

**Course on Introduction to Ancient Indian Technology**  
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**Lecture 15**  
**Module 3**

Let us start this lecture with a thought process, that is nowadays we are doing chemical farming which is unnatural unnatural farming could lead to the annihilation of very life on this beautiful earth as food is the linkage of all lives. Because through food all lives are linked and, let us start discussion on the todays lecture by recalling what we had learnt in the last lecture. If you recall that we started with the types of soil in the modern realm, and then we have we had looked at the various kinds of classification of soil made by our ancestor in the scriptures, based on the odour, colour and taste.

So, and some of this present day classification are matching well with the ancient one, that is quite interesting. And also one of the soil, which I had mentioned last time, which I was having doubt, that is blue soil. But I talked with some other people people say that do exist but is very rare. That means this blue soil was mentioned in the ancient scripture, not in present day. So, therefore, they had having a lot of observation, and then we moved into the How to you know quality improve the quality of seed, how to you know take care of it.

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**Sowing Methods**

- S.R. Rao has identified the figure of seed-drill on an Harappan seal from Lothal
- Harappan practiced line-sowing by using seed-drills.
- The furrows reveal a grid pattern running at right angles to each other, the north-south ones having an average distance of 1.9 m and east-west 30 cm only.
- The current practice at Kalibangan in fields suggests for mixed/inter cropping and horizontal furrow for sowing one crop and vertical for another.
- RV.X.9.23 says "Harness the ploughs fit on the yolks, now that the womb of the earth is ready to seeds therein"
- Aiyer(p.16) interprets it as showing the seeds were "either sown in plough furrows or broadcast and then covered over by ploughing"
- RV X.101.3-4 says "Attach the sira spread apart yolks, sow the seeds into prepared womb" which according to J. Bloch implies sira occurring in the passage as a plough used for sowing seed. It implies that seed drill plough was used for sowing of seeds.

Agricultural technology in ancient India

And then, today, we will be discussing about basically how to sow the seed Sowing method because sowing of the seed is very important for agriculture. If you look at this S. R. Rao, one of the researcher, who had identified the figure of seed drill on an Harappan seal from Lothal

region. And if look at what is that seed drill that means there might be a hole through which it will be seed will be being sown to the field.

And this Harappan practice is known as line-sowing, method they were using, using a seed drills there will be kind of things. So that it is a very good thing to have that at that time, okay and of course you can broadcast the seed but that is not in a very natural way you can throw the seeds scattered around. And if look at this Harappan kind of things, you can find the furrows reveal a grid of pattern running at the right angles to each other, you might be remembering I had shown you some figure. We will see that that is North-South ones having an average distance of 1.9 metres and East-West, around 30 centimetres, right kind of things. Let us get into this one and then we will see that.

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So if you look at this I had shown you this figure this figure is basically from the Kalibangan, Rajasthan, which is criss-crossing, you know this is something 1.9 metres, around that. If look at this distance, you know this is the East-West side, 1.9 metres kind of thing, This is something 30 centimetres. And and modern days also people are using that means from the Harappan time, Indus Valley Civilization, which is around may be something 3500 B.C, I mean that kind of things and this still existing today, right.

So that is the thing what we have written that kind of agricultural practice. And I am sorry, I had told you this is basically North-South is 1.9 metre and East-west is 30 centimetres, I You know like you should keep that in mind.

So the current practice at Kalibangan in fields suggest what? Suggest the mixed crop. Mixed or inter cropping kind of things which is being used nowadays also with this advent of new what we call organic farming basically it is a natural farming. And natural farming method was basically went from India to other places. Now improvised and coming as a organic farming to this country at this moment, right.

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This is the mixed crop, what do you mean by mixed cropping? Any idea let me show you what is that this is basically if look at, I can have this is a furrow and these are the ridges. And there can be onion, it can be sugar cane and it can be, you know, some other kind of things together you will be having the cultivation, right.

And so also wheat, it may be having some grams, you know, kind of things together. Why you will go for it? Because they will be complementing each other and also that knowledge is very much essential which will complement each others, that is a very important. Beside this, if you go to any forest, you will find there is a very big trees and there is small tree. Various kinds of trees will be living together.

Means, nature various kinds of trees and then plants will be having symbiotic relationship. And that is the things what our ancestor had learned and also we are having that in psychic. That means you should have a symbiotic relationship with among all all are connected, right and that is ethos is very important. Although in modern time we think man is only creature which will live on this earth no man is one of them they all are interlinked. And that ethos,

that philosophy and the thought process is very important to have. And that is reflected in our ancient agriculture as well, right and it is going to the you know Indus Valley Civilization.

So, what I was telling Horizontal furrows for the sowing one crop and vertical for another one can think of and varieties kind of thing if you go to any natural forest, not man made one. Today man is making forest, you know that is an unfortunate, right. It is the nature should make and we should preserve it. You will find 5 layers of the trees which are mixing together. There is a we call it Covering 5 layers of covering. I will be talking about that little bit later on. We call it Achchadan or mulching, okay.

So, that our ancestors had you know observed and then they were trying to understand the nature and do that. As you look at most of the technology today even, we try to mimic the nature. But we should do in a positive way, not spoiling the nature in the process. So that is the very important point of what kind of technology we need to develop, right and that philosophy is important.

So which I am emphasizing again and again, so that you will not get swayed by the modern philosophy of consume more and produce more and then, you know and then disruptive technology those things you should not get swayed by those are basically market forces who are doing for their own greedy to satisfy their greed.

And, what Rig Veda says: Harness the plough fit on a yokes, now that the womb of the earth is ready to seeds therein, right Rig Veda I have given this you know Rig Vedas Chapter 10 and 9.23. And of course, how to interpret this is a you know Aiyer interprets as sowing the seeds where sowing the seeds either sown in a plough furrows or broadcast, as I told earlier then covered over by ploughing, why will do? Some of you might have sown a seed or a plant, right or saplings, right saplings you might have done. And when you do, what you do? You put a sow a seed, make a little you know hole kind of things or you put the seed and then put the soil on the top of it and then give the water am I right?

So also for the plant, why do we do that? Because that is a things which is very much essential and this is going on and we are doing it. And that is so that you will give, you know, cover to that and it will not get spoiled and it will be enough for it to germinate. Because you need air, you need not only air, moist air, you need also not very heat but enough heat to have that temperature to have that and also the ingredients, you know.

So Aiyer interprets that way covered by the ploughing and Rig Veda 101.3-4 says Attach the sera, spread apart yolks, right and sow the seeds into the prepared womb, right. That is been ploughed, when you plough, you know, you add as shown in the picture, that you know, Soil will be getting up and there will be some trench kind of thing, furrow.

And which according to J. Bolch, who tried to interpreted it, he says Siram sera is basically plural word and Siram is a singular, occurring in the passage as the plough used for sowing seeds, and it implies that the seed drill plough was used for sowing of seeds you know, if look at, when you are ploughing itself, you should have a mechanism, you know first it is ploughing, and then you know you put the seed there.

So, both the work been done, not that, you know, another person has to do. But, now it is separated, people are using some machine for doing that. I told it is already clubbed in our ancient time together, okay. Sometimes you will only plough, sometimes you will plough and also put the seed and it is covered. So that is a very, you know, good techniques of of sowing, right.

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**Sowing Method:**

- In *Anguttara Nikaya* (I 239-40) the expression *bijani patitthapeti* is explained as meaning 'planting of seeds'.
- In the Jain text *Nayadhammakahao* (VII 68 p. 85) there is relevance to five paddy grains being sown on a well prepared bed and seedlings being transplanted twice or thrice.
- The usual practice was to sow the seeds after the field had been ploughed. [*Satapata Brahman* 1.1.6.3]
- **Panini** mentions the term *Bijakaroti* (V 4.58), which is explained by the Karika to mean tilling along with the seeds. *Saha bijena vlekhanam karoti*: A device by which a cultivator sows the seeds in the line of tilling through a cone attached to the pole of the plough.
- *Medhatithi* (*On Manu smriti* II 112) also refers the seeds being sown with the help of the plough.
- The weeds are to be removed from paddy field between Sravana and Bhadra. The Bhadra water should be drained off and be kept upto the roots only for keeping paddy free from disease.

So in Anguttara Nikaya, like which is a Buddhist text, the expression of Bijani Patitthapeti is explained as a meaning planting of seeds. So we have already see in Vedas, now it is a Buddhist text and in Jains say Nayadhammakahao, and that is a relevance to five paddy grains being sown on the well prepared bed, right.

And I am not too sure about why five, may be some of these together they will be doing and seedling being transplanted twice or thrice, right this is transplanted, you know, you will take

from one place to other, right I will be discussing about it later on. And then, that is very essential particularly for rice. And which is being that means this another text is saying that this is essential to how to have a sowing the seed.

The usual practice according to the Satapata Brahman, is again from Veda, was to sow the seed after the field had been ploughed. That means it been ploughed properly and then you will sow the seed.

The Panini, you might be knowing the author of Ashtadhyayi grammar book, which is a very well-known and mentioned the term Bijakaroti. What is the meaning of Bijakaroti? Which is of course Saha bijena vilekhanam karoti. See in Sanskrit word even our Indian languages, we are having Samas. Of course it is in Hindi but in other thing you will be knowing. It would give a meaning, detail meaning of a word, but unlike the English, where you will have to remember, you know like kind of things.

So, this is basically a device by which a cultivator sow the seeds in the line of tilling through a cone attached to the pole of a plough. Like means, you know there should be a whole cone and then you put it. And it is a very natural way. Cone, if will there, it automatically will go down once it will go. Once will be falling down then it will go. And you will have to give little jerk, may be to do that you have a control over that okay.

And there is another text Medhatithi, basically it is the comments on the Manu Smriti. Manu Smriti, you people may be knowing, that is a very important scriptures in our Indian scriptures. And also refers to the seed being sown with the help of the plough. That means plough is required for putting the seeds on the soil or the land.

So, therefore, plough is been given very important it can do a plough thing and also put the seeds and so that you are having and of course this is another aspect which has to be taken care particularly the weeds had to be removed from paddy field between Sravana and Bhadra. These are the months in our Indian calendar which you people may not be aware, I guess. You may be acquainted with January, February, March and something like that. These are very old calendars, and Sravana and Bhadra. And of course the Bhadra water water means, you know, at that time some scanty rains will be there. And should be drained off and be kept up to the roots only for keeping paddy free from the disease. It says that this rain, if it will be there, then you have to remove, otherwise it will spoil the what you call the paddy particularly it will cause the disease.




So these things has to be re-looked at, because now there is a climate change, okay. So, therefore whether it is right or wrong, one has to see and change accordingly because always as I told, for cultivation, three things a farmer should know soil, season and seed, right. So these three S is important. So, therefore, the season also is important.

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### Sowing Method: Transplantation

- The term *Ropana* and *Ropeti* occurring in early Pali literature refers to **transplantation**.
- *Kalidasa (Raghuvansamsa, IV 20 37)* makes an apt reference of the **seedlings of sali** being uprooted and then transplanted at another place.
- The *Krsi-Parasara* in laying down the processes in cultivation, has in mind the details of paddy cultivation. It prescribes the **procedure of transplantation (ropana)** (*verses 183-185*). It envisages the sowing of seeds for transplantation (*verses 169 172*). It classifies seeds into
  - two, First type plants which are sown and which are latter transplanted.
- **Sowing is free from defects, but transplantation is attended with maladies**
- For transplantation, seedlings are not to be gathered from full grown paddy plants as all seedling grown hard in fields.
- **Seedlings are to be transplanted one cubit from one another in the month of Sravana, half cubit in month of Bhadra and four fingers apart in month of Asvini**
- Agriculture suffers loss due to weeds. Agriculture produce from which weeds are removed becomes highly fruitful (*verses 189-92*)
- The trees are transplanted (*sankrapanaviropana*) after plastering them their root up to branches with *ghee, usira, sesamum, honey, vidanga, milk(ksira) and cow-dung*.



And as I told there is a sowing method, there is another one is Transplantation and the term Ropana and Ropeti occurring in early Pali literature, you might be aware that in Pali language, the Buddha texts most of the Buddhist texts are been written, right and refers to transplantation.

And Kalidasa, which you might be knowing he is the famous poet and Raghuvansam that makes an apt reference to the seedling of Sali being uprooted, then transplanted at another place. That means you have to take one place and do that. So what is the Sali? Sali is a any idea, Sali is basically very good quality of rice, or you can call Dhan basically, right. And which were at that time famous. Today also it is very much there but you know also being sought after.

And as I mentioned earlier that Krsi Parasara also emphasize on the process in cultivation and also had given details of paddy cultivation. It represents a procedure of transplantation (Ropana), right and of course there is a various verses are there one has to look at it. It envisages the sowing of seeds for transplantation. It classified seed into two, first type plants which are sown, which are later transplanted.

For example, here this person is been planted. Now he is taking and making this kind of a bundle, right to be transplanted. I will show in in the next slide what is the process of transplantation. And whenever you sow, that means, you know, that sowing should be free from the defects, right, while sowing. But once this plant and you want to take, you can also check the quality of the plant what is what you want to again place it or transplant it. So, therefore this is also the transplantation is attended maladies, you know, whatever the problems will be having that should be set aside and the right one has to be.

That means a person has to have a knowledge about which is right and which is wrong, you know. Of course with the experience, me and you like that we cannot really do that because we do not have experience of transplantation or looking at this thing. So, therefore, it is very important to have that domain knowledge not only the domain textual knowledge but the practical knowledge.

So, for transplant (seedlings) seedlings are not to be gathered from full grown paddy plant as all seedling grown hard in the field, right it will be not fully it will be small one that you can go and put it. And seedlings had to be transplanted one cubit, you know from one another in the month of Sravana Sravana, you know it is the rainy season basically, towards the end of Sravana and Bhadra end, right that is a rainy season.

And it should be one cubit one cubit you know, you remember it is something 0.45 metres approximately because it is from hand, from this elbow to the fingertip is known as the one cubit. And half cubit in the month of Bhadra that means if it is Sravana it will be one feet, if it is Bhadra, it is half feet, and four fingers apart, in the month of Aswini.

Now, why it is so? What a you know so, if look at Sravana, it is a little earlier, right. So, that may be the logic but more scientific studies need to be looked at it. So therefore, if you give and then if it is a 1 feet and it may grow further, you know so that you are have enough space between this things to have a sunshine and other things, right. So that is the and other another important thing that you also want to collect it for collecting it will be easier, right Earlier these people used to use their hand and then used the sickle to cut it and then put it. Nowadays of course people are using machine.

So, therefore, it should be you know collect properly, cut it and then collect properly therefore, it might be one reason but there might be several other reasons okay. Agriculture suffers loss due to weeds that of course, most of us know agriculture produce from which



weeds are removed, becomes very fruitful, very highly fruitful. That means we need to remove these weeds.

But there is also mention that these weeds, once you remove, you can actually use for the mulching purposes also, right and that will act as a manure for the other things. And it is not only about the plants which will be transplanted, it is also the trees, can be transplanted, it is, you know, that is mentioned in this text and this is known as Sankrapanaviropana, right big trees can be and after plastering them with the root up to the branches with ghee, Usira is one kind of gram kind of thing, and then sesamum sesamum is what we do call Til, I think I have shown you picture earlier, honey, you know and Vidanga is a one kind of again seed kind of things and milk, it is known as Ksira and cow dung.

So if you look at all these materials are available with them and you do that. But, let me tell you recently in IIT-Kanpur, people hired some agents to have these big trees to be replanted and they were saying it is a great success and then it is technology has come from outside of course they they were using the chemicals and they paid a lot of money also because we do not have that knowledge and this has to be also checked whether it is true today or not.

This for example, these ingredients whether it will be useful or not nobody are using these today that is the unfortunate part. Therefore, there is a need to re-look at it and check whether this is this recipe or this methodology, what is given here is useful today or not or is it you know apt for this work or not, right that has to be and they paid lot of money and also those chemical what they are using that may not be the right one because it may spoil not only the soil but also the tree, right but, whereas these are all natural things. So therefore, according to my judgment this may be the better one if it will work for us, right.

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So, now let us look at this transplantation process if look at, these are the small plants of the, let say it can be paddy or the thing and these people are making it, you know removing it from the soil and then making a bundles.

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And these bundles are taken and then placed if look at, there is a distance or something given also, but that distance is not having and is lot of water of course according to me like water is not the right although it is easier to plant it. But however, too much of water also bad for the you know plantation or the crop.

So we will be looking at the mulching. Mulching is a word, is nowadays being very much used because of you know popularization of this organic farming any idea what do you mean by Mulching is basically we call in Hindi Achchadan. In Hindi we call it Achchadan means Covering, right the way we cover our body with the clothes, similarly, when you do cultivation, you have to cover the soil with something, right and that is basically layering up agro materials on the surface soil in the field. But unfortunately, particularly the western people and Indian also because they do not know Indians today do not think, they just follow.

So, therefore, they are using also plastics and other things for the covering of the soil, which is not good, according to me. When I am saying, I might be wrong, but according to my understanding, it is not the right one.

So, there are various kinds of mulching you can get but I will be concentrating only three which are where there in our text, so therefore I will be considering them. But nowadays, it has come various ways.

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**What is Mulching:** Layering of agro material on the surface of soil in the field

**Types of Mulching**


- Soil Mulching
- Straw Mulching
- Live Mulching

**Why do we apply Mulching?**

- Decreasing water loss due to evaporation
- 1 kg of mulching absorbs around 4 liters of water due to dew rain irrigation.
- Reducing weed growth by reducing the amount of light reaching the soil
- Preventing soil erosion
- Increasing the number of micro-organisms in the top soil
- Adding nutrients to the soil and improving soil structure

**How to use Mulches?**

- Always apply mulches to a warm, wet soil. Mulch applied to a dry soil will keep the soil dry.
- Care should be taken as to the thickness of the mulch applied. Too thick mulch will prevent air flow and encourage pests.
- To allow the germination of planted seeds through the mulch, a layer of less than 10 cm should be used.
- To clear an area of land of persistent weeds a layer of 10 cm or more can be used.



So, soil mulching types which you do basically when you plough. Then you do that with the ploughing will put this soil you know top soil will be removing and then putting it back and it will be doing. Question is why we will be having what do you call mulching, putting the soil? There are several reasons for that, one of them it will be making little you know passage for the air to move, because air is required so also moist so also the what you call it will be helpful for the micro-organism to take that. And sun light will not enter into the mulch and heat also, it will be not affecting. If it is too much of heat, it will affect the micro-organisms.

Because the air is there, air will act as an insulating, you know material, so heat will not get into that much, right and it will be helpful for the take some soil, mixing it also, right.

And Straw mulching which is commonly used you know straw, the hay that we use and which is you know that can be used for the mulching, you might have seen if you could have managed to go to the field. Even today some portion of the our country they are still leaving them straw there in the field, you know, that is required for mulching.

And Live mulching is basically by the trees itself. As I told, it is similar to the Inter-cropping or the Mixed cropping you do have so that they would complement each other and the shadow of one will be other, so that it will be helpful for the soil to be remain intact not affected by the heat or not affected by the other things, right. So that is also known also Live mulching.

So, mulching, if you look at this is the picture, what I would like to show it is basically straw mulching here the these are the straw, right and these are the straw which used for mulching, okay and these are the plants are coming so that the weeds will not be allowed to grow in this you know because of the mulching is there, and then it will cover and it will help also the earthworm and other insects which are friends of the soil to grow very easily and also they will come, they will be doing their activity.

So, if we look at, we do apply farm you know mulching because of decreasing water loss due to evaporation, if the mulching cover is not there, lot of water will be evaporated, right it will be acting as a barrier for the evaporation. And people says one KG of mulching absorbs around four litres of water due to dew, rain and irrigation in the night time, you know, some of the dew can form there because there is a surface. So, then you know it will again become wet so you know you need not to give water that much and even during rainy season, or the irrigation, when you put some water, kind of things, it will be remain in the things. It will not get evaporated.

So reducing the weed growth by reducing the amount of light reaching the soil the light, the sun light will not be entering into. Therefore, that other plant will not really germinate nearby.

And preventing soil erosion, you know soil erosion is a big problem because of due to use of these tractors and having a very high depth tillage, they are using a tiller. So that that is making a deep and then the soil erosion and more soils are coming, and then erosion happening and whereas if we use our traditional plough which is having a very small angle of

depth, so that this will be reducing the erosion. So also mulching if you do, again soil erosion will be reducing drastically increasing the number of micro-organisms in the top soil because it helps in developing micro-organisms which is important for the growth of the plants because it acts as their dead bodies and other things act as organic matter it will be helpful for the growth of the plant.

And adding nutrients to soil and improving soil structure, I have told you that this micro-organism and organic matter will help and how to use the mulch? Mulch basically can be applied to a warm or a wet soil that is important it should not be applied for the dry soil when the soil is dry, you should not put because it will not help and as already died it will remain dry, right.

And the care should be taken to the thickness of mulch applied. And too thick mulch will prevent the air flow and encourage the pest to grow, right. So beside these this generally 10 centimetre being you know recommended for the 10 centimetre thick of mulching is recommended for germination of plants and seeds but some places you may go for 10, particularly when you will get the land which is persistence with weed wheat, right. So we may use that depending on that but is not a very what you call fixed number it should use as a guideline, that is all. So with this, I will stopover we will be discussing more about, you know, manures and other things in the next lecture, thank you very much.