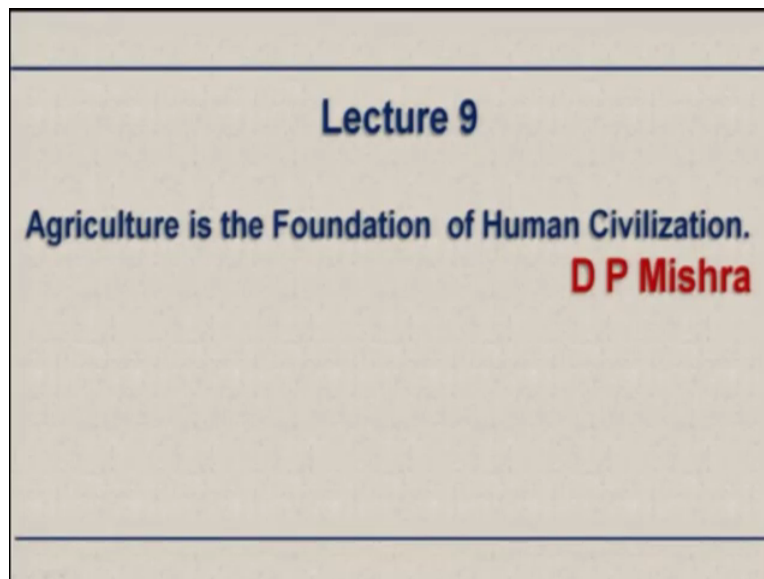


**Introduction to Ancient Indian Technology**  
**Professor D. P. Mishra**  
**Department of Aerospace Engineering**  
**Indian Institute of Technology**  
**Module 2**  
**Lecture No 09**

Speaker (S): Let us start this lecture by recalling what we had learnt in the last few lecture. I had a given introduction to the Ancient Indian Science and Technology. And I am trying to impress upon you people that we had a very good heritage of the ancient there is a very good heritage of the scientist the scientific heritage. We are having. And we should try to learn and also address the problems faced by the modern science and technology due to the wrong philosophy of life and also the philosophy of science and technology is against the Mother Nature.

And I had given a where we can intervene, what we can learn and from the Earlier Indian science and technology so that we can what you call look at it a new perspective and also adapt in the modern day. And today we will be looking at agriculture.

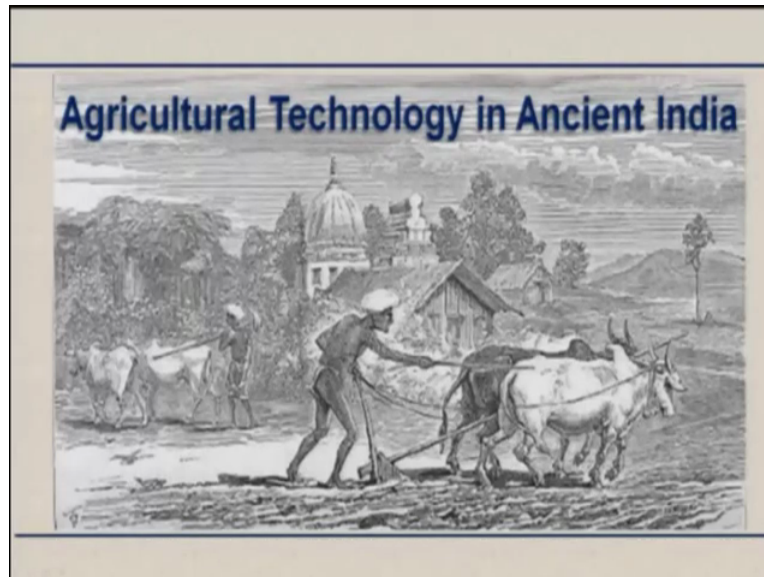
(Refer Slide Time: 1:28)



Therefore let us start with the thought process. That is Agriculture is the Foundation of Human Civilization. If you look at like that we are being told that people were living in the jungles, like animals particularly the man. But later on they learnt how to cultivate and they settle and then civilization start. That is the fulcrum or that is the starting point of human civilization. Therefore

agriculture plays a important role. And if you look at our scriptures that agriculture is very important. Because “Anna Parishta Devaa”. Even the god has to rely on the food. So food is very important.

(Refer Slide Time: 2:25)



And what will be looking at here in this, what are the technology available in ancient India. Particularly pertaining to the agriculture, means farming. And we will have to see how we can adopt it is. But before that we need to ask certain question. Why do we give importance for agriculture in India?

(Refer Slide Time: 2:30)

**Why we do give importance for agriculture in India since ancient times?**

- India has 52 % of cultivatable land as compared to world average (11%).
- Hour of sunshine is quite high as compared to world average.
- All 15 major climatic regions
- 10 Biodiversity regions.
- Over 871318 species of fauna and 47,000 species of flora, found in India so far.
- India has largest livestock population.
- Large number of rivers and water bodies.

Alfred, J.R.B. (1998) [Faunal Diversity in India: An Overview](#); In [Faunal Diversity in India, 1-viii](#), 1-495. (Editors. Alfred, JRB, et al., 1998). ENVIS Centre, Zoological Survey of India, Calcutta.

Since time in memorial. I mean see if you go back to the even like starting of the civilization in this country, which is around what we have looked at historically, like 8000 before the common era kind of things. So therefore why, can anybody tell me? Like why we need to give that much importance to agriculture? Why not will be on service sector or some manufacturing kind of things?

STUDENT: Because food is the basic need.

PROFESSOR: Yes.

STUDENT: So it has to

PROFESSOR: (Interrupts) we can always you know import? I mean there are several other countries who rely on import of food at this moment. Why we cannot? Any idea? And we will have to see what are the you know the land? What kind of land we are having? What are the natural resources we are having? And how those things are conducive for cultivation. So that we will be looking at. Because I have already discussed some of the things.

I am repeating because you have not kept in mind. That is why I was thinking that repeating it. India has 52%age of cultivable land. As compared to the world average. You can say that it is

the, what you call food house of the world. That means she is having, or the India if I say as a mother, you know like always we say Mother India. So she has the you know that capability to produce the food. Provide us food. And food is important.

Beside this for the cultivation or any plantation or trees we rely upon the sunshine. Because that is the energy being captured by the all fauna, you know or the plants. Because that way energy is converted into you know through photosynthesis. And then we use it for our energy need of the body. Ok. Because if you look at whole this thing is energy only. Right. Energy and what you call information. That is the main thing what we do sustain the life.

And so also the other things. So sunshine is very important. And this we are endowed with that. Being a being in a semi-tropical region. And we also, climate is very important for cultivation. So we are having something 15 major climate region. Therefore varieties of the plants we can having. The biodiversity is quite you know phenomenal in this case. 10 bio-diversity regions are in this country. As I told earlier India is not a country, it is a sub-continent. Ok.

It is not a mere country. Because of bio-diversity. Because of this various major climate regions, and we are having endowed with a lot of also fauna and floras. Of course this number I have little bit changed than the earlier one. That is over 8,71,318 species of fauna, we are having. So it is quite a big number. Of course due to the human interventions and due to the what you call abuse and misuse of the modern science and technology, in the name of developments.

Adapting the unsustainable and what you call anti-nature, mother nature, we are spoiling it. And we should keep because the life all are connected. That is the our scripture always talk about. And similarly 47,000 species of flora found in India and there might be much more than that. And of course I will show you that this I have taken from some resources. Because the number I was doubting so then I found out look that this taken from reference. I will show you little bit later on.

And India has a largest livestock populations which is you know quite good for our need to the milk and then you know other kind of things, like as a food also. Even I will let you why we need to rear the animals, is very important. Right. I will be talking about later on that let me ask you a question, “that why we need to have livestock?” Why we need it for our life? Why not we

use machines? What are the advantages? What are the disadvantages? Please think about it. Can anybody tell me now? Why we need to have livestock?

STUDENT: Natural.

PROFESSOR: Huh?

STUDENT: Natural.

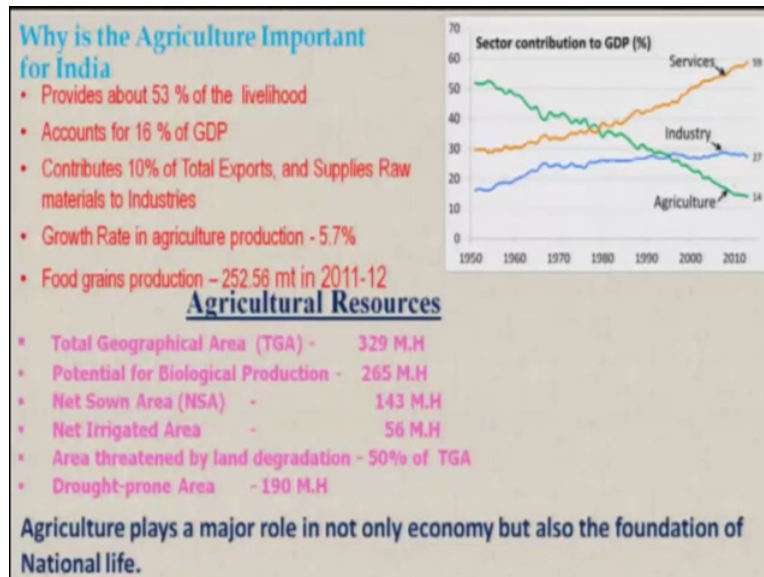
PROFESSOR: But that cannot be part of. Then how it is related to the life? And how? Why not have a machine? For example I can have a tractor, I can have a trailer. I can have some other things, they will do. Why we will have a life? Because is this you know. So those question you need to ask and I am having some logic to it. And we can discuss later on.

And large number of rivers and water bodies. You know if you look at the so many rivers are there. Like you start from Ganga, Brahmaputra, Kaveri- these are big rivers. Mahanadi, Tapi, Godavari, Krishna, there are several rivers if you name you know it will be too many. Right (laughs). These are the big rivers I am talking about. There are several small rivers are there in this country. Not only that we are having lot of water bodies. Lakes are spanning over kilometres.

We are having also unfortunately in modern times we are encroaching into the their portion and taking for our habitats and kind of which is bad. Because of growing populations. And also not concerned for the nature. That is the very important. So if you look at I was talking about, I have taken this data (slide shown) Alfred Gearbe, written by the Overview and Fauna Diversity in India. And of course as I told Alfred Gearbe and others also. And this is from NV Centre Zoological Survey 1998. This is little old data. But however this numbers will be correct to whatever I am quoting.

So that is the reason you know, one of the I am the reason why we should go for cultivation. Because we are teaming population of 130 crore, I am mean you can say 125 crore, by official. But actually according to me, it will be around 130 crore people. Right. And we cannot rely on the outside country to for their food. We will be in trouble.

(Refer Slide Time: 9:36)



And why is the agriculture important for India, as I told that even today the livelihood of the people, 130 crore people you know 53% something being provided by the agriculture. Although, in spite of that still we are finding difficulties to having you know labourer for the agriculture. That is the problem today we are facing in the village area, rural areas, or the villages. And this is accounts for 16% of GDP.

Let me tell you it has been lowered down. Because of fact that services are increasing. I will show you a diagram maybe. It will be tell you. (Slide shown) if you look at agriculture was highest in the 1950. Something 50% of GDP was from agriculture. And in industries was something around maybe 18% roughly, you know if you look at this diagram. Then it goes up and then you know goes up and then of course now it is going up little bit. It is data is till 12<sup>th</sup> no 2010, you know 16% maybe little higher because lot of importance given for manufacturing with the new government in the centre.

And the of course the service sectors has been increasing at rapid rate. But it can fall at any time because we are depending on the foreign countries for that. Because we became a service provider for the most of the western countries in software particularly. So it will fall down where will go? right that is the one question we need to ask? And food is important. Of course agriculture GDP is going down. But we need to take care of our own food security. So if you

look at that contribution of total export, we do export, lot of food stuff to other countries around 10% and supplies raw materials to industries.

For the other foreign countries. I feel that what we need to do that we need not to supply the raw material. Rather process it and go so that we can have value addition to that. And for that we need to have our own enterprises will do that. Ok. And in modern time particularly lot of multi-national companies are coming and then they are doing business and we became a you know what you call consumers, and also we are going and doing a job.

I will call upon of you, all of you to become entrepreneurs. And generate you know value added products and then sell, like we can sell to other countries and become richer and then get gain something you know wealth for our own country and for our own sake. So therefore we need not to be a job seeker we should be job provider. That should you should be keep in mind. And lot of things we can do that.

And growth rate in agriculture production of course 5.7%, this data is from 2000, you can say 2010 or 2011 and 2012 kind of thing. And food grain production is something 252.56 million tonnes. It is in 2011-2012. Now it might have gone up a bit. This that I you know I have giving to have a feel that what we are having you know like, and what is the potential and how we can grow and other things and why will go for agriculture. That is the thing to make a point. You need not to worry about you know about like exact data but you can see the exact data.

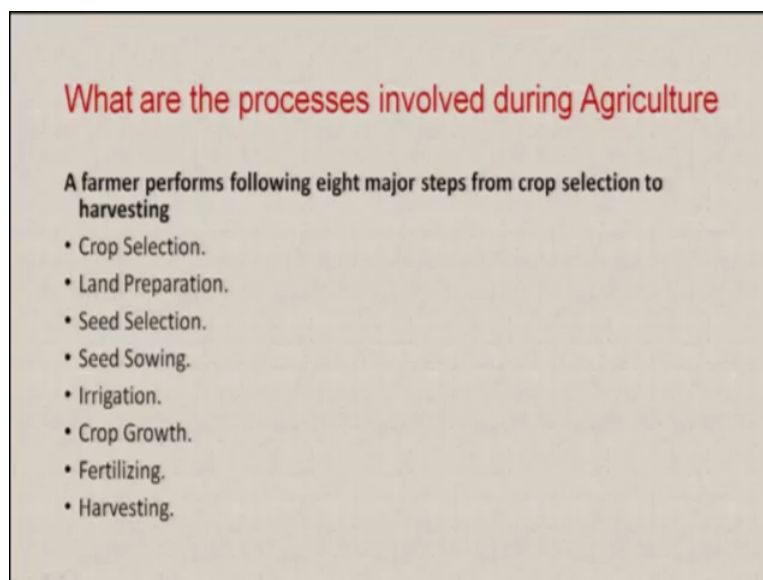
And if you look at total geographical area what we are having is 329 mega hectares. And potential for biological products to 65 mega hectares. Net sown area is 143 mega hectares. We can have also increase this land. And net irrigated area is very small, that is 56mega hectares. Area threatened by land degradations 50% of this TGA what is the agrarian. Because of wrong method of cultivation and also the industrializations, you know our soil is being getting spoiled. And of course the drought prone area is 190 mega hectares.

But what I am thinking that it can be changed, provided if we have a relations, develop a relationship with them mother nature I mean if we make our system integrated and sustainable then we won't have this problem. We can manage well. These are all according to me drought prone area is a rather man-made. In other words if we understand the nature and work with her to

do that thing, then you know will don't have that. As you go along will be discussing, as I will be talking about the natural farming toward the end of the series of lecture on agriculture. Right. So therefore the agriculture plays a major role not only in economy but also that is the foundation of national life.

So it is very important that we need to stick to our agriculture and use our technology, I mean like whichever we can have, get from our ancient practices or traditional practices. And then do that.

(Refer Slide Time: 15:11)



So before getting into that let us look at what are the processes involved during this farming. You want to have like, let us say you want to grow rice, wheat or paddy or any other things. And take it as a profession or as this thing, for our own. What are the things we need to look at it? Can anybody tell me? Like?

STUDENT: Selection of soil.

PROFESSOR: Yes, selection of soil. Any other thing?

STUDENT: Seed selection.



PROFESSOR: Seed selection, very good. What else? Huh? What are the resources? Soil is very important. That means you need to identify the soil, what you are having? How to improve it? What else? Any other thing?

STUDENT: Availability of water resources.

PROFESSOR: Yes. Water, how to you will get for irrigation or something. Any other things? If you want to farmer, you will have to look at 8 major steps for you know crop selection to the harvesting. Because what kind of crop you will have to do today, we are all being swayed away by the profit. Rather I call profit-maniac you know is being coming into pictures.

But if you look at your tradition it is not the profit alone. You will have to have profit. It is not that you will do with the loss. Ok. But it should be attached to the auspicious thing. You know I ask you in your all "auspicious occasion we write "Subh Labh". Why it is so? Why not only profit? Labh means profit. Why not only profit? Profit cannot stand of its own. Only for profit we should not live a life.

We should not do anything. Only for profit, no. It should be always will be auspicious means will be integrated with do good to the others, to the society. Right? That is very important. That is our culture. But we have forgotten. We are just writing on maybe this marriage occasion or some other celebration, traditional celebrations. We write down we do not know why we are writing? Are you getting my point? So it is very important to look that the signatures which are there till now we are having but it is going, it is you know being driven out of our mind and also our traditions.

Due to this blatant adoption of the western way of life. Right? And we should understand that this is the legacy what we are having. This is the heritage which we have inherited. And we, and it is very important to have profit but it must be proper. It must be for the welfare of the society. It must be welfare of the Mother Nature. All integrated. Those are things. So therefore profit is required.

So therefore you will have to select the crop. When you select the crop, how will have to do that? Will have to see what are the crops can the soil, we can have. And what are the your need. For example you need food. Right? I should not do this what I call tobacco cultivation. Because I

want money, fast money. Right. Of course tobacco is required for certain thing. But it should not make it like what you call “nasha”. Right. Addiction. And then all people will be you are getting money but the society is into turmoil. Are you getting?

So those things one has to look at it. But tobacco is having also effect on this some Ayurvedic medicine or some other thing. That is alright. Are you getting my point? So therefore it is important, to look at what you want? I should be ethical. It should be societal benefits. One has to do that. And the land preparation. For example you are having a land, where you want to have rice. But it is not very suitable. What you will have to do? You will have to prepare. And you will prepare, what are the things? And how you will do it naturally without really spoiling?

And seed selection. How will you select a seed, is very important. Now a day’s seeds are coming, that companies are coming with a seed. Which will not having you know kind of thing it won’t germinate. Even if you produce seed. Sometimes seedless things are coming now. you know. They are controlling, we do not have to the knowledge. How to keep it, how to select it, how to you know take care of it. Which seed will have to select and how it will be integrated with the local areas?

And seed sowing? You will have to sow it. How to sow it properly so that it won’t get affected. Which time will have to do? And then what is that thing you will have to look at it. And irrigation, as you told, some of you told water is very important. Because our shastra says “Anath Bhavantibhutani, parjaynathanashambh.” That means from the rain water or the water, you know the aana means the food will come. “Anathbhavantibhutani” that means from what you call food the life has come. Bhutani means living beings. Ok?

Therefore you will have to look at water. How to take care of it and what are the areas. And how to protect the waters so that it won’t be taken away, by the sun. You know it will evaporate and go. And then you will have to preserve it. How you will do that? How will integrate? Then what is the crop growth? Right. The growth, how it is? How will enhance? Of course you need to have how you will protect so that growth can be done.

And then fertilizing, like you will have to use some fertilizers. What kind of fertilizers? Whether you can do it naturally without using fertilizer? All those things you need to look at it. And

harvesting. How you will do? That is the so you know key factors. If you look at harvesting, is a very very important if you look at that the plants. They grow themselves. We need not to do anything. Is it will have to do except will have to take care, you know like things are in proper this thing. Otherwise they grow of their own. Provided sun shines, shade is not being shade. You know shade is not there or the sun is there. Proper you know these thing will be there. So and the soil will be proper.

And like animals and other things are prey or other things should not spoil. So those things you will have to look at. So these are the processes, general process I have told. So that you will be you know familiar with what are the things to be done in agriculture. Because most of you may not have idea about the agriculture. Right? Am I right? So therefore I have given some introduction. So will now see I am let us ask a question, what do you mean by modern agriculture?

(Refer Slide Time: 22:13)


### What is Modern Agriculture ?

- **Modern agricultural Practice** uses hybrid seeds of single crop variety, technologically advanced equipments (tractor, tiller, shredder, rice transplanter, fertilizer spreader, etc ), fertilizers, pesticides and water to produce large amounts of single crop.

**Energy: Cost :** Plowing, Harrowing, Planting, Fencing, Weeding, Harvesting, Pest Control, Storage, etc.

#### Characteristics of Modern Agriculture

- It has higher levels of input and output per unit of agricultural area.
- It has a low fallow ratio, higher use of inputs such as capital, labor, higher fertilizers, pesticides, plant growth regulators, and mechanization for higher crop yields per unit land area.
- It demands more detailed analysis of growing conditions, including weather, soil, water, weeds and pests.
- It relies ongoing innovation in agricultural machinery and farming methods, genetic technology, techniques for achieving economies of scale logistics and data collection and analysis technology.



Any idea in modern time, we are adopting basically agriculture as an industry. People are trying to as if it is an industry. It is there basically business you know. Earlier day's people used to do for their own food productions or food their need. And then there are using it in a village, kind of things. But in modern time, it is an industry. Right? Right? In a..western country it is an industry almost. Very rich people will be farmer.

Not like in our country where poor fellow will be farmer. Right? Here poor fellow. And that is that is I am afraid that within may be 50-60yrs the same thing will be there. The food will be controlled by the rich people. And they will dictate what are the prices will be. And the poor fellow will be labourers. Not there farmers. Right? And farming is very important. You want to grow spiritually, you will have to do farming. Because I call “Rishi banne ke liye, Krishi karna zarori hai”. Right?

So therefore it is important, but what are the problem is what is modern agriculture? So if you look at modern agriculture, you just basically hybrid seeds of single crop varieties. Right? They use hybrid seeds or technologically advanced equipment like tractors, trailers, shredders, rice transplanter, and fertilizer spreaders. You know lot of things, gadgets you will have to use. And fertilizer, pesticides and water.

Like you know by the modern irrigation system. To produce large amount of single crop. If you look at even in India, today rice, only rice are there. You know only wheat are there. So that is not really right thing. Because you look at nature, if you go to a jungle, what do you see? Is it that only this will be there, only one crop, one plant will be there? No, altogether. So therefore the togetherness is very important. Right?

So nature works in that way. If you look at animal will be there, insect will be there and that plants will be there, together in the nature. So similarly plant kingdom also like that. So but where in the modern you want to have so therefore you this thing. So and you use this various gadgets. And as a result the energy cost, you use a lot of energy. Energy means you know like basically fossil fuel. We use for getting energy. And then ploughing, for ploughing will be using the tractors for you know like a ploughing. Earlier day's we used to have a bullock for that, and with a plougher. But today mechanized one, you can do that. And then you can use them harrowing.

Harrowing, may some kind of making this soil to be conditions. Or you can make it break the soils, and then you know also make this kind of what you call so that it will be smaller one and air can get into all those things, that is there. If you look at this is the harrowing, some kind of a pin will be there and that will be. You will have to also planting, you know. Right you know, you will have to plant and you need to have fence this things.

And weeding out suppose some other things, other you know plants will be growing because of some unnecessary this thing that will take away you're what you call fertilizer what you are using. You know, then you will remove it. But those may be beneficials, you know, you do not know. And then pest controls. And of course how to store this food, that is also another because we use air conditioner and other things. You know lot of energy is required. That is result the cost is very high. So what I am thinking I will give an assignment maybe to look at what are the cost involved. How this cost is increasing day by day of the food price?

The production who to while cultivation you know the farming cost is increasing. Right? And where we are the coster so that we can minimize it. And in India, we don't need really big machines. Because we are having a lot of people and then they can work, manually or little bit small machine they can use which is not consuming the or guzzling the you know what you call energy, either electricity or the diesel or the petrol kind of things or any other fuel. So that we can and also once they will work they will get also physically fit. They need not to go for a walk or for a run and then do that thing for maintaining the body. These are all wrong notion that therefore one has to use that thing.

And if you look at characteristics of modern agriculture (slide shown) it has higher level of input. Because you are giving a lot of energy or lot of costing is involved, we give lot of buy this aa. Pesticides. You will have to buy this fungicide, we will have to buy this fertilizers, will have to buy the seed also. Right? You will have to use this all this gadgets, from the market. And output per unit agriculture they want to have higher. But unfortunately it is not. Therefore lot of farmers are committing suicide.

It has a low fallow ratio. Fallow means you know this thing for cultivator, so that you know like less number of people will be required. Because they are using machine and higher use of inputs such as capital, labour, higher fertilizer I have told, pesticides. And plant growth regulator. They want to regulate, control it artificially. And mechanization of higher crop yields per unit land. They want to have but then they will have to pay the price for it. Cost is increasing.

Demands more detail analysis of growing condition including weather, soil, water, weeds, pest, and you know all this modern technology we are using, to predict it. So that they will be and then as a result what is happening, people don't have a feel for it. There now farmers are now

labourers or farmers are dumb fellows. They don't have understanding what is happening. And realize on-going innovation agriculture machinery, farming methods, genetic technologies, techniques for the achieving economic sub-scale, logistics.

Even data collections, analysis technology, you know lot of sophistication has come up. And then that also for that you will have to pay price. Ok. Which is natural one and we are doing it unnaturally we are paying a lot of price for that. So that is the problem with as a result you know it is very costly affairs. So what will say that will stop over here and we have seen that what is the, what you mean by the agriculture. And what are the processes involve in agriculture. And then will, we also looked at why we need to go for agriculture in our country. And we have also seen what is the methodology adopted for modern agriculture and what are the fallacies. Right? Will stop over here. Thank you.