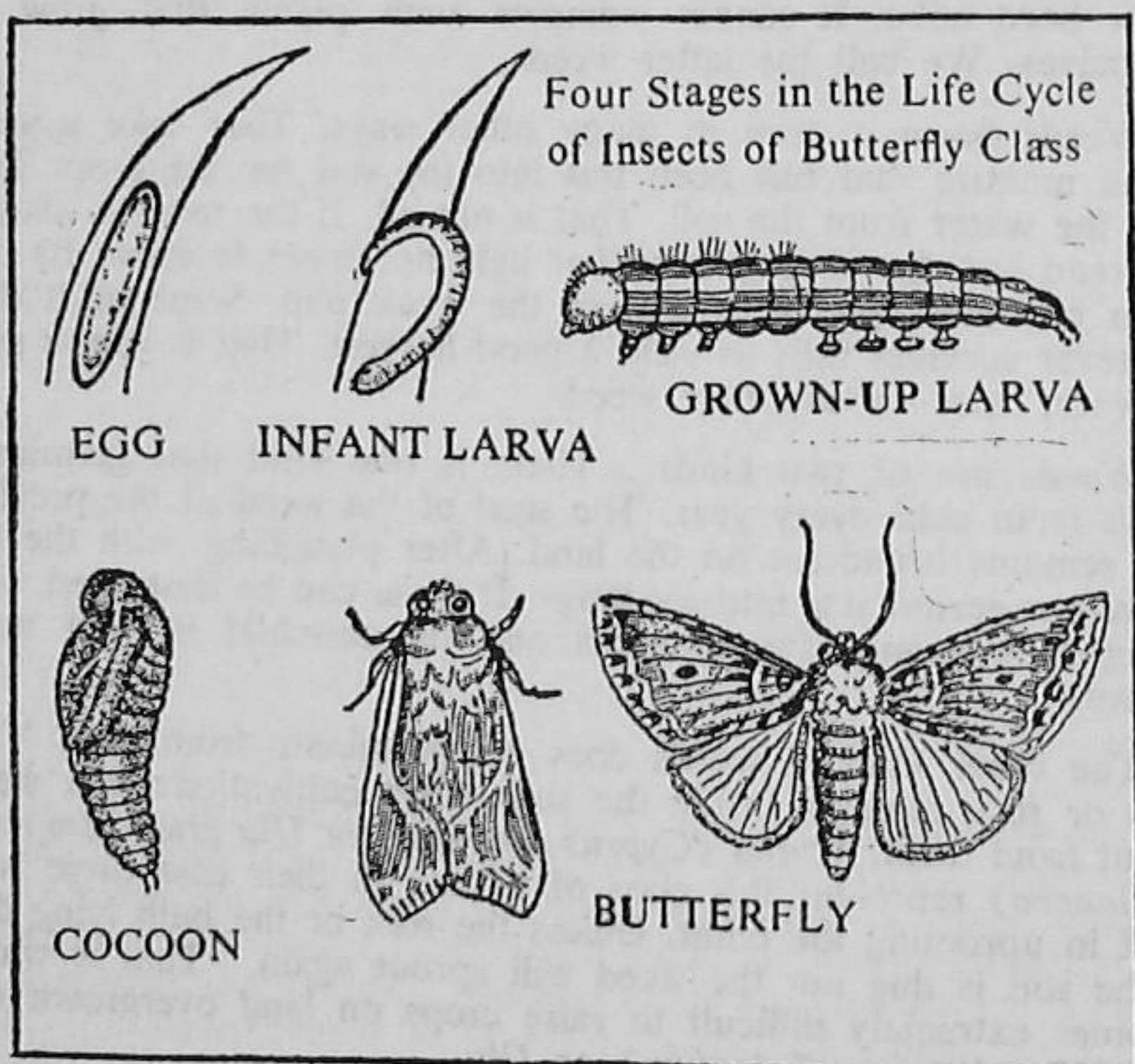
INSECTS

Insects represent another kind of enemies of plants. Those with which we should be familiar are :

- (1) Insects of the butterfly class.
- (2) Insects of the fly class.
- (3) Insects of the grasshopper class.
- (4) Insects of the spider class.

Insects of the Butterfly Class

The life cycle of the butterfly class insect is very interesting. We know that animals that suck their mother's milk are born only once and then grow in size. Their physical features remain unchanged even when they grow up. We also know that birds are born twice. When born they are in the form of eggs. Afterwards when the eggs are hatched the shell breaks and the bird emerges. The life cycle of these insects, however, is even more interesting. Some of them are born three times, while others are born four times. Between the physical features of one phase and another there is a good deal of difference.



Insects of the butterfly class change their forms four times in the course of their life. So we can say that they are born four times. The mother butterfly lays a large number of eggs at a time. Usually they are laid on the leaves of trees or vegetables. After a few days the eggs hatch and young ones come out. These young ones have many legs. They look like caterpillars. Some have hair on their bodies, others have none. Those which have hair on their bodies are called hairy caterpillars. Both are called larva. The larva feeds on vegetables or leaves of trees. The more it feeds on leaves the bigger it grows. Then after a few days it changes its form. It spins silk thread round its body and covers itself up and then hangs in that form attached to a branch of a tree. In that stage it does not move, nor takes any food and keeps absolutely still. In this form it is known as cocoon. It is so called for it wraps up itself with silk into the shape of a ball. It keeps this form for a few days. Then one day it cuts through the ball of silk and comes out. That is its last birth. At this stage it has grown wings. As a butterfly it flits about from flower to flower sucking honey. Who could have perceived the link between the caterpillar and the butterfly?

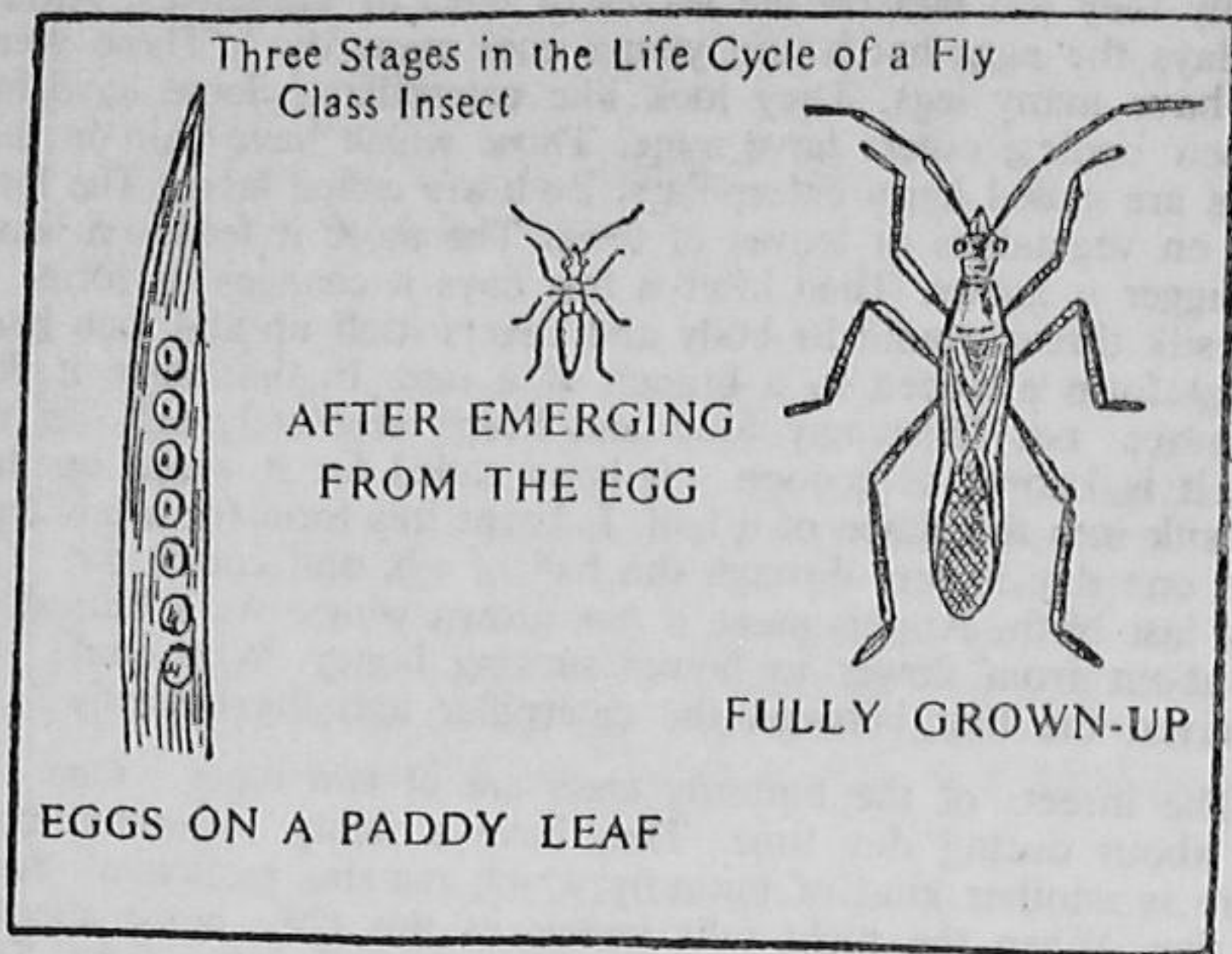
The insects of the butterfly class are of two types. One class flits about during day time. They have a richly variegated body. There is another kind of butterfly which remains motionless during the day. When the night falls insects of this class move about in darkness. They sometimes enter rooms where they see light. Their bodies are not so colourful. They are called moths. The kind of butterflies that infest plants belong to the class of moths.

These moths damage plants or crops. When they are in the form of caterpillars they live on leaves. If this class of insects infest crops their leaves get damaged, the plant sustains injury and due to loss of leaves cannot effectively draw food from the air. The *leda* (Swarming caterpillar) and *majra* (stem borer) insects that infest the paddy plant belong to this class of caterpillars. Our cultivator friends must be well acquainted with them.

Insects of the Fly Class

Insects of the fly class are born thrice. The mother insect like the butterfly lays eggs on leaves. After a time the eggs are hatched and baby insects come out. At this stage they look like insects but they are small in size and the two wings are very tiny. Almost the entire body remains bare. After some time the insect attains its maximum growth. The wings grow big and cover the entire body. This is its third birth. It sucks the juice of leaves. As a result the leaves get spotted and the plant weakens. At times they bore into the stem of the plant. The stalk of the plant then shrivels up. The

gandhi (paddy fly) insect that infests the paddy belongs to this class of flies. Our cultivator friends can recognise the paddy fly.

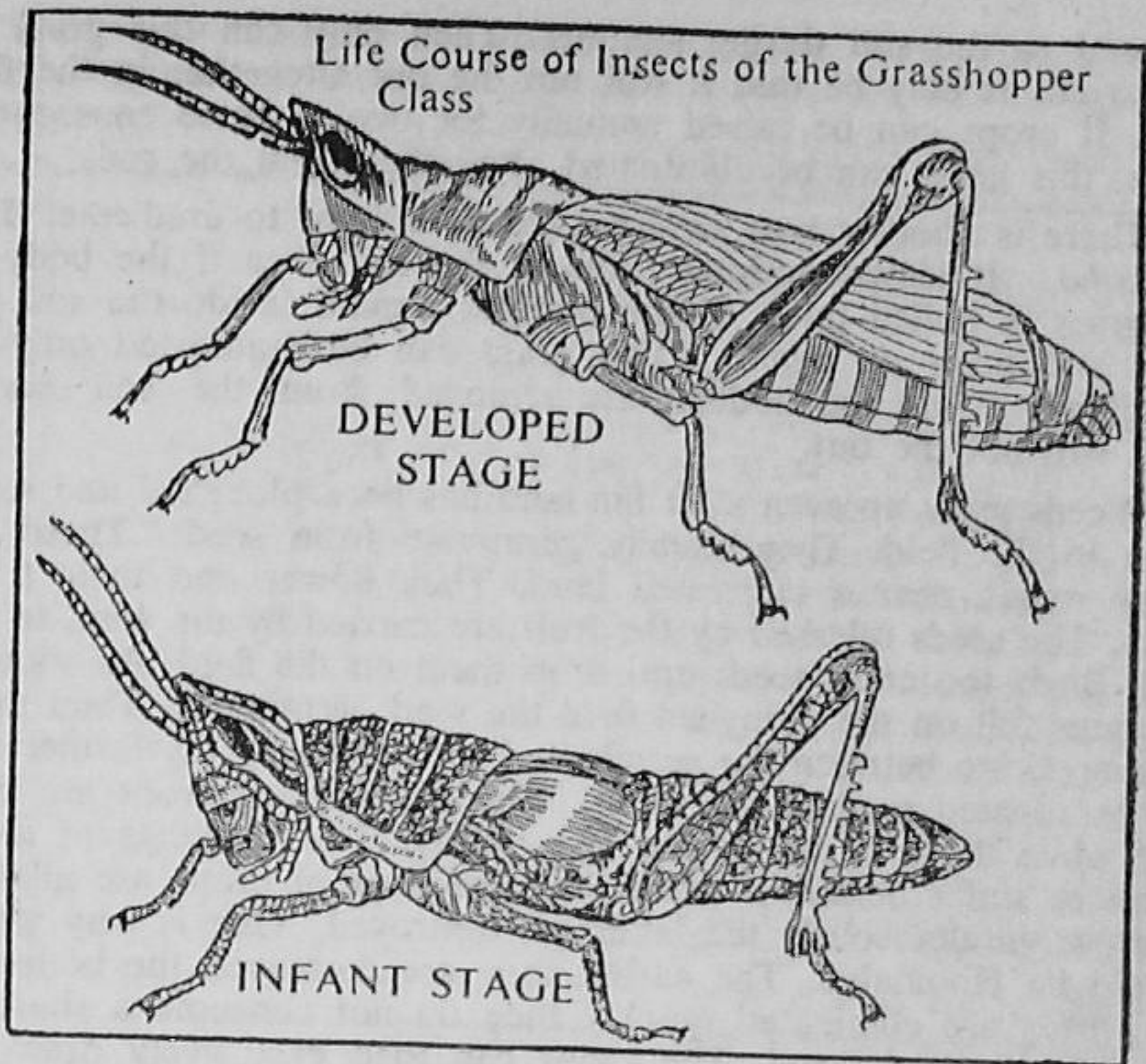


Insects of the Grasshopper Class

We all know insects of the grasshopper class. Most of us must have caught grasshoppers in our childhood. We have asked them, 'Daddy long legs, how deep is the water in the Ganga?' The grasshopper is a major enemy of plants. The mother grasshopper lays eggs inside the soil. When the eggs are hatched baby grasshoppers come out. At that stage they are similar in appearance to full grown grasshoppers. But they are different in two ways; they are smaller in size and their wings are so tiny that they are hardly noticeable unless minutely observed. They also feed on leaves. After a time when they become full grown their wings develop.

Insects of the Spider Class

We have all seen spiders. They are varied in appearance. Some are big, others small. They cause injury to plants in two ways. When they lay eggs on young leaves they cover them up with a fibrous substance like cotton, so that when the leaf grows it gets crumpled. Again when the eggs are hatched the baby spiders feed on the sap from the leaves. This also weakens the plant.



PROTECTION FROM ENEMIES

We already know that plants have two kinds of enemies, weeds and insect pests. To destroy the enemy it is necessary to have full knowledge about it first. That is why we have already learnt the essential facts necessary for the protection of plants against pests. It is now for us to learn how we can save our crops from their enemies. Different measures are necessary to fight different enemies.

Protection from Weeds

Before sowing the land it should be thoroughly ploughed and then dried in the sun. The more it is ploughed the better the soil is loosened. Simultaneously weeds and grass will be pulled out along with their roots. They will die if exposed to the sun. Thereafter they may be allowed to rot and mix with the soil. It is possible to eradicate weeds by vigorous ploughing.

Some grasses are difficult to uproot. Even if the body has been pulled out the grass will grow again from the root that has been left inside the soil. The *ulu* grass belongs to this class. It cannot be easily eradicated. The soil has to be ploughed deep again and

exposed to the sun during summer. Then only can this grass be destroyed. It may be that it will not die out altogether in the first year. If crops can be raised annually for two to three consecutive years, this grass can be eliminated altogether from the soil.

There is another type of grass which is hard to eradicate. This is *mutha*. It leaves nodular roots in the soil even if the body of the grass is pulled out. If the nodules remain inside the soil the plant will grow up again. This grass can be eradicated only by ploughing. Until the nodules are removed from the soil *mutha* grass will not die out.

Weeds grow up even after the land has been ploughed and seeds sown in the field. They usually germinate from seeds. There are many weeds near a cultivated land. They flower and their fruits ripen. The seeds released by the fruit are carried by the wind to the field. Birds too carry seeds and drop them on the field. As soon as the rains fall on the ploughed field the seed germinates. Then there is competition between the germinated seed sown by the farmer and the germinated seed of the weeds. The seedlings of crops are delicate while those of weeds are very hardy. The seedlings of crops therefore suffer defeat. If weeds and seedlings of crops are allowed to grow simultaneously the latter get destroyed. That is why weeds should be eliminated. The earlier they are destroyed the better. If the weeds are eliminated quickly they do not consume a share of the manure in the soil. The crops can then exclusively draw the sap from the soil. Secondly, when fields are weeded the soil becomes loosened, and seedlings can comfortably spread out their roots. Then there is an additional advantage. The chances of weeds sprouting up next season are reduced. So a good farmer conducts a weeding operation in the field at the earliest possible opportunity, after the seeds have germinated.

To take out weeds we uproot them singly with a weeding implement. This involves considerable labour. So many labourers have to be engaged to weed out a field. It is as costly as it is time-consuming. On the other hand, the greater the delay in eliminating weeds the more is the danger to the young crop. It will be of great advantage, therefore, if we could get an efficient weeding implement.

For this work Government has introduced Japanese weeders which are available in the market. If this weeder is used between two rows of plants the weeds will be uprooted, and the soil at the roots will be turned up. To be able to use this, seed should not be scattered in the field. It should be sowed in lines.

Protection from Insect Pests

The second group of enemies of plants is insects. We have already gathered some details about their life cycle. It will now be

easy for us to study how we can prevent these different insects from doing mischief.

Insects can be destroyed in two ways : by preventing their multiplication and by destruction after birth. The wise man prefers the former.

There are four kinds of insect pests : the butterfly class, the fly class, the grasshopper class and the spider class. The grasshopper lays eggs inside the soil. Some insects of the butterfly class remain inside the soil in the caterpillar stage or the cocoon stage. For example, the caterpillar of the *leda* (swarming caterpillar) moth turns itself into a cocoon inside the soil. The caterpillar of the *katui* (cut worm) variety weeps itself hidden inside the soil or in a crack on the soil during day time. The best method of destroying these insects, therefore, is to thoroughly plough the soil. It is particularly necessary to take out the stubble of the paddy of the previous year. The soil at the base of boundary ridge should be carefully ploughed. If ploughing is done properly insects are exposed and birds will come and eat them.

The grasshopper lays eggs inside the cultivated land. By ploughing their eggs can be destroyed. Other insects lay eggs close to the cultivated land or on the weeds growing on the boundary ridge. That is why it is necessary to destroy the weeds on the *ail* (boundary ridge) and near the cultivated land a long time before the seeds are sown either by cutting them down or setting fire to them. That will reduce damage by insect pests.

When the insect grows up and attacks the crop in the field, there is no remedy but to destroy it. Various measures can be adopted for this.

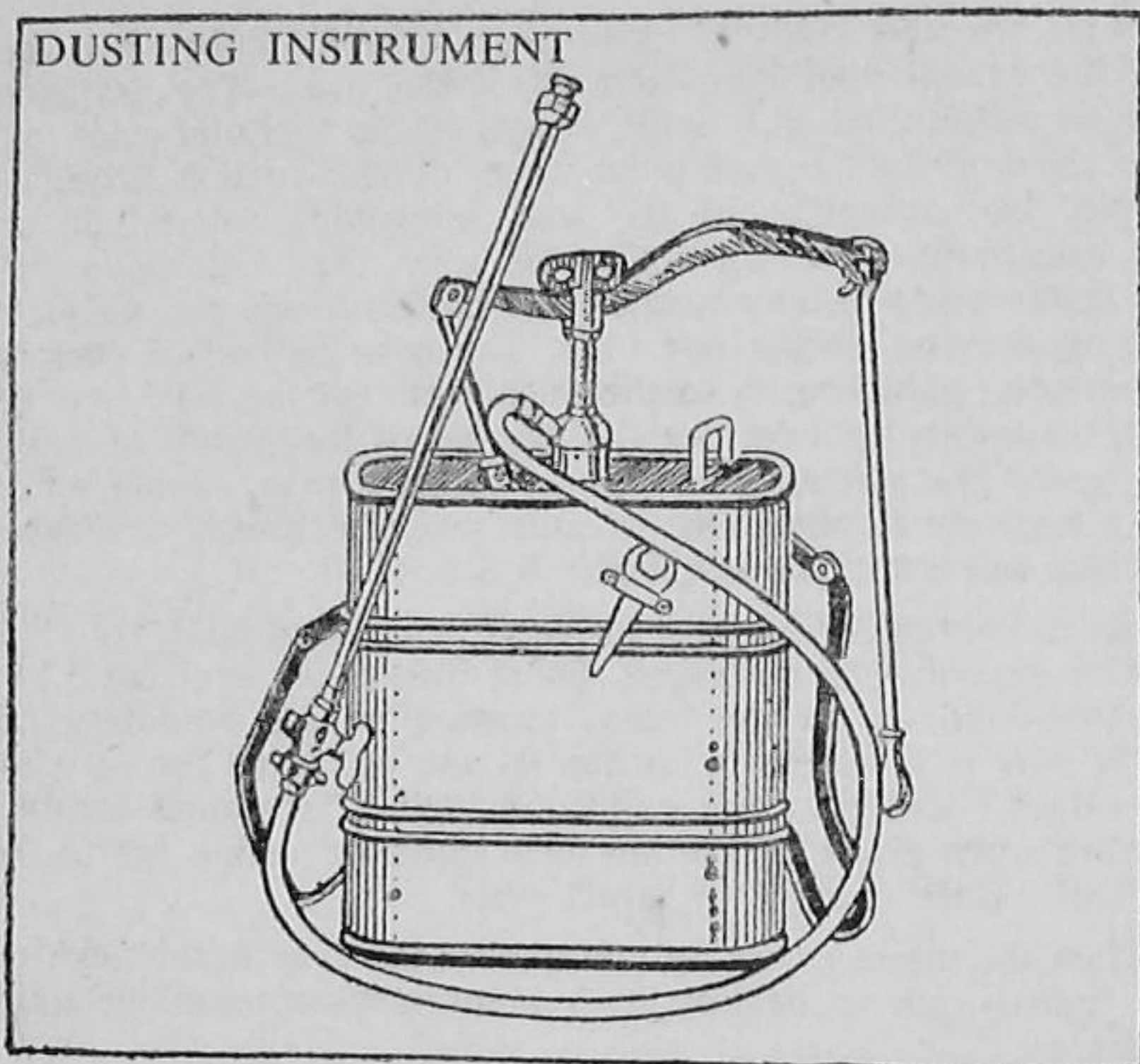
The easiest way is to destroy the insects with poison. The poison that kills insects is available in the market. It may be in the form of powder. It can be scattered on the field. An instrument has been devised for dusting this powder. This can also be purchased from the market. The poison in the form of powder can also be mixed with water and then sprinkled on the field. For this purpose one should use a spraying syringe.

The different insecticides that can be scattered in the form of powder are the following :

B.H.C. powder or Gammexane
Hexidol
Neoseed

The powder has five parts poison in 100, and the other 95 parts are made up of other matter. That is why these insecticides are named B.H.C. 5 per cent, Gammexane 5 per cent, etc.

The method of application is the same for all of them. For each *bigha* (0.33 acre) of land two to two-and-a-half seers of powder should be scattered in the field. This is an effective dose for insects.



D.D.T. powder can also be used as an insecticide. It should be mixed with water before use. The solution should be sprinkled on the land with a spraying syringe. Two seers of D.D.T. powder will suffice for each *bigha* (0.33 acre) and it should be mixed with a hundred gallons of water. Five standard seers of water make a gallon. There is an easier method of working it out. The big bucket that is sold in the market has capacity for four gallons of water. So to make one hundred gallons the powder should be mixed with twenty five buckets of water. Then it should be sprinkled on the field.

When too many cockroaches infest our homes we kill them by offering food mixed with poison. There is a similar method of killing insect pests. A poison called Sodium Flan Silicate is used for this purpose. One seer of this poison should be mixed with one seer of molasses. Then it should be mixed up with one maund of bran.

This should be mixed with water and scattered in the field. Grasshoppers love to eat this food. By taking poison with the food the grasshoppers die.

This insecticide powder as well as the spray for insecticides are available in the Plant Protection Branch of the Agriculture Department of Government. The necessary information will be available from the Union Agricultural Assistant or the Village Level Worker.

V. THE 'VRATA' OF GROWING CROPS

It is the duty of every mother to help the child grow into a healthy and strong man. It may be that not all mothers are conscious of this responsibility. The mother who is, will take up the rearing of a child as *vrata*. Even if such a mother is not educated and does not know how to bring up a baby, her child will grow up well. The reason is that in this case the mother has the desire to bring up the child properly. That child can be brought up even better if the mother can also learn the rules of child care.

The crop is to the cultivator what a child is to the mother. His food and clothing depend on crops. Consequently he has concern for the crops and has affection for them. But mere concern is not enough to grow good crops. It is also necessary to know how to grow good crops. For that it is necessary to know the basic facts about crops. We have discussed these basic facts at some length.

Keeping in mind the facts we have learnt about plants we should inform ourselves about the practices that should be adopted to secure good yield. That is the only way to be an ideal cultivator.

People in other countries give a good deal of thought to the problem of increasing the yield of crops. The knowledge they have acquired has brought about considerable improvement in the methods of cultivation in their countries. Like our country Japan is densely populated. The cultivators in that country have learnt to grow exceedingly good crops in small holdings. We, too, can take to the improved practices and the improved equipment they have adopted.

The United States of America is a leading nation of the world. It has adopted many measures for the improvement of agriculture. We can learn a good deal from that country.

Our Government seriously desires that we should increase the yield of crops. That is why it has dammed rivers and provided for improved facilities for irrigation. With the help of specialists in agriculture, the Government has evolved new methods for increasing the yield of land. We can acquire knowledge of these.

We shall discuss these methods.

We know now that not every kind of land is fit for crops. Again different kinds of crops grow in different kinds of lands. So we have to know how to select land for a particular crop.

Again crops will not just grow if we select a land and broadcast seed in it. We know that the crops we grow are comparatively weak and delicate plants. For that reason the land has to be prepared before the seed is sown. It is necessary for us to know how to prepare the land.

We know the kind of food that a plant needs and of the deficiency in the soil. We have manure to make up this deficiency. It is also necessary to know the kind of manure needed for a particular crop.

We have learnt that a plant draws food through its roots in the form of sap. That is why it needs water. We cannot always depend on rainfall for water. It is, therefore, necessary to make provision for irrigation.

We have also become acquainted with the enemies of plants. We must know how to protect the crops from these pests.

Lastly, we have to bear in mind that our objective is to increase the yield of crops. A good milkman is concerned with increasing the milk yield of his cow. He knows that good parents alone can produce a good calf, and he sees to it that both the father and mother of his calf belong to a good breed. A good cultivator should similarly see that his seed comes from plants that give a good crop. We must, therefore, know how to obtain good seed.

It is only after we have picked up knowledge of all these that we become good cultivators. These are like the rules of the *vrata* (vow) for growing crops. We have now to inform ourselves about rules for the following :

1. Selection of land.
2. Preparation of land.
3. Use of manure.
4. Provision of irrigation.
5. Protection from pests.
6. Use of good seeds.

Selection of Land

What water is to the fish soil is to the plant. Fish cannot grow without water. Plants cannot grow without soil. But different kinds of fish do not like the same kind of water. Some fish like tanks, others ditches. Some fish thrive in rivers while others in marshes. Again there are fish which grow well in the salt water of the sea. The *magur* (sheat fish) of the stagnant ditch does not grow in a good pond. Again the *hilsa* fish thrives only in the sea.

Similarly plants have their own preferences. Some grow well in high, dry lands, others in sandy soil. Some plants like clay soil. Most plants do not like salty soil. However, there are plants like the coconut which can grow in salty soil.

So when selecting land we should bear in mind the preferences of the plants to be sown.

We have learnt that the plant lives on food drawn from the soil through roots. Before the food can be drawn it must mix with water and become liquid. So we have to avoid the soil that cannot retain moisture and the soil through which roots cannot pass. Again no crops can grow on the soil that lacks nourishment which a plant needs.

We have already learnt that the plant draws food not only through the roots but through leaves as well. To help the leaves to filter carbon it is necessary that sunlight should fall on them. Without sunlight a plant grows weak. You may have observed that on many occasions plants do not grow horizontally but only in height if they are grown very close together. That is because they grow upwards in their effort to get sunlight. Plants thus go mad for the sun's rays. So one basic principle should be to select such land for raising crops as gets the sunlight. Of course there are plants like pine-apple which can grow even in shade. But the crops that we raise by cultivation invariably like sunlight.

We already know that the soil consists of sand and clay. If there is more clay in it, it is clayey soil. If there is more sand in it, it is sandy soil. And if sand and clay are in equal parts it is loamy soil. Now different kinds of crops have different habits. For each kind of crop the soil that it likes should be selected. We too have different preferences. Some of us like wheat, others rice. Some take both. A good cultivator should select lands suited to the requirements of each crop.

Let us now consider the preferences of crops that usually grow in our country. Paddy likes clayey soil. Cotton also has the same preference. Wheat and jute like loamy soil. Sugarcane, however, prefers sandy soil.

Again plants have preferences about high and low lands. All crops need water. But there are a few plants which like lands filled with water. Sugarcane, wheat and cotton do not like water-logged land. Paddy prefers water-logged land. Jute can survive even if water accumulates on the land but it prefers land which is not filled with water. In selecting lands for different kinds of crops these facts have to be borne in mind. So we should select low land for paddy, and high land for wheat and sugarcane; for jute also it is desirable to select high land.

Many people may have the impression that hilly countries do not grow crops. They reason that hills are made of rocks. That hills are made of rocks is correct. But hills have also a layer of earth on them. When the rains wash away the layer at places the rock inside gets exposed. Where the hill is steep it is more subject to such erosion. But where the hill slopes down gently and the upper layer of earth has not been washed away, crops can be grown.

To grow crops on the hills, an additional precaution is necessary. The rain water flows very fast on the hill sides. To prevent this the cultivators in the hills must have terraced fields in tiers like stairs on the slope of the hill. At the edge of each terrace they raise bunds. These bunds have two functions. Firstly, they help retain water in the soil and do not allow it to flow down. Secondly, they prevent landslides during heavy rains. The cultivator grows a variety of crops on terraced fields. In the hills of Darjeeling are grown plenty of potatoes and cabbages. Even paddy is grown on such lands.

Preparation of Land

It has already been stated that the plant that sprouts in fallow lands can grow without care as it is very hardy. But the crops that we raise in our cultivated lands are comparatively weak. If we just broadcast their seeds on fallow lands they cannot survive. Grass and weeds will kill them. To grow them successfully the soil must first be prepared.

Firstly, the grass and weeds should be uprooted. Their roots should be dug out of the soil. Then the soil should be loosened before seed is sown or seedlings are transplanted. If the soil is loosened roots can easily spread and air can penetrate it. The more air gets into the soil, the better the bacteria in the soil will work. As a result manure will decompose and mix well with the soil and the plant can draw sap properly.

It is for these reasons that the land must be tilled before a crop is sown. For this we use the plough. The plough that is commonly used in our country has a thick piece of wood one end of which tapers to a point. This part encased in a steel plate is called the ploughshare. It is drawn by bullocks in the front, while the man at the back keeps it well within the soil. As the bullocks move the soil is opened up.

This indigenous plough, however, does not open up the soil sufficiently. Its thin pointed head displaces the earth only along a thin line. The plough is, however, different in other countries. The ploughshare of such ploughs is not so pointed, it is a little tilted to

one side and is fitted with a sharp blade which resembles a spade. As a result one layer of earth is deeply cut. Again a curved plate is fitted with that. Its function is to turn the earth upside down.

We are now manufacturing in our country an improved type of plough. Its ploughshare is fitted with a tilted blade and to turn the earth upside down there is a curved plate. To till a field properly we should use this new plough. This plough is available in the market.

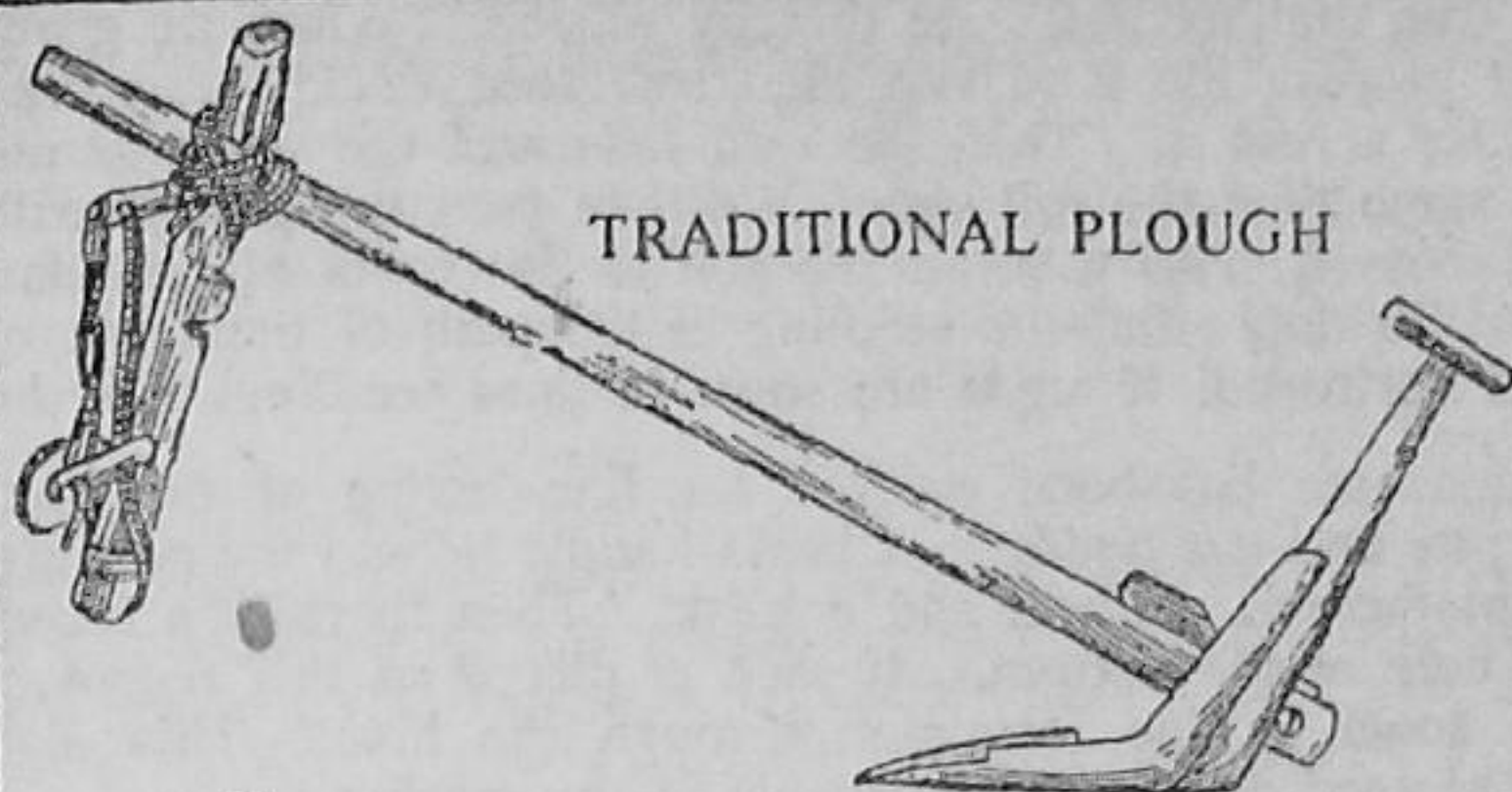
For winter crops it is necessary that the land retains its moisture, for rains are scarce at the time. For this reason when land is to be prepared for a winter crop it should be ploughed deep. This is not necessary for the crop that grows in the rainy season.

We grow many crops in lines, for example, sugarcane. The space in between has to be dug up from time to time. If the soil is loosened the air can enter it and the plant can spread out its roots. This can be done with a spade operated by hand. This, however, involves considerable effort. To avoid this people use power-operated spades. But in our country there are a few cultivators so rich as can afford to buy such a costly machine. That is why a new kind of spade has been evolved which can be operated by pushing. It has to be pushed from behind. It is fitted with three small blades with a wheel in front. If pushed the blades lean on the wheel and open out the soil. We can call this machine a wheel hoe. This wheel hoe is now manufactured in our country.

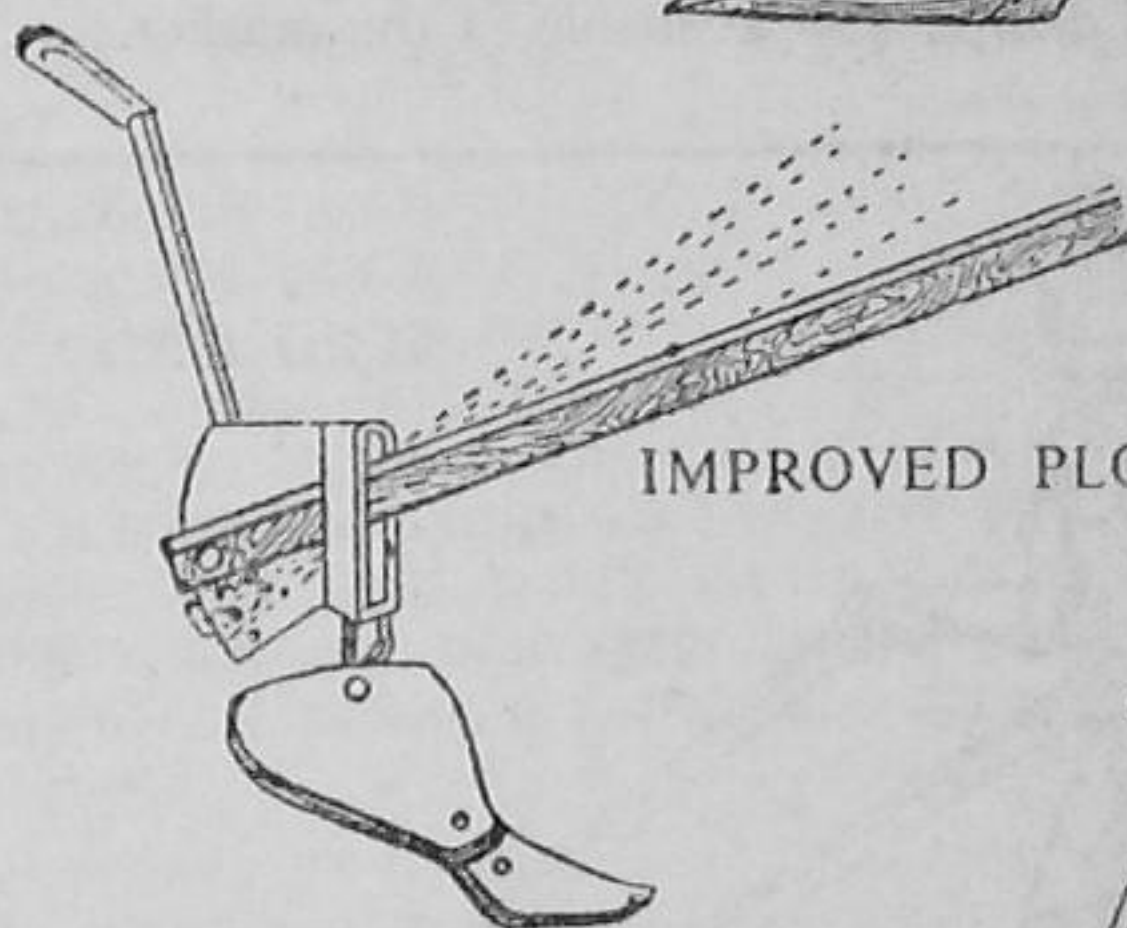
After a crop has been sown weeds and grasses sprout. Unless they are removed the crop cannot grow. They may even die out altogether. For this reason there is the practice of weeding the lands. For this purpose we use weeders. Weeders are effective no doubt, but the process takes time and many labourers have to be employed. A machine is now available for weeding fields. This can do the work quickly. This is called the Japanese weeder. It has a wheel in front and a steel comb behind. There is a handle fitted at the back. If it is pushed with the handle the weed is uprooted from the soil and the earth at the root of the plants is loosened.

To make it possible for the Japanese weeder to work, it is necessary to sow seeds in a line. If seeds are sown in lines the work of weeding can be done quickly with little labour with the help of this Japanese weeder. It will not be necessary to engage many labourers. Moreover, there is an additional gain. If seed is sown in lines more land can be sown with less seed. Furthermore, space between two rows of plants stimulates growth.

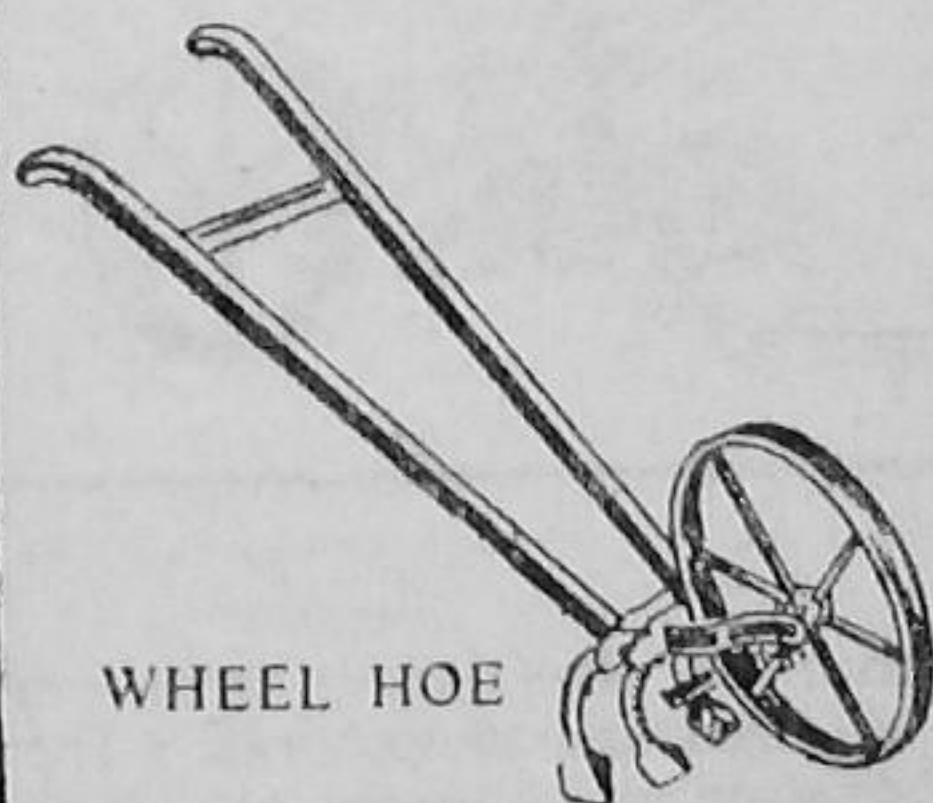
How can we sow seed in lines? Ordinarily the cultivator scatters seeds with his hands. That ensures distribution to all parts



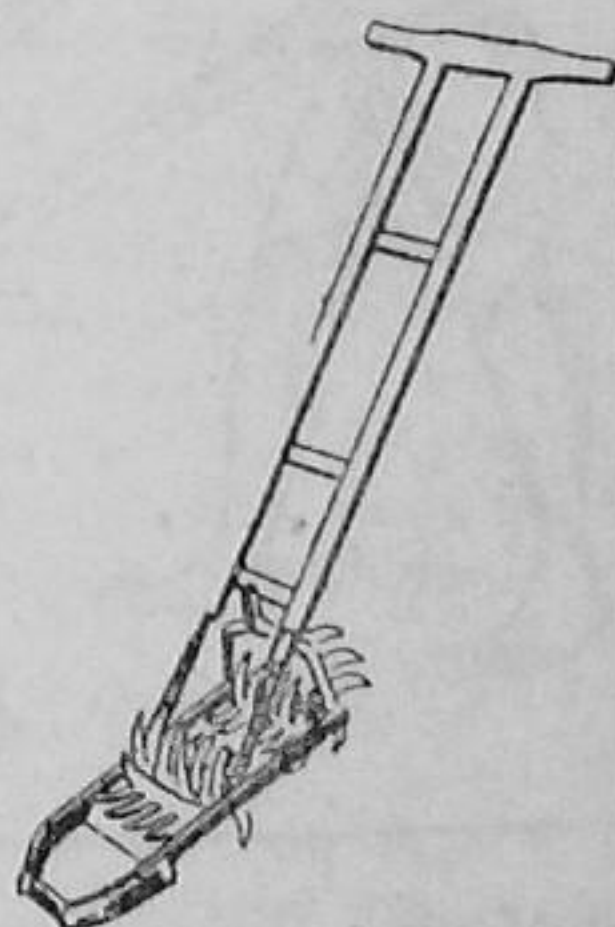
TRADITIONAL PLOUGH



IMPROVED PLOUGH



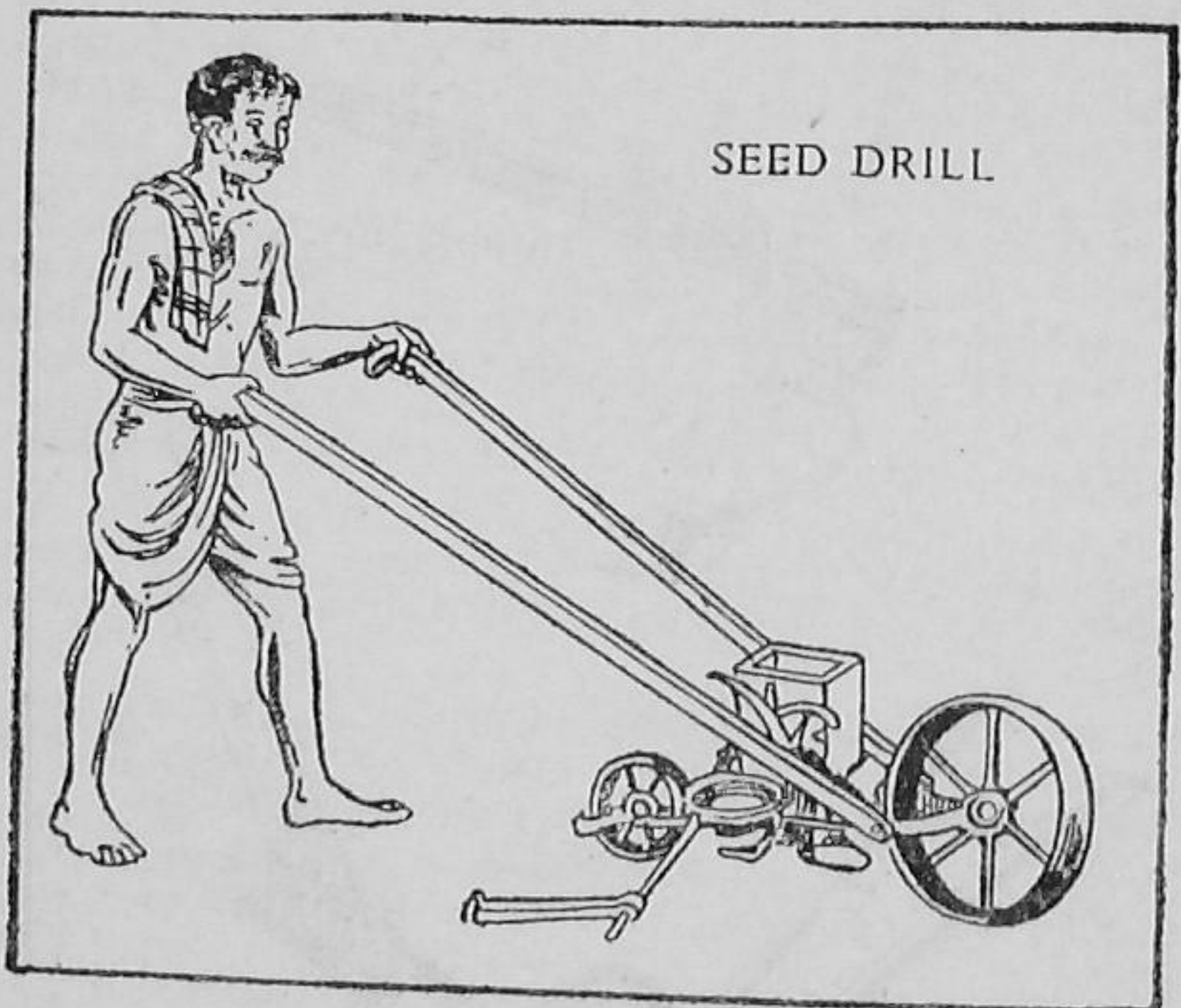
WHEEL HOE



JAPANESE WEEDER

of the land but does not lead to line sowing. On the other hand it is also true that seedlings are thereby wasted. When we grow jute we first prepare the land and then sow seed thickly and then put the ladder across it. Then the rain falls and the seeds germinate. At the same time the soil sets. We then pass the plough with the comb across it. As a result the soil at the roots of the plants is loosened no doubt but the seedling in the path of the tooth of the comb is destroyed. If seeds are sown in lines seedlings are saved.

A machine has been evolved for line-sowing of the seeds of wheat, jute and *aus* paddy. It has a handle behind for pushing. In the front there is a wheel and a hook. Then there is a receptacle with a hole at the bottom. If seed is placed in this receptacle, it can be sown in line formation through the hole. This machine called the seed drill is also available in the market.



Use of Manure

We have already learnt that the plant draws three principal foods from the soil—potash, nitrogen and phosphorus. The land in our country is deficient in nitrogen and phosphorus. If there is shortage of either of these two in the soil the crop fails to grow. It is necessary that both kinds of manures are put in the soil in the requisite quantities. Now the plant assimilates nitrogen in the form

of nitrate and phosphorus in the form of phosphate. This food can be put in the soil in the form of four different kinds of manure :

1. Cowdung manure.
2. Oil cake.
3. Chemical fertiliser.
4. Green manure.

COWDUNG MANURE

Cowdung is the manure of the poor farmer. Anyone who keeps a cow can make this manure. Easy to get, cowdung is also a good manure. It has both phosphate and nitrate. If cowdung is picked up from the cowshed we get urine mixed with it. Urine of cattle is also a good fertiliser. It is good to have urine mixed with cowdung.

In our country we burn cowdung as fuel. If one cannot afford fuel for cooking one uses cowdung cake instead. This prevents us from using cowdung as a fertiliser. In consequence the soil is deprived of the manure that could have been available free of cost. The land belonging to those who cannot afford to buy fertilisers goes without manure, and crops do not grow well on it. And the man who has money buys a different kind of manure. Thereby the money that could have been spent for other purposes is diverted to manure. For this reason, it is necessary for every farmer to see to it that as much of cowdung is used as manure as possible.

To use cowdung as fertiliser it is necessary to convert it into manure. One cannot produce good manure by piling up cowdung anywhere. There is a method of making manure from cowdung. It has to be learnt.

If cowdung is piled up on land part of it is washed away by water, or dries up by exposure to sun. To avoid waste the following method should be adopted for composting cowdung.

A rectangular pit should be dug up. Its length and width will depend on the quantity of cowdung to be composted. The pit should be about one-and-a-half cubits (27 inches) deep. Part of the earth that will be dug up should be used for raising a bund around the pit. Cowdung is affected as much by loss of moisture as by an overdose of water. The bund may be raised to a height of one cubit (18 inches). After the digging has been completed a layer of straw or grass should be spread at the bottom of the pit. Over that should be deposited a layer of powdered earth of a span's depth. If there is a liquid component in the cowdung, it will get mixed up with the powdered earth. Over the layer of grass or straw cowdung should be deposited to fill up the pit.

Above that should be erected a shed thatched with grass to prevent the cowdung from drying up by exposure to sun or the rain water saturating it.

OIL CAKE

In our country we also use oil cake as manure. In Bengal we use mustard oil cake. In other parts of the country people use castor oil cake, groundnut cake and *mahua* (butter tree, *Modhuca latifolia*) cake. Mustard oil cake is also a good manure like cowdung. It contains both phosphate and nitrate. But oil cake cannot be had free like cowdung. One has to buy oil cake from the oilman. Oil cake is more concentrated fertiliser than cowdung. A plant will consume less oil cake manure than cowdung manure. Oil cake and cowdung mixture also makes good manure. Oil cake manure can be applied in two ways. It can be mixed up with the soil after pulverising it before the crop is sown. The reason is that oil cake produces heat. If a seedling is transplanted or seed is sown before oil cake has been thoroughly decomposed the plant dries up. There is also the practice of applying oil cake when the plant has grown up a little. The soil near the root should be dug up a little and removed and then powdered oil cake should be mixed with it. It is better to put the oil cake a digit or two away from the stem, otherwise the plant may shrivel up. There is the practice of applying oil cake at the root of cabbages when they grow up a little. This stimulates growth.

Cowdung and oil cake belong to the same group of manures. That is because both are produced from organic bodies. Cowdung comes from the cow's body. And oil cake comes from the seeds of mustard oil plant. As they come from living bodies they are called organic manures. They have one great quality that they make the soil soft. Where this manure is applied the soil becomes light and porous. Air can enter it, water does not accumulate and the plant can spread out its roots easily.

CHEMICAL MANURE

The earth contains many constituents. Some of them are in the form of gas. They are not visible but can be felt; for example, air. It has been already mentioned that air is made up of many elements like nitrogen, oxygen, carbon. In addition, the earth has solid elements like iron, copper, and gold. When two mix they form what are called chemical compounds. The fertiliser that is produced by such chemical compounding is called chemical manure.

The two plant foods that are most deficient in the soil of our country are nitrogen and phosphorus as we have already learnt. The deficiency can be met equally from organic manure as well as chemical manures. To remove the deficiency in phosphorus we use superphosphate and ammonium sulphate or nitrate to make up the deficit in nitrogen. Previously this fertiliser used to be imported. Our national Government has now set up a factory for the production of chemical fertilisers. It produces ammonium sulphate. But our country is so vast that the fertiliser produced in this factory is not sufficient to meet our demand, and new factories are being set up.

Chemical fertiliser has one great advantage. When organic manure is put in the soil the bacteria in the soil works on it. It is after that that the manure decomposes and becomes fit for consumption by the plant. That is why organic manure takes a little time to produce results after application. The plant can, however, draw chemical fertiliser as it is applied. That is why the plant becomes vigorous soon after its application. If sufficient chemical fertiliser is applied vegetables and crops are seen to assume a deep green colour. If this manure is applied to cabbages the leaves of cabbages become deep blue in colour. If it becomes necessary to expedite growth of a vegetable or a crop, application of this manure will give very good results.

Chemical fertiliser is a costly manure. Moreover, there is the chance of its being washed away by water. For this reason a special method is adopted for applying it to the soil. We mix up organic manure with the soil before sowing or transplantation. The earlier it is mixed with the soil the better it will decompose for consumption by the plant. But chemical fertiliser may be applied after the plant has germinated and grown a little. When the plant grows up a little the soil round it should be dug up a little from above and then mixed with chemical manure. When the plant has grown it can draw the food quickly.

If organic manure alone is applied to the land no harm is done to the soil. If cowdung manure is applied year after year to a particular land its fertility will go on increasing. If, however, chemical fertiliser alone is applied to a particular land again and again the soil gets damaged. It ceases to remain light and porous. That is why the practice has grown of mixing organic and chemical manures for application to the soil.

For the benefit of the cultivator a new kind of manure called fertiliser mixture has been introduced. As both organic manure

and chemical fertilisers are its ingredients it is suitable for all kinds of crops. The mixture has the following ingredients :

| | | |
|-------------------|----|-------------|
| Ammonium sulphate | .. | 40 per cent |
| Superphosphate | .. | 35 per cent |
| Bone meal | .. | 15 per cent |
| Sludge | .. | 10 per cent |

It may not be known to many that the sludge from night soil is the best manure. The Chinese use this manure extensively. In our country this manure is not much in use.

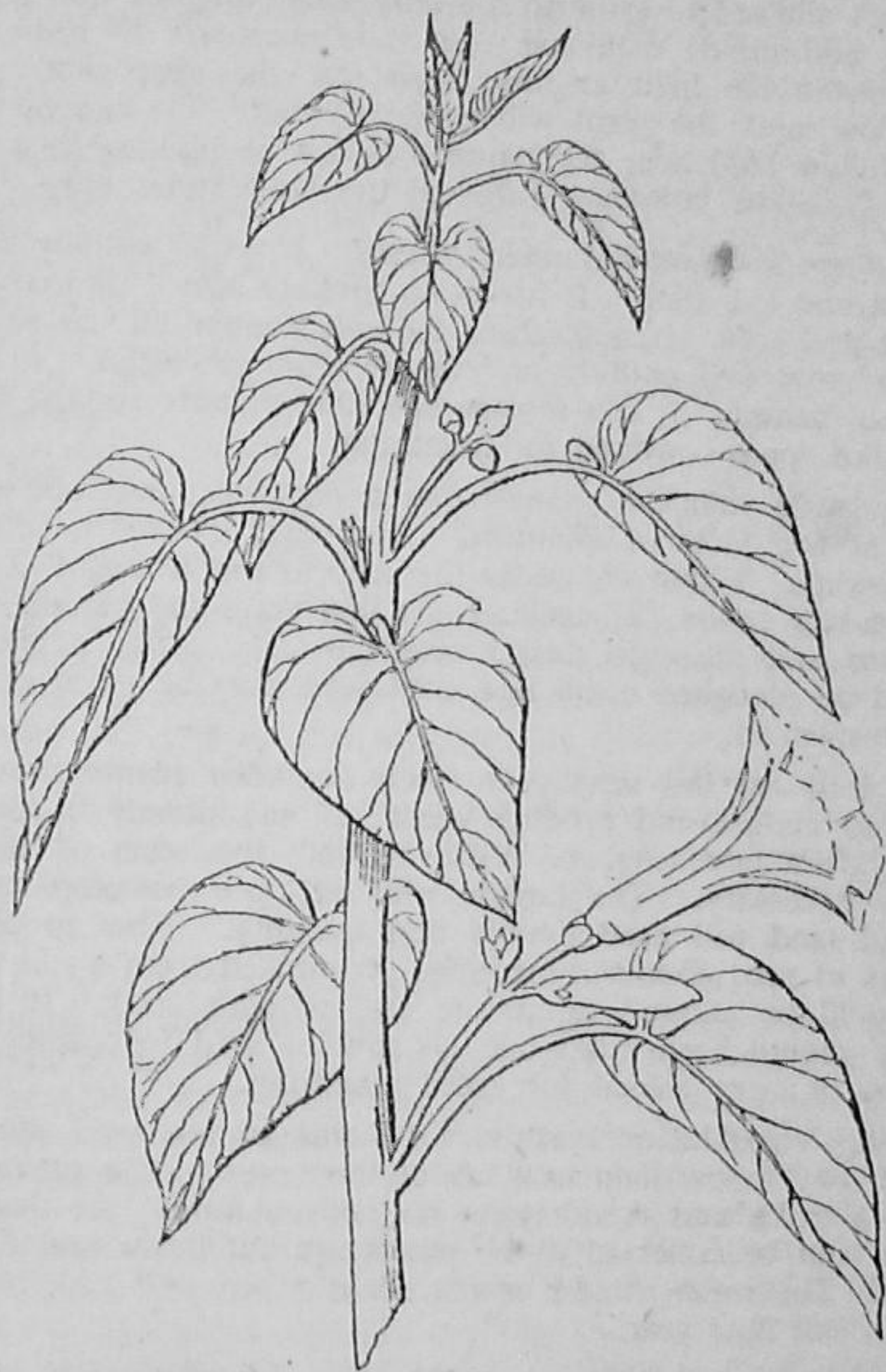
GREEN MANURE

Green manure is a kind of organic manure. It is so called because the plant which will produce the manure is ploughed into the soil before flowering while it is still green. It becomes food for the crop that we may raise.

For green manuring different kinds of plants and shrubs are grown outside the cultivated land in Madras area in the South. One of these shrubs also grows in other parts of the country. Its scientific name is *Ipomoea Carnea*. In Bengali it is called *bera-kalmi*. This is no doubt an appropriate name for this shrub. The leaves of this plant look like the *kalmi* creeper (water bindweed) which thrives in water. Its flower also looks like the light violet coloured flowers of water bindweed. It grows well in dry high land. Goats and cattle do not eat it. When the branches are cut they grow again. Many build hedges round the compound of their house with this shrub.

Very good green manure can be produced by putting the cuttings of *bera-kalmi* in the land. If it is used as hedge for the compound wall of the house it can serve two purposes simultaneously. It provides seclusion for the inmates of the house. Its top can be cut three to four times in the year and put in the soil as green manure. It is easily grown. If the branches of a mature plant are cut and put into the soil on a rainy day they take root. They need no looking after.

There is another kind of green manure which has to be grown on the land to which it is to be applied. When the plant grows a little it should be ploughed down and mixed with the soil. For the purpose of green manuring we ordinarily use leguminous plants. There are two points in its favour. Firstly, the plant mixes with the soil and is converted into organic manure. Secondly, bacteria draw nitrogen from the air and fix it in the root. So this green manure supplies manure to the soil in two ways.



IPOMOEA CARNEA
Bera Kalmi

In this respect green manure from *dhaincha* (*Secsabania aculeata*) is the best. The plant grows quickly. Also it is easy to raise seed for the next year. The crop that will fertilise the land is not allowed to grow to maturity, but ploughed down before flowering and mixed with soil. So it is necessary to grow some plants outside the field to raise seeds for the next year. High land or low land, the plant will grow anywhere. It can be raised on any fallow land near the house. It can be planted in a single row alongside the boundary ridge of the land under crop.

The *dhaincha* plant has many virtues. It grows equally well in high land and low land. It needs no looking after. It makes the soil light and soft. It neutralises the salt content in the soil. A crop can grow well entirely on manure from *dhaincha*. It is the best green manure. It can replace cowdung manure for the farmer who cannot spare cowdung for manuring.

To provide sufficient manure for a *bigha* of land one should sow about five seers of *dhaincha*. The land should be ploughed before sowing. Within six weeks the crop attains a height of about one-and-a-half cubits (27 inches). At that stage the plough should be applied and the crop mixed with the soil. After a few days it should be ploughed again and then seed may be sown or seedlings transplanted.

For seed for the next year some *dhaincha* plants should be allowed to mature and produce seed. It has already been stated that for green manuring one *bigha* of land, five seers of *dhaincha* seed are necessary. The farmer who has to raise crops on two *bighas* of land will need double that quantity. Now to produce five seers of seed *dhaincha* seedlings germinated from a *chhatak* of seed should be allowed to mature and produce seed. It follows that one should keep apart one *chhatak* of seed for raising every five seers of crop needed for green manuring.

During Vaisakha or Jyaistha a *chhatak* of this seed should be sown on any fallow land near about the house. The plant grows and by Kartika and Agrahayana its pods mature. At that stage the seed can be collected if the plants are cut down and dried in the sun. The seeds should be placed in a box and kept in a dry place for use next year.

If no land is available for raising seed, *dhaincha* grown in a line can be put alongside the boundary ridge of a paddy field. It will not take much space, nor will it have any injurious effect on the paddy crop. When seedlings for the paddy are raised a small part of the seed bed should be sown with *dhaincha* seed. After that when the seedling has grown a little and paddy plants are being transplanted to the field *dhaincha* seedlings should be trans-

planted along the boundary ridge. When paddy ripens *dhaincha* plants will mature. When paddy is put in the barn *dhaincha* seed will be taken into the house. In this manner every farmer can raise his own *dhaincha* seed for his annual consumption.

Provision of Irrigation

Unless its food mixes with water, a plant cannot draw it through its roots. For this reason it is essential that there should be water in the soil. It may be that there is some manure in the soil. But if there is no water in the soil, what use is the manure? It is like shutting up the mouth of a man and then placing good dishes before him. Without water no crop can grow. Raising of crops should be taken in hand only after provision has been made for watering.

In the olden days man used to depend on rain-water for irrigation. That is why the farmer would grow only such crops as grew in the rainy season.

But if we depend entirely on rains for our crops it often amounts to depending purely on luck. It is true that rains come every year. But in one year rainfall may be heavy, in another year it may be scanty. We just do not get the right quantity of rainfall every year. Again for different crops we need varying quantities of water at different stages. If water is not available in the required manner the crop is damaged. What an advantage it would be, if we could provide for a regular supply of water without depending on luck!

We grow *aman* paddy in the rainy season. Even for that water is necessary at different stages. After germination in the seed-beds *aman* seedlings are transplanted to the field. Before that as much water is necessary as would flood the field and when ploughed will turn the soil into mud. The best month for transplantation is *Sravana*. At most it can be delayed till the first week of August. After that the greater the delay in the transplantation of seedlings the less is the yield. At this stage if the rainfall is insufficient the seedlings cannot be transplanted. One has to wait for more rains. If there is insufficient rainfall in *Sravana* the transplantation is delayed. The yield also decreases. If there is arrangement for supply of water when desired, raising of paddy can be much easier. One need not then depend helplessly on rains. That is why provision of irrigation is necessary.

There are other advantages of irrigation. It takes three or four months for a crop to mature in a field. There are of course crops which may even take a year to mature, for example

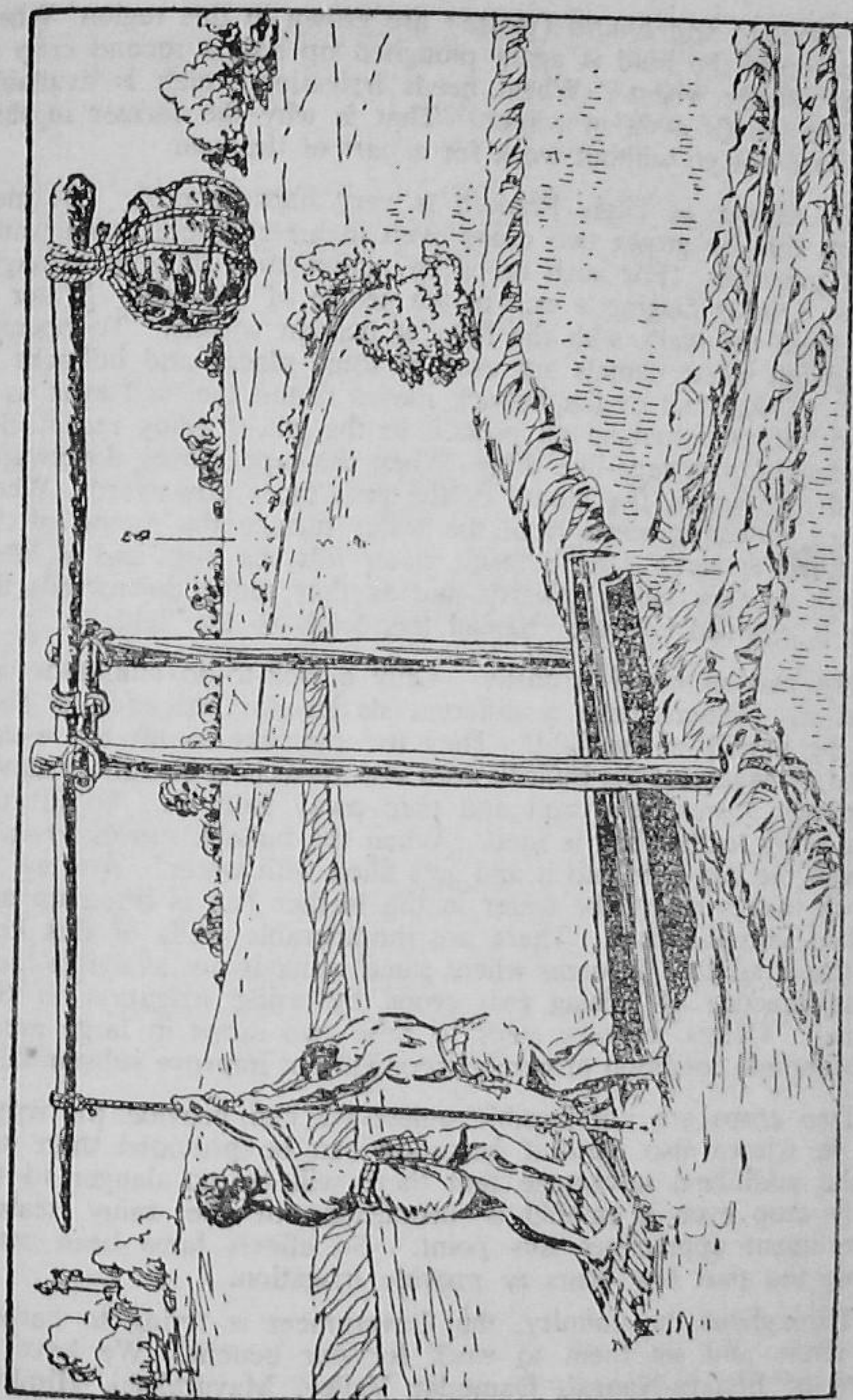
sugar-cane. Ordinarily a crop can be raised in three to four months. If one depends entirely on rain-water for irrigating crops, one cannot grow more than one crop on a piece of land. If there is an alternative in the form of irrigation, it is possible to grow more crops than one on the same piece of land.

It is for this reason that man has in all ages tried through different methods to provide for irrigation. In addition to paddy, we grow in our country some crops in winter in some areas where irrigation is available. Take the case of Burdwan and Hughli districts. Many areas in these districts receive water from the Damodar canal system. Taking advantage of this many farmers grow potatoes in these regions. Potato cultivation is spreading even to areas where canal water is not available. In these places the farmers draw water from tanks. They take the water that accumulates in the borrowpits on the road side. For this purpose they use a contraption which is called *don*. The trunk of a palmyra palm is taken and then the inside is scooped out to form a sort of receptacle. It is done in the same way as a dug-out is made out of a palmyra plant. The only difference is that in the case of the dug-out both the ends are closed, but in the case of a *don* only one end is closed. The open end is placed on the land to be watered, while the closed one faces the water. For irrigation the end towards the water is dipped into water and then raised up. The water flows into the field through the open end.

In many areas, for example in Uttar Pradesh, there is more land under double crop than in West Bengal. In all the land that grows *aman* paddy in West Bengal, hardly a second crop is raised. Where there is high land we grow *aus* or jute in the rainy season and a *rabi* crop in winter. If we grow mustard or *kalai* (*Phaseolus radiatus*) there is no need for irrigation. But there are crops which need irrigation. Potato and tobacco are examples.

In Uttar Pradesh there is provision for bringing water to the fields from the rivers by digging canals. The Ganga and the Yamuna are very big rivers. They flow from the Himalayas. The Himalayas are the highest mountain range in the world. Its highest peak is nearly six miles high. The high Himalayan peaks are snow-clad throughout the year. During winter snow accumulates. Then as the summer sets in the snow melts and keeps the rivers flowing. For this reason there is water in these two rivers even in summer. Even if there is no rainfall there is no scarcity of water. We then get water from melted snow. That is why there is water in these rivers at all times and irrigation is possible throughout the year.

It is possible to grow two crops in Uttar Pradesh as irrigation is available there. It may be noticed that during the rainy season



Irrigation by don

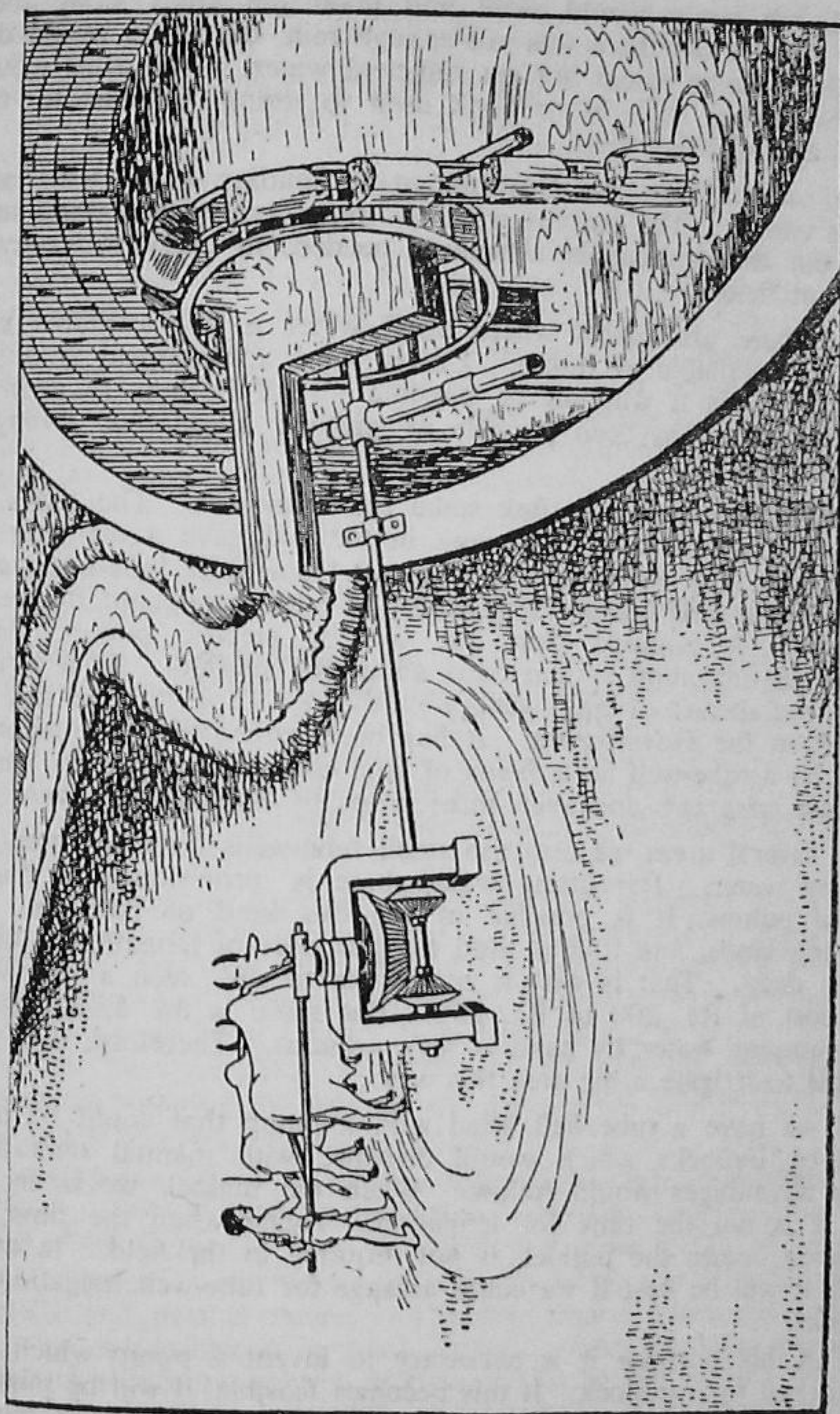
jowar (millet) and *bhutta* (maize) are grown in this region. When winter comes the land is again ploughed up and a second crop is grown, usually wheat. Wheat needs irrigation which is available from the canals even in winter. That is why the farmer in that State does not go without work for a part of the year.

The farmer of Uttar Pradesh is very hard working. It may be seen that he grows two crops even in areas where canal water is not available. For such crops he makes two different arrangements. One is digging a well in the centre of the field. Water is lifted from the wells with the help of persian wheels. To operate the persian wheel camels are used in some places and bullocks in others. The camel or the bullock moves round the well even as a bullock moves round an oil press. In the wheel many receptacles are attached to a tape-like thing. When the tape moves downwards towards the water, the mouth of the pots faces downwards. When the tape moves upwards from the water surface the mouth of the pots turns upwards. As a result water fills the pots and is lifted upwards as they move upwards and as they move downwards the water is emptied into the channel that leads to the field.

The persian wheel is costly. Only a well-to-do cultivator can afford it. Others have a different device for irrigation. They also dig a well in the field. They use bullocks to lift the water. In this arrangement the bullock does not move in a circle. It moves alternately towards the well and then away from it. To lift the water a big leather bag is used. When the bullock moves towards the well the bag falls into it and gets filled with water. And as the bullock moves away, the water in the leather bag is lifted up and emptied into the field. There are innumerable wells of this kind in Uttar Pradesh. In areas where canal water is not available there is the practice of raising two crops by using irrigation in this manner. Unless we take steps to raise two crops in large areas, the economic condition of our farmers will not improve substantially.

Two crops are not feasible unless we can provide for irrigation in winter also. And if irrigation can be provided there will be the additional advantage that there will be no danger to the paddy crop even if rainfall is insufficient in the rainy season. Government appreciates this point. So efforts have been made during the past few years to provide irrigation.

Throughout the country, the Government is trying to harness the rivers and set them to work for our benefit. We have all heard of Bhakra-Nangal, Damodar Valley, Mayurakshi, Hirakud, Nagarjunasagar, Kosi, Tungabhadra, Chambal and a number of other river valley projects. Our rivers have plenty of water which used to run to waste in the sea. Whenever there was a heavy



Persian Wheel

rainfall, the rivers would swell and flood the areas along their banks. And when there was not enough rain, the rivers would dry up and the fields would not get sufficient water. The crops would die. So, either drought or flood used to bring distress to the people almost every year.

To prevent this, the Government is building huge dams and digging canals. The surplus water is stored behind the dams and is let out through canals, whenever needed, to carry water even to distant fields.

But there are places where canal water is not available nor will it be available in future. Unless some arrangement is made for such places it will not be possible for all farmers to grow a second crop. It has been possible to provide alternative arrangements for this.

The Government has sunk some big tube-wells. The tubes of these wells which have been sunk in the soil have a diameter of six inches. The water that is pumped from such tube-wells can irrigate about 750 *bighas* (250 acres) of land throughout the year. The water is pumped from the soil by electric power. Such a tube-well irrigation system costs about Rs. 66,000. So it is not within the means of an ordinary cultivator. For this he has to depend on the Government. It has been estimated that one irrigation by a tube-well for a *bigha* of land costs about 66 *naye paise*. One can raise two and even three crops by utilising this water.

In several areas we also use small tube-wells for the supply of drinking water. For lifting water there is provision for hand-worked pumps. It is possible to use this kind of tube-well for irrigating lands, and if it is used for purposes of irrigation it need not go deep. That is why it is possible to sink such a tube-well at a cost of Rs. 200 to Rs. 250. But there is the disadvantage that pumping water by hand is very arduous. Therefore, it is not possible to irrigate a big area this way.

If we have a tube-well fitted with a pump that could be operated by bullocks which would dispense with manual operation, many advantages would follow. When the bullock works in the field it is not the time for irrigation. Again when the time for irrigation comes the bullock is not required in the field. In other words it will be best if we could arrange for tube-well irrigation by bullocks.

For this purpose it is necessary to invent a pump which can be worked by a bullock. If this becomes feasible, it will be possible to provide irrigation all the year round through bullock power wherever a tube-well can be sunk, and two crops in the year can easily be raised. The lands which used to remain fallow for half

the year will cease to remain so. The economic condition of the cultivator will improve considerably.

The West Bengal Government has paid some attention to this problem. As a result a pump has been evolved which can be operated by bullocks. This pump can lift about 400 gallons of water per hour. If the bullock works 7 hours a day then the discharge will be 2,800 gallons. We know that a *bigha* (0.33 acre) of land requires 7,500 gallons of water for irrigation. So this pump can irrigate a *bigha* in three days. This pump will cost about Rs. 800. This being rather costly efforts are being made to evolve a cheaper type. If this pump can be produced cheaply it will be within the reach of the small cultivator and he will be able to irrigate his land throughout the year. A bullock-driven pump has since been devised which can discharge 700 gallons per hour and costs Rs. 500.

Use of Good Seeds

We have seen men from Nepal. They are short in stature. Bengalis grow taller than them. Again the Punjabis grow taller than the Bengalis. A Bengali will appear short by the side of a Punjabi. If we bring together a Nepali boy, a Bengali boy and a Punjabi boy and bring them up under identical conditions the Nepali will remain short, the Bengali will attain medium height and the Punjabi will grow fairly tall. Even if we supply them with equally good food the result will be the same.

Why does this happen? Each race has a special quality. The quality does not change even if the environment changes. What applies to man also applies to crops and vegetables. To grow good crops one should procure good seeds, otherwise whatever our efforts we cannot get good crops. If poor quality seed is used the yield will not be appreciable whatever else we may do. On the other hand, if we sow good seed we can get a good harvest even without much care.

The seed has two main qualities. The more important is the capacity to give a high yield. After all we want to grow more crops. From that point of view the seed that gives better yield should receive preference. Next to that is the quality which will increase its demand in the market. The rice that is fine, good to taste and sweet smelling is in great demand. For banquets people look for such rice in the market and are willing to pay a fancy price. To sum up, therefore, the seed has two different qualities: increased yield and superior quality which creates increased demand for it in the market.

Good seed can be procured in two ways. The seed of the variety that has a high yield or is in great demand in the market can be kept separate. If instead of selling it or eating it we use it next year it will displace inferior quality seed. It is possible to collect good seed in another way. By uniting two different high quality crops we can create a new hybrid class which combines the virtues of both. After that we can spread the use of this new variety. The place where wise men work on such matters is called a research centre. In Delhi the Government of India runs a big research centre, the Indian Institute of Agricultural Research. Some State Governments also maintain several similar research centres.

For production of good seed and its distribution various State Governments have acquired land and set up seed multiplication farms. The quality seeds produced by these farms are distributed among farmers. Information about this is available from the officers of the Agriculture Department. The farmer friend who cares for quality seeds should contact that Department.

Apart from this, every cultivator can raise his own quality seeds. One can set apart seed for the next year from the crop that has given a satisfactory yield. Also, if a farmer happens to grow a good crop in the village one may take some of that for seed.

VI. IMPROVED METHODS OF CULTIVATION

We have taken the vow of rebuilding our country for our own welfare. If we do not observe this vow our poverty will continue and our necessities of life will never be met. This vow has to be observed by each one of us. The development of a big country like ours requires sustained effort. In this task every one has to do his bit. A doctor has work to do even as an engineer has. As there is work for the teacher there is also work for the public servant. An artisan has as much to do as a farmer. No body's contribution is insignificant. The vow can be properly observed if everybody does his duty. In this context the role of the cultivator is also very important. Unless more crops are raised the work of developing the country cannot progress. One must eat before one can work. If crops can be grown well the farmer will be well off and there will be plenty of food to go round. The country's welfare and the farmers' own welfare are thus tied up.

The cultivator normally raises his crops by following the same methods that were in vogue ages back. These were the best methods in olden days. But these are not so now. People in other countries have given serious thought to the problem of evolving new methods for increasing the yield of crops. As a result they have been able to introduce many new methods and new implements. Unless we learn about these new practices and new implements we cannot increase the productivity of our lands. We must also remember that the population of our country is increasing daily. The boy of today becomes an adult tomorrow and marries. Children are born to him. After years he grows old. In the meantime his sons and daughters have grown up. They have in their turn married. His grandchildren have started calling him grandpa now. In this way, man multiplies in number but the land does not increase in area. In the circumstances, to be able to provide food for every mouth it is essential to increase production by the adoption of new practices. It is necessary to have a clear idea of how much we are behind other countries in respect of production. An illustration will help us to understand this better. Paddy is the most important crop in many parts of India. There are many other countries in the world where rice is grown. Like us they grow paddy in their fields. Now if we find out how much paddy we grow in a *bigha* of land and how much these other countries grow we can realise how much ahead of us they are. Some of the countries that have a good yield of paddy are Japan, China and the United States of America. Italy,

too, has a high yield. The table below gives figures for the production of paddy in a *bigha* of land in different countries :

Japan—575 seers or 14 maunds 15 seers

China—405 seers or 10 maunds 5 seers

United States—357 seers or 8 maunds 37 seers

India (rice, 1956-57)—128 seers or 3 maunds 8 seers.

We have given here the average for each country as a whole. In India some lands yield 10 maunds of paddy to the *bigha* and some others have an yield of less than 3 maunds per *bigha*. From the statement above it will be seen that the productivity in other countries is much higher than that of India.

The reason for this high yield in other countries is the use of improved methods and new implements which make cultivation more efficient. To be able to reach that level we should adopt their methods and their implements. In the olden days we would either walk or use a bullock-cart to go to a distant place. Now we use motor cars. If we compete with a man who uses a motor vehicle by riding a bullock-cart our defeat is assured. In the field of agriculture our position is similar to that. Unless new methods replace the old ones we are bound to lose.

Of the improved practices adopted in these countries for raising production not all are at present within our reach, and even if within reach some do not suit us. In China and Japan night soil is used as manure, because it is the best fertiliser. Its use, however, is not popular in our country. In other countries crops are grown in big plots. They are not big in the sense that they measure 10 to 15 *bighas*; they measure hundreds and even thousands of *bighas*. The advantage of cultivating big plots lies in the fact that we can operate machines which are power-driven. This makes cultivation less laborious and cheaper. In China cultivation is done under the direct supervision of Government in big plots. In the United States of America big farms are cultivated by peasant proprietors. They have no dearth of money. So they can afford to buy power-driven machines. Ours is a country of small cultivators. So cultivation on a big scale, unless we take to cultivation on a co-operative basis, is impossible. Co-operative farms have been set up in a few places, but the progress is extremely slow.

So we must try to increase productivity in small holdings. In this respect our condition is comparable to that of Japan. That country is small in area and made up of numerous islands. Much of the area, again, is covered by mountains. Still the Japanese would not take defeat. They till small fields using improved techniques. They use many implements that can be operated by hand. As a result they have become big cultivators even with small holdings. We should also become big cultivators with small holdings.

So it should be our vow to increase production even in small holdings. We have so far discussed how yield can be increased even in small holdings by adopting new practices and new implements. We have described them as so many rules for the observance of the *vrata* of growing crops. If we observe these rules we, too, can become good cultivators and cultivation will become a pleasure.

We may now study how these practices can be utilised for raising crops. Ours is a vast country. It is so big that it is difficult to form an idea of its vastness. Even the village we live in does not appear small to us. The distance from one end of the village to the other will easily be about two miles. On an average about 130 families live in such a village. Our country is made up of five and a half lakhs of such villages. This will give us some idea of the vast size of our country.

A country which is so big naturally has all kinds of soil, all kinds of terrain and all kinds of men. It will also have varied climatic conditions. In our country there are big mountains as well as small hillocks, fertile plains as well as stretches of sandy deserts. Just as there are big rivers like the Ganga and the Godavari so also there are small rivulets which carry no name. In the high mountains snow falls in winter. Again there are places where hot blasts of wind blow in summer. There are places where it rains continually for eight months in the year. Again there are spots where it hardly rains for even seven days in the year. Some of our lands are so fertile that they yield bumper crops without effort. Again in other places the soil is so infertile that hardly any crop can be raised even with the greatest effort. At one place the soil is red, at another it is grey, and again at another place it is black. To sum up we may say that there is hardly anything in the world which is not represented in our country. So goes the adage in Bengali "What is not in Bharat is not outside Bharat".

Where there is such a variety of soil, climatic conditions and rainfall patterns the practice of growing different crops in different areas is bound to develop. The people in different parts of the country will develop different habits of food. That is why we have so many kinds of foodgrains to supply staple food. For some of us rice is the staple food, for others it is wheat, again for others it may be *jowar* or *bajra*. In some areas we grow jute and in others cotton. In some areas we grow groundnuts and in others linseed.

The rules for raising good crops so far discussed by us will apply generally to all kinds of crops. All the rules, however, do not apply invariably to all crops. Different crops have different habits. The method of cultivation has to be varied to suit such differences. This reminds us of a story told by Thakur Ram Krishna.

There was a mother who had four sons. She had purchased fish to prepare courses for them. It so happened that one of her sons loved hot dishes. For him she prepared fish curry liberally spiced with pepper. Another son was fond of sour dishes. For him she prepared a course with tamarind. The third son was fond of crisp fried things. For him she fried the fish. Now the fourth son had a delicate stomach. So for him she prepared a light dish without spices. She knew all the methods of preparing different courses with fish. She utilised different methods to prepare different courses to suit the taste and capacity for digestion of her four sons.

A good farmer should follow her example. After all the farmer is like a mother to his crops. He knows the different methods of growing crops. It will not, however, do to apply the same method uniformly to all crops. He will have to apply different methods to suit different crops.

There is, therefore, a definite advantage in learning the different methods of cultivation of the principal crops raised in our country. We shall thereby get an idea of the special methods which should apply to different conditions. The farmer should also pick up a close acquaintance with the improved methods of cultivation of these crops.

The crops which supply our staple food are those grown most extensively in our country. Of the crops that yield foodgrains the most important are paddy and wheat. In areas where the rainfall is low and the soil is poor the farmer raises *bajra* and *jowar*.

Next to food, cloth is our essential need. Cloth is produced from cotton. That is why cotton is also one of our principal crops. Another important crop in our country is groundnut. No country in the world produces as much groundnut as we do.

Improved Method of Paddy Cultivation

A crop we use for subsistence is called staple crop. Paddy is the most important staple crop in our country. Of the total area under cultivation a quarter grows paddy. Except for Rajasthan there is no State where paddy is not grown. Even a mountainous country like Kashmir grows paddy.

The technique that has been developed for raising the output of paddy is known as the Japanese method of cultivation.

Ordinarily to grow a good crop it is necessary to prepare the land well, to sow good seed, to apply manure and to protect the plant from its enemies. The customary practice in our country of

growing transplanted *aman* paddy pays no attention to good seed and seedlings are transplanted at random. In consequence, there is little scope for loosening the soil at the root of the paddy plant. There is no provision for the application of manure. On the other hand, special attention is paid to these matters in the Japanese method.



Seed-beds under the Japanese method of paddy cultivation

In the first instance, care is taken to see that healthy seedlings raised from good seed are transplanted. For this reason particular care is taken to prepare the seed-bed. The seed-bed should be six digits (or 3 in.) high and two and three-fourths cubits ($49\frac{1}{2}$ in.) wide. The soil should be dug, turned and reduced to powder. After that cowdung manure and ammonium sulphate should be mixed with the soil. Before the seed is sown it is washed in salt water and treated with Agrosan G.N. to destroy disease germs. If good

seed treated with Agrosan G. N. is sown in well-manured soil we get vigorous seedlings.

Then comes the application of manure to the field after thorough ploughing. If green manure is used, *dhaincha* is sown and after a growth of five to six weeks it is ploughed into the field with a ladder and then mixed with the soil. Alternatively, there is application of cowdung manure. Then, when the soil has turned into mud eight seers of ammonium sulphate and half a maund of superphosphate are applied per *bigha*.

Again transplantation is done in such a manner that the seedlings are arranged in rows and some space is left between them. Rows should be spaced sixteen digits (or 8 in.) apart and in each row three seedlings should be planted at a spot vertically, ten digits or one span apart along the row. Ordinarily we transplant seedlings at random with a slant. This method consumes more seedlings and makes it difficult to turn the soil. It becomes easy to plant in a row if we tie a rope between two pegs and transplant seedlings along it. It is desirable to complete transplantation within the month of *Sravana*. After that the longer the delay the lesser will be the yield. The crop will be unsatisfactory, however well-manured the land may be. If we can feed a child well during his growth he grows vigorous. But once beyond the stage of growth a boy will not develop however well fed he is. It is the same with plants.

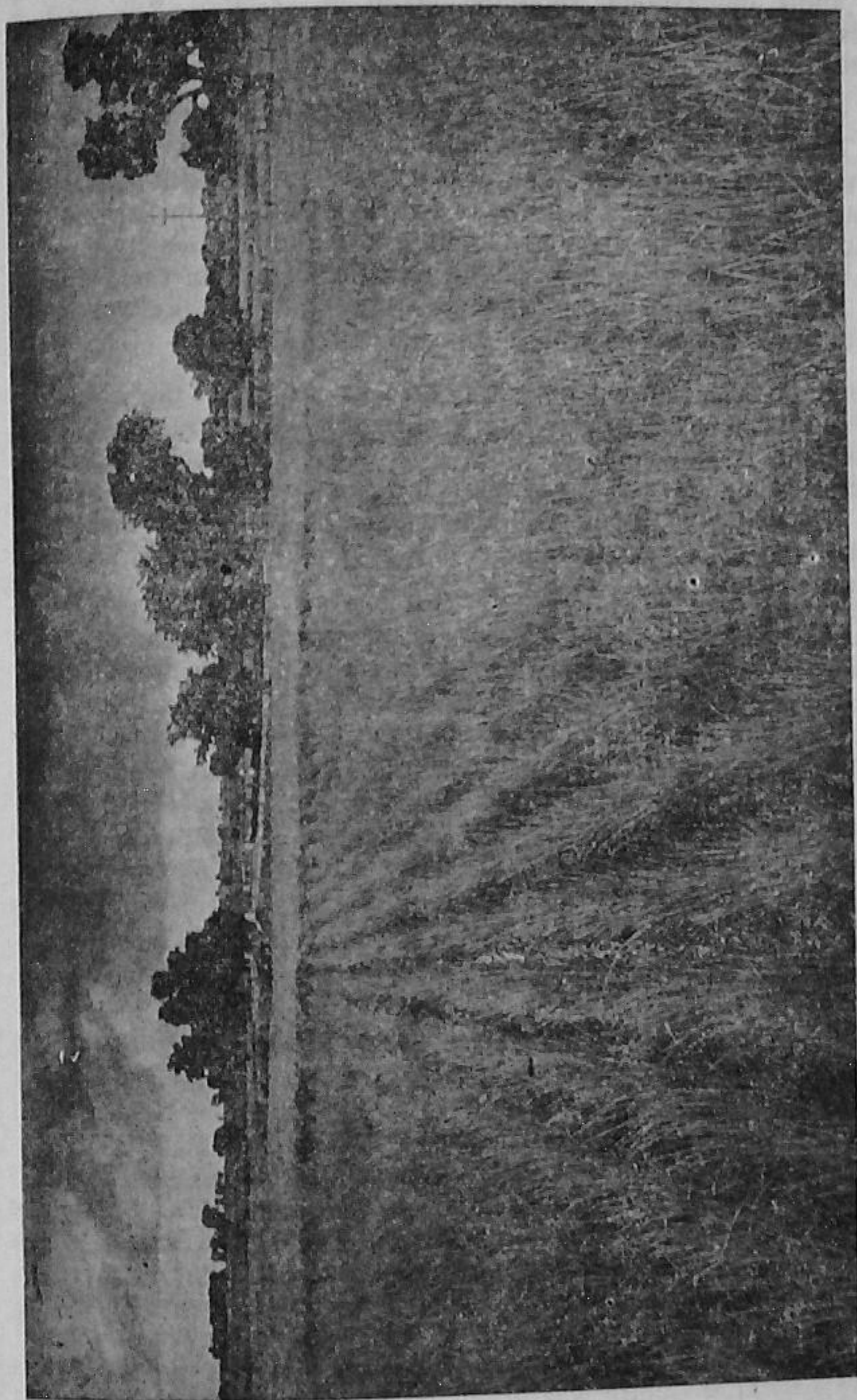
When the seedlings grow up a little a Japanese weeder is moved in the space between the rows. That kills the weeds as well as loosens the soil at the roots of the plants. Plants are sown in lines to make it easy for the Japanese weeder to operate. As a result the plant gets space to grow and can spread out roots to feed on the manure.

Improved Method of Wheat Cultivation

Next to paddy, wheat is our most important foodgrain. It thrives in clayey soil. But the land should not be water-logged. The area under wheat in our country is about one-third of that under paddy. Wheat is grown principally in Uttar Pradesh, the Punjab and Madhya Pradesh. Vast stretches of land under wheat crops are a common sight in winter in these States. The States of Maharashtra, Gujarat and Bihar also grow wheat. There are other States which raise wheat in small quantities.

Compared to other countries, the wheat yield per *bigha* in India is low as will be seen from the following table :

| |
|---------------------------------|
| France—6 maunds 20 seers |
| Italy—6 maunds 1 seer |
| United States—4 maunds 6 seers. |



Paddy sown in rows

In India the average yield per *bigha* in 1956-57 was only 2 maunds 20 seers, because we do not make use of improved methods of cultivation.

In some parts of our country wheat takes only four months to ripen. There are, however, other varieties of wheat which take seven to eight months to mature. The wheat grown in the hills belongs to the latter variety. Wheat is sown in Madhya Pradesh in September. In Uttar Pradesh it is sown in October. In the Punjab it is sown in November. Wheat is grown with irrigation water in the Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra and Gujerat. In other States it is a rain-fed crop.

Where it is a rain-fed crop the land is ploughed eight to ten times before seed is sown. When it is raised with irrigation water and the land is ploughed six times it is desirable that at least on one occasion the mould board plough is used so that the soil is turned upside down. This will give better crops. Before seed is sown the field should be planked. This will help to break the soil and retain moisture.

One *bigha* of land needs 90 maunds of cowdung manure. As it takes time for cowdung manure to show results it is desirable that it should be mixed in the soil seven to eight weeks before seeds are sown. If mustard cake is applied a *bigha* will require seven seers. The yield will go up if nitrogen is added. Ammonium sulphate or sodium nitrate may be mixed with the soil at the rate of three seers per *bigha*. Where the soil is deficient in phosphate an equal quantity of phosphate may be applied. This will push up the yield further. This practice obtains in Bihar.

There are two varieties of wheat grown extensively in our country. One variety is grown in the plains of the northern States. *Sharvati* wheat is a representative of this class. There is another variety which grows in the black soil of the Deccan. *Kathio* wheat represents this type. To secure better yield we need a variety which is sturdy and yet gives a good yield. We had occasion before this to speak about the Agricultural Research Institute of Pusa in New Delhi. Scientists work there to evolve improved varieties of crops. As a result of research work they have evolved new strains of wheat which yield bigger crops and can resist rusting. The farmer who is keen to achieve high yields can get these improved varieties from the Agricultural Directorate of his State. We can mention here names of two improved varieties, N.P. 710 and N.P. 718. These names may strike as rather strange, but they have a significance. The Pusa Research Centre was originally located at a place bearing that name in Bihar. That was destroyed by the great earthquake of 1934. After that the centre was moved to New Delhi. That is why

it is known as New Pusa. The letters N and P signify that the improved varieties were evolved in the new Pusa Research Institute.

Some people sow wheat by broadcasting. There is also the practice of sowing seed along the furrows left by the ploughshare. Eight to fourteen seers of seed are needed to sow a *bigha* of land. Broadcasting consumes the maximum quantity of seed. Sowing along the furrow consumes less. If the seed is sown with a seed drill, still less seed is needed. To get good crops one should adopt the practice of sowing in lines with a seed drill. There should be intervening space between the lines. This results in the economic use of seed, helps better growth of the plants and provides better facilities for loosening the soil.

After the seed germinates the field should be hoed once to destroy weeds, loosen the soil and help the retention of moisture.

Where irrigation is available the fields should be irrigated about 45 days after sowing. One crop needs irrigation three to four times.

Wheat matures in our country towards the end of the winter season. It should be harvested before it is over-ripe, otherwise grains drop from the sheaf and are lost.

Improved Method of Bajra Cultivation

Bajra is also a food-grain. It is a hardy crop which needs little water. It can stand bad soil. For these reasons it can be raised where other delicate crops will fail. It will grow well in good soil. It will grow in bad soil as well. It dislikes one thing, that is it cannot stand heavy rainfall. The rainfall in West Bengal and Assam being very heavy it will not grow in these States. The strongest point in its favour, however, is that it can be grown where the soil is too poor for other crops to grow. It is cultivated extensively in sandy and dry Rajasthan. It is also grown in the dry tracts of Maharashtra, Gujarat, Uttar Pradesh, Madras and Andhra Pradesh. Bajra gives an yield of three maunds to the *bigha*.

It has already been stated that bajra grows on any kind of dry soil under conditions of low rainfall. The land does not need much preparation either. Before sowing the land should be ploughed crosswise. That is to say if the plough is driven north to south first, it should be driven east to west on the second ploughing. After each ploughing the land should be planked. It should be only harrowed. Bajra does not need heavy manuring. Two to three cartloads of cowdung manure or compost are sufficient for a *bigha* of land. In the south there is the practice of applying groundnut cake at the rate of fifty seers per *bigha*.

It takes three months for bajra to mature. As it cannot stand heavy rain it is not sown immediately after the outbreak of the monsoon. The proper time for sowing is June or July and the harvesting takes place in August or September. The yield will increase if better quality seed is used. In the States where this crop is grown improved varieties have been evolved. Improved seed is available from the Agriculture Directorates.

Bajra is sown both by broadcasting and in lines. When it is sown in lines the space between two lines should be one and a half to two spans. Bajra can be grown exclusively on a field or in combination with another crop. Where it is raised exclusively a *bigha* of land needs one seer of seed. Where it is grown along with another crop half a seer will suffice.

After the seed has been sown the field should be planked. After germination when the seedling attains a height of six to eight digits the field should be harrowed. This will loosen the soil and encourage tillering. It needs little care after that. When the corn ripens, however, it is attacked by birds. So it must be protected from birds during day-time. The children of the family are generally employed on this work.

Improved Method of Groundnut Cultivation

It is not understood why groundnut is called *Chinabadam* in north India. It did not come from China at all. It belonged originally to Brazil in South America. The Portuguese brought it to our country.

Some extraordinary features distinguish groundnut from other crops. It flowers outside the soil but bears fruit inside. Moreover, the fruit is protected by a hard shell. Within the shell there is no flesh but only seed.

Groundnut has many qualities. The plant is good fodder. When baked the nuts are crisp to taste. For inexpensive nutrition it is hard to beat. It is the raw material for cooking oil known as *vanaspati*. In fact, nearly three-quarters of the groundnut crop we produce is used in the manufacture of *vanaspati*. It loves a tropical climate. That is why it thrives in the southern part of the country. Of the total area under groundnut in the world more than one-third is in India. We are the biggest producers of groundnut. In Maharashtra, Gujerat, Andhra Pradesh and Madras States it is the principal crop.

Groundnut does not like clayey soil. It thrives in loamy and sandy soils. It also grows well in the black soil of the Deccan. It cannot stand extreme heat or extreme moisture. It is particularly suitable for a hot country like ours. To prepare the ground for

the crop it is not necessary to plough deep. Groundnut consumes a lot of potash. It is, therefore, necessary to apply ash to the soil. Two to three cartloads of manure should also be applied. Its roots fix nitrogen in the soil. It is desirable to apply silt from the bed of old tanks every three to five years to the soil.

This treatment is particularly suitable for sandy soil. There are two varieties of groundnut. One of these grows erect. The nuts grow in a bunch near its root. *Lal boria* variety of groundnut belongs to this class. It is also known as *lal dana* variety. There is another variety which spreads out. The nuts form under the branches in lines. The *Coromandal* variety represents this class. The erect variety has nuts which are roundish and plump while the spreading variety yields nuts which are oval in shape. The proportionate weight of shell to the nut is lower in the spreading variety. Consequently the spreading variety gives a higher yield. Better seed is found to give even higher yields. The different States that grow groundnuts have evolved improved seed, and this may be obtained from their Agricultural Directorates.

Groundnuts can be raised as *kharif* crop during the rains and also as a *rabi* crop during dry months. When grown during the dry season it needs irrigation. Line sowing gives better yield. This can be achieved by sowing seeds along the furrow of the plough. The space between the lines should be one and a half to two spans. For the spreading variety a *bigha* of land requires ten seers of seed. For the erect variety the requirement is twenty seers.

Three weeks after sowing, the field should be hoed and weeds taken out. After an interval of another month the land should be hoed again and weeded.

There is a special method of harvesting groundnut. If this is not followed the yield goes down. The nut remains inside the soil and is not visible to the eye. Again the kernel remains inside the shell and cannot be seen unless the shell is broken. So great care is necessary to time the harvesting accurately. The erect variety matures in three to four months. The spreading variety takes longer, that is five to six months. When it is time for harvesting, a few plants should be pulled out from different places. If the shell has hardened and breaks on pressure, the crop is mature. The husk of the kernel should also have the proper colouring. If these conditions are satisfied the crop can be harvested on a dry sunny day. After harvesting the shells should be exposed to the sun and dried.

Improved Method of Cotton Cultivation

Next to food, cloth is our greatest need. Cloth comes from cotton. Next to food crops, therefore, cotton is valued by us. That

explains why cotton is grown in large areas in our country. In fact, there is more land under cotton in our country than in any other country. The area under cotton is about two-thirds of the area under wheat in India.

The total produce from our cotton crop is, however, low. If we compare our yield with that in other countries we can realise how we stand in this respect. The yield per *bigha* in the principal cotton growing countries is shown below :

Russia—2 maunds 3 seers

United States—1 maund 29 seers

In India we produce 15 seers per *bigha*. The reasons for this poor yield are many. In many places the farmer depends on rain water for irrigation but it is an uncertain factor. If the rain is insufficient the yield is affected. Moreover, our seeds do not give a high yield. Also, we use old methods of cultivation. To increase the yield, it is necessary to adopt improved methods of cultivation.

The land to be sown with cotton should be thoroughly ploughed three times. Then it should be harrowed once. Two to three cart-loads of manure should be applied per *bigha*. After that seed should be sown. About a month later when the plants have germinated, ammonium sulphate should be applied as top dressing. The dose should be 33 seers per *bigha*. After another month the application should be repeated.

There are many varieties of cotton. Some produce short fibres, others produce medium fibres, while others, again, produce long fibres. The bolls of some varieties yield less cotton than those of others. The American varieties have long fibres and big bolls. The States which grow cotton have evolved improved varieties which are available from the Agricultural Directorates. The black soil of the Deccan grows cotton extensively. The varieties grown in Maharashtra, Gujerat and Madhya Pradesh yield medium fibres. Madras, the Punjab and Uttar Pradesh produce long staple cotton.

Where the cotton crop is rain-fed, the seed should be sown in June. Where it is irrigated the seed should be sown earlier in April and May. The seed can be sown on plain ground or on ridges. The seed should, however, be sown in lines. If it is sown by dibbling, three to four seeds should be put in each hole. After they have germinated the healthiest seedlings should be retained and the others pulled out. The spacing varies according to varieties. The space between two lines may be from 3 cubits to even less than a cubit and the distance between plants along the line may be from $\frac{1}{2}$ cubit to 2 cubits. A *bigha* of land requires one and a half to two and a half seers of seed.

Where irrigation is available for the crop the land should be hoed before it is irrigated on the first occasion. After that the land should be hoed every time after irrigation. Where the crop is rain-fed it should similarly be hoed after every spell of rain. The first irrigation should be given about a month after the sowing of seed. Subsequently, it should be irrigated at intervals of 30 days. When the plants start flowering a heavier dose of irrigation is desirable.

VII. KITCHEN GARDENING

So far we have discussed the crops that are raised by the cultivator to earn a living. We can also cultivate for another purpose, that is for consumption at home. In towns most people have small plots attached to their houses. In the villages there are peasants, potters, blacksmiths and other artisans. Their houses do not lie as close as they do in the towns. Each house has a piece of land which usually remains unused. All householders can raise not only crops but even fruits on these plots. The produce need not be sold in the market, it may be consumed at home.

What do we gain by this? If we give a little thought we will realise that we gain a great deal. We do not work throughout the day. Everyone enjoys some leisure. Even the master of the house who works in the field has some leisure, so has the mistress of the house. The children too have plenty of it. If this spare time is so spent that it can both be enjoyed and utilised for producing food it is no mean gain. If all the members of a family spend their spare time on kitchen gardening the surplus land in the compound can be put to use. Moreover, it will be a source of joy to see before one's own eyes seeds germinate, plants flower and flowers give birth to fruit. Then, again, it is a matter of great satisfaction to cook and eat vegetables and fruits grown by one's own hands.

It may be said that this possibly brings us some enjoyment but what economic gains does it mean? By growing some fruit or vegetables how much money can one save? For a single individual or a household the economic gain may appear negligible. But what is insignificant as a separate unit becomes big in the aggregate. The juice of the date-palm coming down in small drops fills the pot. The bee collects small particles of honey from innumerable flowers to fill its hive. In the same manner a little effort involving no expense made on an unused piece of land during spare time leads to results which cumulatively have considerable value.

This is not a new idea. In olden days a good householder would engage in such pursuits. There is evidence of this in the verses of Khana. We have now forgotten her teachings and even if we remember them we feel no inclination to follow them. This path is closed to us today because we have become indifferent to it. On the other hand, this method of earning a little extra is open not only to farmers but to all householders in the village.

To grow vegetables in the compound of your house the first step is to provide for the protection of crops from cattle and goats. For

this a fence is necessary. A fence made of bamboo costs money. The most convenient thing to do is to build a fence with *bera kalmi* plants. If cuttings from branches are put in the soil they take root. They do not die of drought. Cattle and goats do not eat their leaves. A good fence can be raised in three months' time. Also, if its branches are cut down two to three times a year and allowed to rot they make good manure for vegetables.

Within the fenced area of the compound we can plant some fruit plants alongside the fence. There are fruit plants which do not need much space. If these are planted during the rainy season they will grow without attention. The Government organises the Vana Mahotsava (Forest Festival) every year to give encouragement to this. The Government also distributes saplings on this occasion. Saplings are also sold in the fairs organised during the *Rath* festival. One can put a cluster of bamboos in a corner and a few coconut and arecanut palms alongside the fence and these will be a permanent source of income. Khana's verses recommend these. Khana has said :

A coconut palm treated with salt in the soil bears fruit early.

About arecanut palms she has said :

*Every four cubits apart dig a hole one cubit deep
Peasant brother and then plant the areca palm.*

Elsewhere she has said :

*The coconut of the man who gives them away and the
bamboo of the miser*

Do not fall in number but increase all the year round.

It is true that bamboos, coconuts and arecanuts pave the way to a permanent income for the householder.

Besides, there are certain fruits, such as papaya and banana, which can be easily grown in homestead lands. If we plant them during the rainy season they will bear fruit within a year. Khana has said :

*First plant banana
Then grow vegetables,
After planting banana do not cut its leaves,
That will provide both for food and cloth.*

We may now discuss the cultivation of vegetables. There are vegetables, one single plant of which, brought up with care, will yield a considerable quantity. Bottle gourd, beans, and wax gourd are such plants. If we can grow a bottle gourd or a wax gourd plant during the rainy season and place it on the thatched roof or on a

bamboo platform it will yield a bountiful crop in winter. Khana says :

Compound filled with bottle gourd and cucumber, Khana says, brings prosperity.

Where the thatch is covered with sweet gourd leaves Lakshmi says she stays there.

Similarly, if we can grow a bean plant it will bear so many pods during winter that baskets will be overfilled.

In addition, some other vegetables may also be grown. There are some vegetables which grow in summer or in the rainy season. The vegetables that grow during the rains need no watering. There are other vegetables which grow in winter. If we can grow one set of vegetables in winter and another in summer then the land adjacent to the homestead can supply vegetables throughout the year.

Of the vegetables that grow in summer the following are easy to grow as well as good to eat :

Lady's finger

Puin (Basella)

Danta

Ridge gourd

It is convenient to grow dwarf lady's finger. It will not take much space and the yield will be good. *Katwa danta* is sweet to chew. If we dig the soil and put a little manure in it these vegetables can be easily raised. If there is no rain a little watering will do. Then as the rains come there will be no further need for watering.

Similarly, the following vegetables can be grown in winter :

Spinach

Radish

Turnips

Carrot

Tomatoes

These can be grown easily. But they need watering as they grow in winter. If a householder is prepared to work harder he can grow English vegetables like cauliflowers and cabbages. He can also grow peas. The plants, however, need plenty of care and manure. Cabbages and cauliflowers moreover need plenty of water. Does that matter? If there is will all this can be provided.

We can also name two vegetables which can be grown and consumed throughout the year. They are chillies and brinjals. Chillies are used in every kind of dish. Brinjals can be taken fried or made into other delicious dishes. Chillies and brinjals are very old vege-

tables in our country. Khana has written about them. About chillies she has said :

*Grow bottle gourd on the ash pit
and chillies in the courtyard
You son of farmer.*

And about brinjals she has left nothing unsaid. Whatever information is necessary has been given :

*Baraha's daughter has left this advice :
Grow Brinjals ten months in the year.
There is no difference of opinion that the months of Chaitra
and Vaisakha should be left out.
If infested with insects, put ash on the plant.
There is no better method.
If the soil dries up pour water,
Thereby you get fruit every month.*

The crops we have referred to so far are all meant to be eaten. We may now refer to a crop which is not edible but can be put to other uses.

In the olden days there was the practice of growing cotton on homestead lands. This has now been discontinued. It should be revived. Only a little labour is needed to grow cotton. Also, it does not take much land. If we dig holes alongside the fence two cubits (three feet) apart and put cotton plants in them they will grow without care. They will produce cotton for six months in the year. Cotton cannot be eaten but it can be spun into yarn for weaving cloth. Thus it also becomes easy to pass spare time. We can keep an ordinary spinning wheel in the house for the use of the members of the family whenever they have time. This way there will be enough yarn in a year to weave two pieces of cloth without any cost. The cotton produced by the plant has seed mixed with it. Before spinning the seed has to be removed. It is food for ducks and poultry.

Half a seer of cotton will produce yarn sufficient for a *dhoti* or a *sari*. One plant yields up to one *chhatak* (2 ounces) of cotton in a year. Two-thirds of it is seed and one-third cotton. So to produce half seer of cotton we need twenty-four plants. There are cotton plants in our country which grow to a height of 8 to 10 cubits (12 to 15 feet) and yield cotton for many years. They are called tree cotton. The boll, however, contains a small quantity of cotton. There is another kind of cotton plant which can be grown annually. It does not grow so high, but it yields more cotton. It starts bearing cotton at the age of six months and continues to do so for a period of six months. The cotton plants in Egypt and the United States of America give better yields and better quality

cotton. Each of these plants can yield more than a *chhatak* (2 ounces) of cotton. Seeds of such plants can be had from the Government.

We start our kitchen gardening after fencing the fallow land in the compound of the house. If we plant these dwarf cotton plants alongside the fence two cubits (three feet) apart little space will be taken. If we can put thirty plants they will yield enough cotton to spin yarn weighing one seer.

It is desirable to sow cotton plants before the rainy season. The reason is that the cotton plant cannot stand too much of water. If the plant grows a little before the rains come, the rain water will not do them much damage. On the other hand, there will be no need for watering them throughout the rainy season. When the soil dries up during winter some watering will be necessary at intervals.

To raise cotton it is best to germinate the seedlings in a separate bed first. This will prevent waste of seed. When the seed germinates and the seedlings have six to eight leaves they should be transplanted. The soil where the seedlings are to be transplanted should be dug up deep. Then some cowdung manure and leaf mould should be put in it. Some ash may also be put in the hole as cotton plants require a lot of potash. The soil at the root should be turned up from time to time until the plant grows up. If the seed is sown at the end of Vaisakha or the beginning of Jyaistha and then the seedlings transplanted, the plants will flower from the month of Kartika. The bolls will grow thereafter and burst out to expose the cotton. At that stage the bolls should be plucked.

It should be noted that cotton plants are very much subject to attack by insect pests. Special attention is necessary to protect them from insects. As soon as an insect is detected it should be removed by hand.

In this manner, we can devote our spare time to raising crops for consumption and growing cotton for spinning yarn in our kitchen gardens. There is as much pleasure in eating fruit and vegetables raised by our own hands as in wearing cloth woven from cotton grown by ourselves. What is even more important, we thus have an opportunity of spending our spare time joyfully.



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