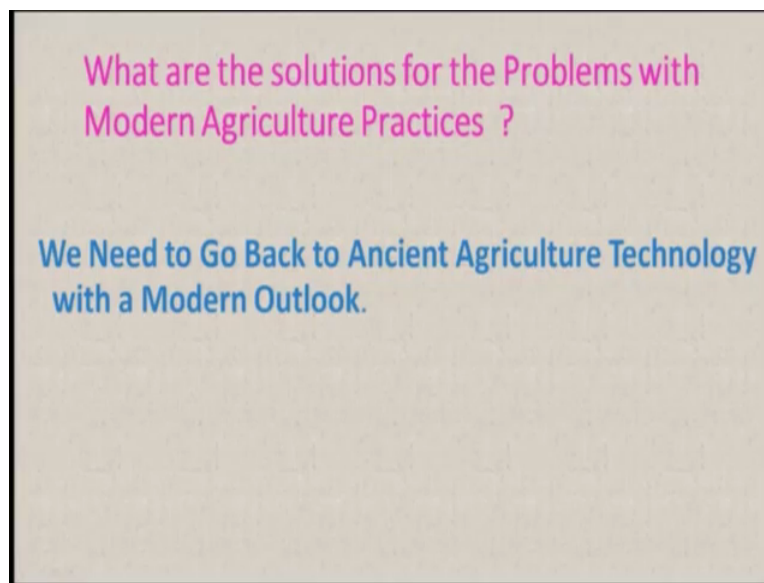


Introduction to Ancient Indian Technology
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Module 3
Lecture No 12

Let us start this lecture with a thought process from Mahatma Gandhi. According to him, to forget how to dig the earth and tend the soil is to forget ourselves. It's really, aptly said by him that it is important for us to cultivate or do farming ourselves for our own food. And we have seen in the last lecture that how the modern farming has spoiled not only the food but also the environment and our own health and also the health of not only the animals also the other plants. And it is having a very bigger ramification on the entire ecosystem.

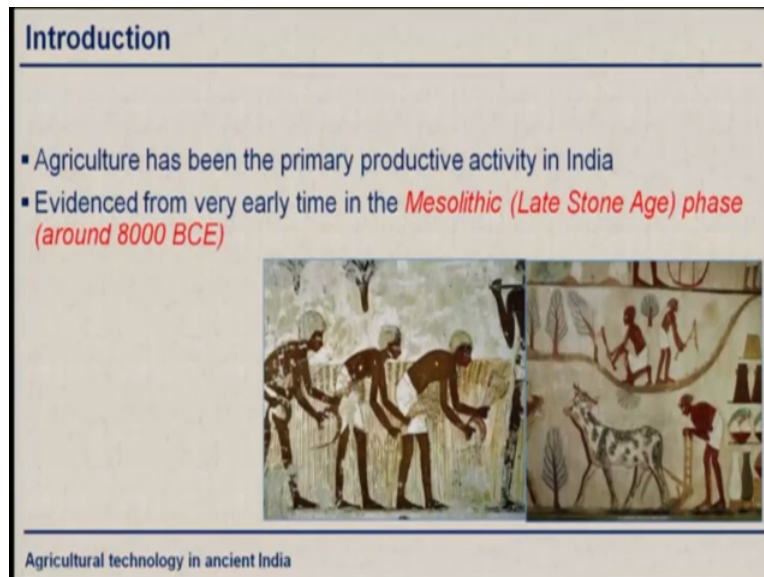
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So therefore it is important to us, to you know, look at like how to overcome the problems with the modern agriculture practices, because we are in deep trouble. So far the food is concerned, so far our life is concerned, so far the (who) entire ecosystem is concerned because of using the chemical fertilisers and also the modern way of cultivation and we have created unemployment, right, and lot of air pollution, water pollution and then soil pollution what not. Now what are the solutions then, how to go about it? Any idea? Because if we will not use the chemicals, chemical fertilisers, pesticides, insecticides, then what will happen, our production will be going down, and at the same time if we will be using more, then we are spoiling the soil.

We are aggravating the problem, so what are the solution then. So if you look at, for that reason, we need to go back to the ancient agriculture technology with a modern outlook. It's not that we will just copy and paste what our ancestors did and we sustained for years together. We need to also do research on that and find out the ethos behind it and adopt it in the modern times. Therefore it is important to look at the ancient way of farming.

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So if you, for that let us look at, agriculture is as old as our civilisation. And you might be knowing the legendary figure, in our puranic times, is Krishna, all of you know. So Krishna name itself comes from a root word, known as Kri, 'krisathi ithi krishna' that means it is basically, according to me who might have started, the organised, the agriculture, and if you look at, little bit, and connect this narrative. These are narratives, you need to connect, and he was a potent of the cow, rearing the cows, right? Not only for milk and also, this thing. If you remember, that Govardhan Parvat, you remember that story, Govardhan Parvat that you know where, he was having a fight with the Indra, Indra means the person who will be giving the rains, right.

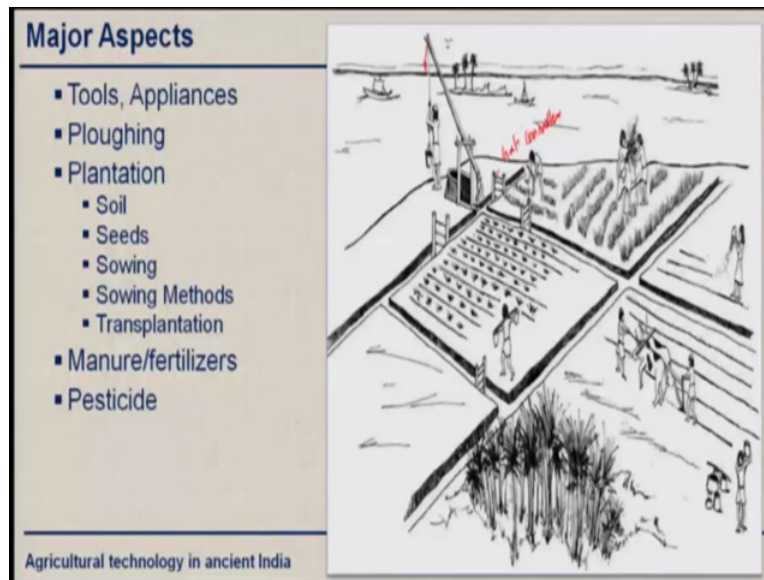
That means the irrigation system, he must have started. And if you look at the Balram, Balram was having what, plough, his brother, Balram. So you need to connect, see unless we look at from that narratives in the perspective, you know, we won't get it. So if you connect all those things, you will find, look it might be from that period, you know, improvised agriculture might

have come up, using the cow dung for the, as a manure and the irrigation system and plough and other things, you need to connect it. I am sure that most of you may not have this ideas, connecting together, looking different way than what tradition is going on.

So if you look at there are several stories will be there also, we will have to, can tell us, that ours is an agricultural society earlier and today we must be agricultural society not a industrial society the way we are moving towards. Because food is important and good food is important as well for our sustenance and also the sustenance of other animals, insects, and other things. So agriculture has been a primary productive activity in India because that is the primary wealth, the rest of the things are secondary wealth, but we are giving more importance on the secondary wealth which is not the right thing. And evidence from the very early time, now you can get in particularly Mesolithic time late Stone Age phase around 8000 BC. BC means Before Common Era right and it is more than that, but this is the accepted fact that we are having.

If you look at this picture, these are all basically paddies being taken and then you look at this one instrument here, this person is holding, this instrument you know, and what is that can anybody tell me. This one, this portion, what is that, this is an instrument for cutting ok. So similarly if you look at, there is another instrument here, right, which is there, and there is another instrument. We will be talking about technology. There is another instrument here. Could you see that? This is another instrument you know, there is another instrument here. What are those things? These are all earlier days people will be having right.

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So we need to look at that and let us see the major aspects of the farming and if you recall from the history that most of the civilization across the globe is basically started where, wherever water is there, river basin you know. So you can think there is a river here, right, these are river, this is a boat and then there is a in between some place there is some trees you know, and water is important for your cultivation.

So therefore water is the means. How to take this water, this is your mechanism by which you can take very easily, because this is a lever mechanism. It can ease your work input, am I right, are you not getting this is a, this place it will be going up or down, and then up and then that way you will put the water here, water will come over. And then these are all valves, or the gate valves, you can say that gate or controlling valves.

Controller I can say and then water can come over here and beside this of course you can take some material also, maybe some manure or something and you will have to also use a plough, the cultivations and there is, you can carry some, collect these materials. This is the sowing, if you look at the processes involved in that. And agriculture if you look at, as I mentioned earlier we will be using a lot of tools for carrying out the farming work.

And of course the plough is one important tool as I told, so for our narrative goes, it is the Balram, who must, might have invented the 'Hal', because he is known as the Haldhar, hal is

plough, right. A person who is carrying we can call Haldhar 'dharam karta hain tho usko haldar kehtha hain'. You know, do you know that, Balram was having an ayudh, means weapon as a hal, right.

So ploughing is this thing, when you talk about plantation the soil is important. So also the seeds and then it will be also sowing and sowing methodologies, will be discussing about that, transplantations, is very important. And let me ask you a question, what do you understand by the transplantation, and similarly when you talk about all these process then we need to also improve the soil, by using the manure and fertilisers. So the question here is what are the differences between manure and fertilisers. That question might be coming to your mind right and we will be using pesticides, insecticides and other things also, because always pest will be there. Even in ancient times pest will be there, insect might be there. But today insects are too many because of imbalance in the nature, that time it might be there aslo, in ancient time.


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Tools, Appliances

Agriculture Tools: Digging stick, Hoe, Spade, etc

Digging stick : It is reported from Mehrgarh (Balochistan), Chirand (Bihar), Ahar (Rajasthan) and Nevasa (Ahmednagar) since stone age.

- Consists a pointed stick with sharp edge on one/two sides.
- Sometimes a stone or crossbar attached to it.
- Used to loosen and till the soil and to extract plants
- Earlier ploughs were digging stick decorated with handles for pulling or pushing.
- Usually called **Abhri (vedic literature)** about a cubit long
one cubit = 45 cm (Distance from the elbow to finger tips)
- Used for both leveling the land and for digging holes.



Agricultural technology in ancient India

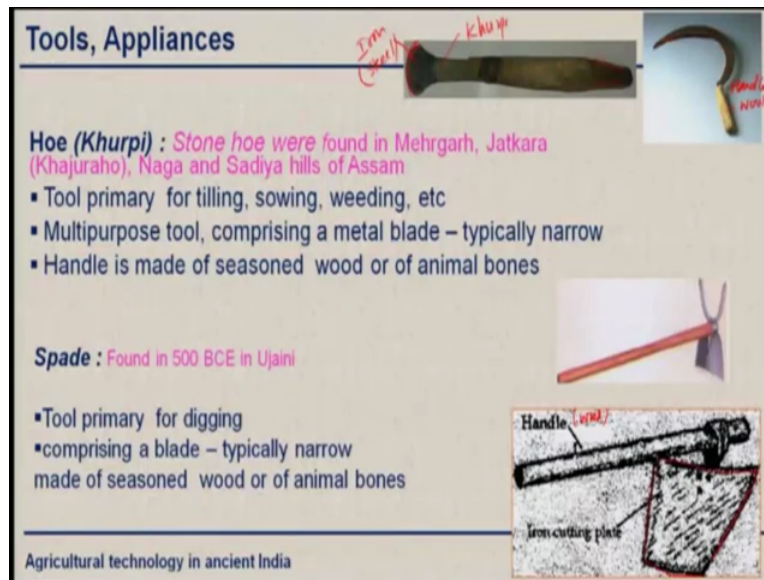
So agriculture tools let us look at some of them like digging stick. So if you, you know go to the history you will find we are having evidence of digging stick right from let's say Mehrgarh now in Baluchistan earlier it was a part of Indian, India like Chirand in Bihar right, if you look at and Ahar in Rajasthan and Nevasa in Ahemmednagar, since stone age right. I have earlier discussed Stone Age is long time before your Indus valley civilisation, right.

And these sticks consist of pointed sticks with a sharp edge. For example if you look at this is a sharp edge, this one side this is a sharp edge, isn't it, this is a sharp edge and there might be another, this is two sides, there might be another one here also. There might be various kinds you know, one can get it so that it will be easier for, to dig. And this is known as a digging stick and in Sanskrit you know in Vedic literature, it is known as the Abhri right. And if you look at this Abhri is about one cubit feet long.

One cubit means basically 45 centimetre. Around that, and this stands from the elbow to the finger. If you look at the elbow here and to the finger average you know depend upon the height of the person but in Indian system if you look at it, it will be around 45 centimetre, it can be also 40, you know on an average that is the thing, and this is also people use. There is another instrument what is being used like here, if you look at this is a stick kind of thing and it is having a cross bar right. This is your cross bar.

It can be made of stone, but what evidence we got is basically you know wood. Maybe people might have stone and then might have used to wood later on or vice versa, I think stone age if you look at modern way of looking, people say stone age first and then later on. But my feeling is that, first is the wood then maybe, I don't know, that is a controversy, but let us say that there is a evidence for that. Earlier ploughs were digging sticks decorated with handles like for example here, this is the handles you know. This is your handles and plough we will see this is the primitive way of ploughing and handles for pushing and pulling the things and these thing can used used both for the levelling of the land and also for digging the holes. So suppose if I want to put something I will have to dig. So this is a simple tool what people might have used earlier time.

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And there is another thing which is known as hoe, and in local language in Hindi we still calling it as the Khurpi. Khurpi if you look at there are several kinds, of course can I call it as a Khurpi this one this instrument if you look at. What is the purpose? That is we call it as a sickle right, and what purpose it will be used, can I till it with this. I can but it will be not that easy, and it is used for cutting the paddies or sowing, particular sowing, weeding. Weeding you know, if you have to remove some unwanted plants whatever will be coming out, and tilling of course it will be difficult. But there is another one I was thinking of bringing and show you, because in my garden this is having this is basically known as Khurpi, in UP, even at this moment, this is your Khurpi. And this is made of iron, or you call it steel, right. This will be which steel, mild steel.

This will be made of mild steel and it is having a sharp edge this edge is sharp edge, right. And it can be used I have used myself with this and this is having an angle you know. Like this it will be and there is an end here and then you put, it will act like a lever, like with less force and this design well, I have done myself I have used it. It's quite interesting very simple tool which you can use in your garden. Even somebody claim that you can also what you call, handle the (sma) little medium size land also for cultivation, right.

So in the Khurpi if you look at stone hoe. It is made of stone aslo, it is found in Mehrgarh and Jatkara in Khajuraho in MP, you must be knowing Khajuraho is famous for sun temple and Naga and Sadya hills of Assam. These we got from the archaeological excavations, we have already

got these things and tool, primary is this tool basically used primarily for tilling, sowing and weeding. As I had told earlier and as I told this is a basically sickle which is a multipurpose you know tool, its having a blade, a metal blade, narrow blade and this portion will be little zig zag kind of thing, so that it will be easier to cut sometimes it is sharp also. Right, and handle is made of seasoned wood.

This is made of wood right, this is your handle, and aslo earlier these people were using bones, animal bones right that is there but nowadays we are using wood. But those things are there still today. That is the thing whatever it was there, let's say 6-7000 years ago and today we are having similar stuff going on that is the thing what we are having. And there is another instrument or the tool which is being used is the spade. There are several evidences but I could managed to get that thing that it was found in 500 BC, BC mean you know before common era, I think 2005 years back around 2005 years back from now in Ujjain right.

And this tool basically primarily is for digging. Do you know the shape of this spade? What do you call in Hindi the spade, any idea? It's known as kodha, right. So this will be looking like you know, this is having a handle here, this is made of wood generally, and this is which is connected with that and this is the iron cutting plate, this plate you know is made of plate right. You might have seen these things right. So this still is being used and comprise of a blade and kind of things there are several varieties.

I will show you another of them which is little modern maybe. It's having the same piece here, this is your sharp, and this is having a kind of rode which is having sharp here. So this will be, when I will use lower portion when I will use upper portion, if I say this is lower one or one sided, in this example where I will be using and when I will be using, see if the soil is very hard, naturally I will have to use this one. Are you getting, this is for hard soil.

And one you do, I want to take of one place to another. If it is a soft soil, or you now muddy soil like you know, not muddy, like what you are having already being rained and it became soft so this can be used for, used for soft soil. It is easy and also with the help of this portion, right, this blade, you can carry the material from one place to another you can throw right. But with the help of this portion you cannot. So you can look at, it is a very good design one can think of, you can do two things with the same tool.

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Ploughing

- It was regarded as an important process in cultivation
- Observed in *Satapatha Brahmana* that furrow is like the womb in which seeds are sown.
- *Milindapanho* (a dialogue between the king Menander and a Buddhist monk Nagasena around 100 BCE) notes the one of the four essential requirements for successful crop is - **well ploughed land.**
- Term *Sambakṛta* (*Panini* V.4.58) provides ploughing to be done one end to another twice and second time in **reverse direction.**

Kṛṣi-Parasara recommends ploughing to be done **five times** in year.

- It is believed, first ploughing gives **wealth**, the third the **desired object**, and the fifth rich **harvest.**
- But ploughing must be restricted to **Sama** or **14 angulas = 10 inches**

As to **Jataka story**, man's prosperity depends on number of ploughs being possessed by him.



Agricultural technology in ancient India

And ploughing, if you look at the ploughing is a very important one right because we will have to plough the land before cultivation and even after cultivation kind of things. So it is very important as I told this plough which was basically according to our narrative, Indian narrative, it might have designed by the Balram, we call him Haldhar. So this plough is being joined, you know with this connected, this is your plough right, and it will be having a pole which will be connected to this 'bhel' or what you call the ox, two oxen and then it will be tilling the soil or the land. And when you do that, you will get something like a reach here and this is like a furrow. There will be like a drench sorry trench, and this is the reach it will be helpful.

Why we do this ploughing, that is the question, what might be coming to your mind. Is it not that I will take the seed and throw and then it will be germinated and it will be done, why should I do that. Are you getting these questions? So we will be answering these questions, if you don't know, but think about it later on and if you look at this is this furrow. What we call in Sathapatha Brahmana, like that is from the Veda, right, they consider this furrow is like the womb in which seeds are to be sown, right, like in womb we will have to put a seed, similarly they consider that.

In Vedic era people were having the understanding what really it is having, right, of course they have written a very little cryptic way. And that is another evidence if you look at the Milindapanho there is a dialogue between the king Menander and the Buddhist monk Nagasena around 100 BC and who emphasised the importance you know and the requirement for a

successful crop that is basically well ploughed land is essential for successful crop. For getting a bumper crop you need to plough it. That means plough is important, that dialogue is there and how to do and what are the things. There is also Sambakrta in Panini.

Panini you know like who has given the grammar which is very scientific of course there are several grammar book but Panini grammar book is known as Astadai, that means Astadai is written by Panini he has compiled lot of things and he has used this term which provides basically ploughing to be done one end to another. That means if there is a land, you will go from one end to another and twice and second time in the reverse direction, that you will go this way and come this way. Right, then only it will be the right one. So what I am trying to do is, basically I am giving evidence that look it is as old as our civilisation, that ploughing is going on.

And there is another book which is known as Krsi parasara even I think 50 years back people were using it religiously. Unfortunately now nobody knows, about this book but this was, and there's a local version also ether, local means, if you go to Tamil Nadu it will be having different version but most of the things are taken from here, Krsi parasara and other things, and that recommends ploughing to be done 5 times in a year.

For having two crops basically you have to do 5 times, kind of things and it is believed that first ploughing gives wealth, and the third the desire of what you want, and 5th which give the rich harvest which is important. So that's why ploughing plays a very important role for that. But very important thing, ploughing what is being prescribed that, that ploughing much be restricted to same means 14 angulates, 10 inches around.

It should be less than that. and why it is so, why not more than the way the tractor does, you use a tractor and its machineries for ploughing right, the land tilling the land then it will be going very deep. Why can't we do the deep this is old one, therefore he will be, you know the tenants will be not right. Actually it is not, that means the modern way of tilling is no right you should not spoil the top soil. When you do plough what is happening, the top soil will be entering into the next layer of soil and top soil is very important for the cultivation, right. And our ancestors were aware and they have also given the precision that you should not go beyond 10 inches, modern, they are talking about 'angulas' right.

So that is the thing, what, whereas the modern people were not aware till recently when there was problem people are finding out why we should not use tractors and then other instruments, ploughing instruments, devised by the modern people and we are now seeing that look they were knowing, where you know long time back, our ancestors. So that is very important. But why I didn't tell you. I am leaving that for you to think and explore, but as I go along we will discuss. As to the Jathaka story man's prosperity depends on the number of ploughs being purchased by him, right.

That mean more the plough will be, that means more the land he can manage to till right. That is the thing one can think of, that means prosperity. Prosperity in getting the food, producing the food, not in you know getting the other things, secondary things, because the farming or the crop, farming or the food is the first, primary wealth you know, kind of thing. So that was being emphasised. That's why our culture, whenever we think ours is basically agricultural based country, that is the reason. Let me just show you, how this is going on plough.

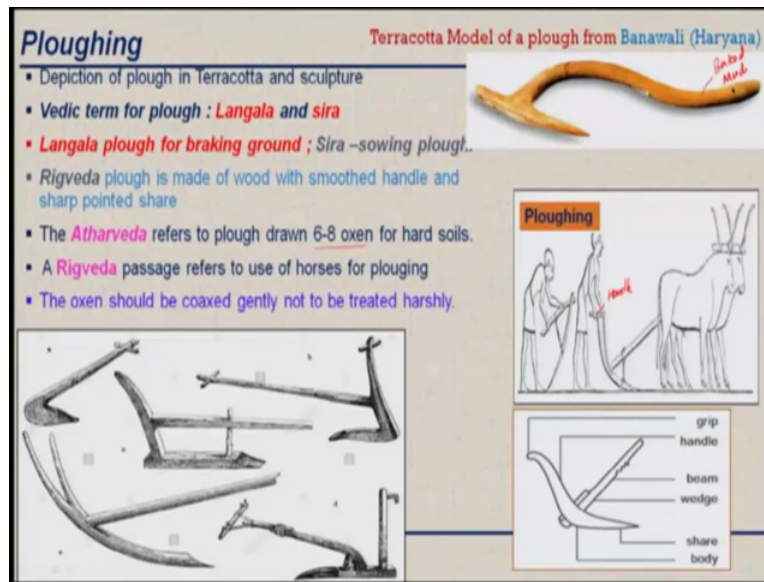
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Of course you can look at these videos and see that. Can you see that, you know this is having a 'bhel' and this is a one kind of plough which is there and it looks to be he is not doing anything, very nicely its doing and he is making furrow and ridges. If yo look at, let me again, this is making furrow and ridges kind of thing very easily. Of course let me tell you it is not the raw, the soil or the land, it is already done a layer. Therefore it looks to be very easy ok. Don't think it is that easy. And he is just, not doing anything. Just holding and then going, very easily right. But it is being already ploughed and he is doing second time. So there for you know, it is, look to be easier.

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And we will be looking at, also some parts of that. And 'ah' let is look at the plough means, you know, how does it look. And the plough, you can get you know in a Terracotta sculptures we got it. I mean this is the terracotta plough which is made of mud. Terracotta is made of mud ad this mud is being baked right, right. This is basically baked mud made of baked mud. And we got this evidence from Banawali in Haryana the place and which is quite old.

And Vedic term for plough is 'Langala' or some people call it also Sira, but there are two things what being used in Vedas, one is Langala this. Langala is meant for ploughing or breaking the ground, but Sira is for sowing, kind of sowing plough you can say. Like suppose I want to have, you know put the seeds, then you know you will do something to put the seeds very easily right. And Rig-Veda, in Rig-Veda, according to Rig-Veda the plough is made of wood with smoothen handle and sharp pointed share.

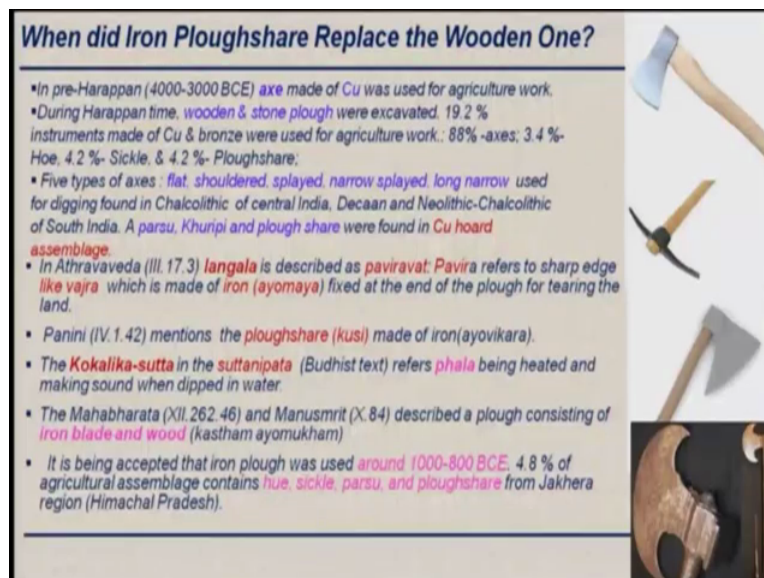
So you might be thinking what this is. This if you look at there is a handle here, right. This is your handle and this is a plough right, and this is of course the pictorial. Let me show you another picture, this is basically a figure which is indicating you know ploughing is being done, so this is the thing, is your handle, or the grip right. This one will be grip or handle you can call and this is your share, body and this would be pointed. In Vedic era the wood was being used. This would be sharp enough to pierce into the ground, the soil and Atharveda refers to ploughing

done by 6 to 8 oxen. This is really very, of course difficult to digest because what we are using maybe two oxen or 4 oxen. I have not seen 6 to 8 in my lifetime.

Of course I am not exposed to the rural environment and most of you might not have seen. Nowadays tractors are being used. And this is of course they are saying for hard soil. That means more force is required. That may be the reason. And Rig-Veda passage refers to the use of horses for ploughing and that is a very different thing, because Rig Vedic or the Vedic people were very fond of horses and at the time they were using for ploughing, ok. So the oxen would be coaxed gently, not to be treated harshly you know. Today you might be finding that people are very cruel to the animals. They might be (())(32.12) also, that is why they are being asked not to be cruel to them but to take care of them and gently coax you know, so that they would do the work for you.

So and there are various kinds of plough you can design you can think of, this is one kind of plough and this is another kind of plough. If you look at this is your handle. Similarly this is another kind of plough and this is another kind, various designs you can get across the country. But unfortunately nowadays it is very difficult to get plough because most of the people nowadays using the tractors and the tillers you know for tilling the land.

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When did Iron Ploughshare Replace the Wooden One?

- In pre-Harappan (4000-3000 BCE) axe made of Cu was used for agriculture work.
- During Harappan time, wooden & stone plough were excavated. 19.2 % instruments made of Cu & bronze were used for agriculture work: 88% -axes; 3.4 % -Hoe, 4.2 % - Sickle, & 4.2 % - Ploughshare.
- Five types of axes : flat, shouldered, splayed, narrow splayed, long narrow used for digging found in Chalcolithic of central India, Deccan and Neolithic-Chalcolithic of South India. A parsu, Khuripi and plough share were found in Cu hoard assemblage.
- In Athravaveda (III, 17.3) langala is described as paviravat; Pavira refers to sharp edge like vajra which is made of iron (ayomaya) fixed at the end of the plough for tearing the land.
- Panini (IV.1.42) mentions the ploughshare (kusi) made of iron (ayovikara).
- The Kokalika-sutta in the suttanipata (Buddhist text) refers phala being heated and making sound when dipped in water.
- The Mahabharata (XII, 262.46) and Manusmriti (X, 84) described a plough consisting of iron blade and wood (kastham ayomukham)
- It is being accepted that iron plough was used around 1000-800 BCE. 4.8 % of agricultural assemblage contains hoe, sickle, parsu, and ploughshare from Jakhera region (Himachal Pradesh).

And let us say that as I told that Vedic era people were using the wood as a ploughshare right, and when did iron ploughshare replace the wooden one that we will see. In pre Harappan period,

something 4000 to 3000 BC, axe made of copper was used for agriculture work, right and that is being you know discussed and whether it is, how they arrive that, this is one question coming to the mind you know. But however there are several axe I have shown you. Here you can just have a look at it.

During Harappan time, wood and stone ploughs were excavated, were also found and out of which agriculture instruments or the tools. If you look at 19.2% instruments were made of copper. Iron you know was not really being used in Harappan period till now people are not having that evidence and bronze were used in Agricultural work, 88% were axes, therefore they are deducting or they are thinking that axe might be used for the cultivation because the numbers are more.

And 3.4 % hoe, I have shown you, hoe I had shown you varieties of things and sickles is 4.2% and 4.2 % is ploughshare which is very very small in percentage. That might be the reason why they are saying that the axe might be used you know for the cultivation purpose because Harappan civilisation was depending on the agriculture. And 5 types of axes, it can be flat, it can be shouldered, splayed, narrow splayed or long narrow and this is another one, whether you call it axe or not, but I think we call in Hindi is (())(35.15) right. This is you know flat like this surface, like this surface here and then this will be also sharp in this side, so that you can use and this is being used nowadays for making roubles out of concrete because it is having a very force you can do right.

And it can be used also for hard, which one, hard soil or the hard ground it will be used. And this is of course used for the cutting purposes and then if you look at this 5 types axes, where used for the digging, digging purposes. If you know, they are found in Chalcolithic of the central India and also Deccan, Deccan region you know Tamil Nadu and Southern part of that portion and Neolithic and Chalcolithic of the South India. And besides these you know lot of 'parsu' like we are having a legend known as Parsuram who was the, might be the first person to have a parsu' I guess, and parsu looks like this. Parsu is also used as a weapon for fighting war you know.

That is and the Khurpi I already talked about Khurpi earlier, which is nothing but a hoe and ploughshare made of copper in assembly. They have several things they have got it. And in Atharveda, if you look at volume 3 and 17.3 you can get Langala is described as a 'paviravat'.

Pavira refers to a sharp edge like 'vajra'. Vajra you know what Indra used to use, that is this weapon it is made of very hard steel, and which is made of iron. 'Ayomaya' means Ayo means basically iron in ancient times, and fixed at end of the plough for tearing the land, right. And Panini mentions, Panini means the author of Asthadai grammar, Sanskrit grammar.

And he mentions about ploughshare which is also known as 'kusi' made of iron and in Vedic language it is 'ayovikara', right. So that means we are getting a lot of evidence that we are having this in ancient time as well and 'Kokalika- Sutra' is basically in the, Vedic text you can get. This is in Suttanipata, it is a Buddhist text refers to 'phala'. Phala is basically being heated and making a sound when dipping in water. What is the meaning of that? That basically you are tempering it right and making it hard the iron, and this process was there in, where. If you look at this is something around 200 BC. So it is not a new thing what we are talking about, it is very old in our country and Mahabharata and Manusmriti described plough consist of iron blade and wood.

This is 'Kastham Ayomukham' that means Kastham means wood Ayo means iron mukha means the front, there will be iron. That mean it looks to me during the Manu and the Mahabharata that or maybe Buddhist period rather right the iron has come into as a plough, that is the evidence what I could get. Of course it is a debatable thing. But however if you get something more you can tell me so that we can have a discussion to find out. And it is being accepted that iron plough was used something around 1000 to 800 BC.

Of course little bit before the Buddha. Even Buddha is 575 BC. So 4.8% of the agriculture assemblage contains hue, sickle, parasu, ploughshare from Jakhera region in Himachal Pradesh. Because people excavated and they are getting this kind of you know tools for the agriculture. So with this I will stop over here and the we can see that what are the various components of the, what you call plough and then from where we will get the evidence that ok how to design a plough.

Because if today you will go to the farmer, of I do not know, I just do whatever earlier, but we are having a design. I will be talking about in the next lecture that we are having design which is having related to the, a text which is very well known for the agriculture. So with this I will stop

over we will again discuss about it and look at also various aspects of farming and what we need to do. Thank you very much.