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Redesign of Future Agriculture through Innovation and Technology in India

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Abstract

The nature of future agriculture will have to be changed because of the constantly changing climate, increasing population and decreasing land, climate change harm on crop production in the coming times. For this, we will have to research this from now on so that planning and strategies can be made for the future. Looking at the present situation, there will be changes in agricultural practices for future agriculture through technology. What will be the nature of farming through innovation and technology for the future is being discussed in this article.

Keywords: Future farming, organic farming, hydroponics, aeroponics, drip irrigation, kitchen gardening.

Introduction

India's growth rates began looking more like China's after 2003, so with the development of the country infrastructure also drastically developed. As a result of that closer areas near the main roads developed rapidly [6, 8]. Gradually, these are taking the form of towns and cities. This is a continuous evolution with the development of the country, the population also rapidly increased. It cannot be stopped, but its speed can be reduced to some extent by controlling population growth to fulfill the needs of the increasing population they have to consume more lands. So the near future, we will face a crisis of land. Then to overcome this crisis we have to move on the cultivation on roofs and walls of the buildings. Developed countries move to this method and modified now. Meanwhile, we have to increase food production also, but with the increase in population remaining lands also decrease. To overcome this problem research institutes associated with agriculture have to do research work to tackle. At present, the food grains of the country are sufficient to cater to our

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population. But at the pace with which the population is increasing, the yield of food grains will also have to increase. The population is continuously increasing; the arable land is continuously decreasing. In the coming few years we will have to produce food grains to feed more people in less agricultural holdings and this will be possible only when the farmers of this country are aware, they will start benefiting from all the beneficial schemes run by the government for the farmers. All research work from agricultural research institutes will reach the farmer directly.

1. Farming With Hydroponics and Aeroponics

In the hydroponics farming system, vegetables are grown in the air with a mixture of nutrients and water, without using soil [24]. Different nutrient formulas such as nitrogen, phosphorus, and potassium (NPK) are used along with other trace elements to promote optimum growth and development. This solution is incorporated into the water so that plants can soak up the other nutrients they need when they absorb the H_2O through this mixture. But in the aeroponic farming system plant roots never go into the water medium [14]. They absorb relevant nutrients from a mist that is sprayed several times an hour onto their roots. An ideal aeroponic environment is mostly infection-free due to that the plant in this system grows faster and healthier than the plants in the soil medium. In this technique, vegetables are grown according to their nature by the flow of a mixture of nutrients and water in different sizes of trays or other structures. At present, the use of this technology has started in developed countries where arable land is less or not cultivable [27]. If such situations arise in our country in the future, then this method of farming will be an effective option.

. Genetically Modified Seeds

When the original gene of a plant is changed by artificial measures by its original structure, the seed obtained from such a plant is called a genetically modified seed [27]. The main objective of cultivation with genetically modified seeds is to reduce water requirement, disease and pest susceptibility and increase the quality of yield. The results of the cotton crop in the India were very encouraging [9, 13]. Global area of genetically modified crops is presented in table 1.

Table 1: Global area of genetically modified crops.

Country	2010	2011	2012	Crops
US	66.8	69	69.5	Maize, Soyabean, Cotton, Sugarbeet, Papaya, Squash

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Brazil	25.4	30.3	36.6	Sayabean, Maize, Cotton
Argwntina	22.9	23.7	23.9	Sayabean, Maize, Cotton
Canada	8.8	10.4	11.6	Canola, Maize, Soyabean, Sugarbeat
India	9.4	10.6	10.8	Cotton
China	3.5	3.9	4	Cotton, Papaya, Poplar, Tomato, Sweet pepper
Total	136.8	147.9	156.4	

3. Kitchen Garden and Pot Culture

Kitchen gardening is a technique that enables us to grow vegetables free from bacteria and viruses at home. Empty land is used to grow vegetables. If there is no land, empty tins, old and useless pots and earthen pots can be used to grow vegetables for the kitchen garden. This way can not only save our money and time, but can also provide a healthy, useful and environmentally friendly hobby for the whole family [11].Fruit plants increase in size, so their form is changed to bonsai and applied in pots. At present, this method is not very much in vogue, due to a lack of knowledge. But with the absence of space in the future, it will be a more suitable and effective solution. To increase the productivity of a plant of fruits and vegetables more research work is still needed in this area. Fresh fruits and vegetables are available for consumption throughout the year from home pots and kitchens gardens; this is the base of this technique.

4. Cultivation on Roofs and Walls

Look a little bit and see at what speed the cities and villages around you are expanding. Big-sized buildings and colonies are being developed in the vacant places of all the big metro cities of the country. The space in these metros is negligible. Even the small cities of our country are not far behind, new roads and buildings are expanding every day. Gradually small cities are now taking the form of metros. Even our villages are also not behind in this race. There is continuous development in the cities and villages situated along the roads. Gradually, these are taking the form of towns and cities. This is a continuous evolution. It cannot be stopped, but its speed can be reduced to some extent by controlling population growth. If we are unable to do this, then in that case we will face a lack of field for agriculture as a big crisis [12]. Then to overcome this crisis we have to cultivate the roofs and walls of the buildings. In some developed countries of the world, this method of farming has developed. Now, research institutes associated with agriculture will have to do research work to tackle this problem in the future.There is also good news that some institutions in big

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metro cities of India have taken initiative for roof cultivation and people are growing vegetables organically for their consumption by joining these institutions.

5. **Quality Production From Protected Farming**

The main reason for the low productivity of fruits and vegetables and lack of quality production in our country is to do farming in an open environment. Traditional methods are still being used by farmers for fruit and vegetable production. Crops are damaged by living and non-living organisms in the open environment [23]. Consequently, the quality and productivity of the crop are adversely affected. In protected farming, temperature, humidity and light are controlled. Its main purpose is to protect crops from living or non-living factors and produce more quality in adverse environments and conditions. Structures like a greenhouse, poly house, net house and glasshouse etc. are used for protected farming. This technique achieves 5 to 10 times more productive than conventional farming [10].

6. Organic Farming

Cultivation with organic materials is called organic farming. If the continuous use of chemicals in agriculture, its long-term consequences will be very fatal. Organic farming will have to be adopted to avoid ill effects and to balance farming with nature and the environment.In short, organic farming should be free of synthetic fertilizers and chemical pesticides; organic farming can be described as sustainable use of land along with systematically enhancing agro-ecological systems.The top organic farming state of India is presented in Table 3.

Table 3. Top 10 states of India in terms of actual area (ha) and % of the net sown area (NSA) under organic farming.

State	Actual area			% of net sown area		
	NSA ('000 ha)	Certified organic area (ha) in 2013-14	State	NSA ('000 ha)	Certified organic area (ha) in 2013-14	Percent of NSA
MP	15119	232887	**Sikkim**	77	60843	79.0
Maharashtra	17406	85536	**Goa**	131	12853	9.8
Rajasthan	18349	66020	**Uttarakhand**	723	24739	3.4
Sikkim	77	60843	**A&N Islands**	15	321	2.1
Odisha	4682	49813	**MP**	15119	232887	1.5

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Gujarat	10302	46863	**Nagaland**	362	5168	1.4
Uttar Pradesh	16593	44670	**J & K**	732	10035	1.3
Karnataka	10523	30716	**Odisha**	4682	49813	1.0
Uttarakhand	723	24739	**HP**	539	4686	0.8
Kerala	2072	15020	**Kerala**	2072	15020	0.7
All India*	141515	723039	**All India***	141515	723039	0.5

*All India includes other states data also

7. Aggregated Farming

In this time, holistic farming is very important. From the perspective of climate change, diversity in the fields and the combination of trees and animals with crops a lot. Till now, it has been found in experiences and studies that where there is harmony, the percentage of loss has been less [3]. Whereas, where there was a single crop or dependency on animals only, the damage is more. Consistency in farming makes the farmer self-dependent, his food security remains on the market. Because the loss of one or two methods does not destroy the entire process.

8. Changes In The Method Of Irrigation

Water is an invaluable natural asset that is extremely essential for every organism. Due to the lack of proper use of water resources in the world, groundwater is rapidly declining. The availability of water is becoming a serious problem due to the increasing population. In the future, water scarcity for irrigation will be a serious crisis. In this situation, the traditional irrigation systems will have to be abandoned for good use of water; a micro-irrigation system will have to be adopted [33]. This solution saves 40-60 percent of water. By these methods water is distributed to the roots of the plants. There is a definite saving of water from this. This will make farming possible in more areas.

9. Water Conservation in Fields

With the increase in temperature on the earth, moisture is decreasing. In such a situation, it has become necessary to conserve moisture and collect rainwater and use it for irrigation. The water scarcity situation can also be tackled using technological measures such as zero tillage [15]. There has been a decrease in water demand in paddy or wheat cultivation under zero tillage conditions. And an increase in yield and a 10 percent reduction in production costs have also been observed.

10. Change in Sowing Time

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There is also a change in weather due to climate change. Winter season is now starting late. We have to change the sowing time according to the season. So that there is no effect of temperature on the crop. Changes in the calendar of crops sowing can prevent further weather outbreaks.The effect of climate change can be reduced somewhat by adopting mixed farming and intercropping. Plantation should be done to maintain vegetative cover around the fields. By doing this the effects of climate change can be reduced. This will not only reduce the carbon present in the atmosphere but will also help in increasing the fertility of the soil.It is known that climate change and variability have a negative impact on crop production. Changes in rainfall, heat waves and drought have been a constant detrimental effect on grain yield. Future estimates suggest that temperatures will rise by 2-3 ^{0}Cat the end of this century. The number of hot days and hot nights in Asia will increase. There is a possibility of high intense rainfall during the summer monsoon. This state of warming may lead to a drastic reduction in the grain yield of crops by the end of this century. Sugarcane yield in India may be reduced by up to 30% [22]. To deal with this problem the negative effects of climate change have to be reduced. Negative effects of climate change can be overcome through heat-resistance, modification of current crop production technologies. More work is still needed on the effects of climate change in the future so that plans and strategies for future agriculture can be decided accordingly. The details of the reduction in the yield of cereal crops in different countries in the coming time are mentioned in Table 6.

Table 6. Impact of climate change on cereal crop production.

Crops	Country/continent	Yield reduction (%)	References
Wheat	Australia	−32	[29]
	Iran	−37	[40]
	Worldwide	−5.5	[40]
	Mexico	+25	[28]
	China	−17.5	[43]
	Asia	−7.7	[5]
	India	−5.2	[17]
	Pakistan	−50	[18]
	Turkey	−20	[32]
Rice	India	−7	[1]
	Indonesia	−11	[31]
	India	−8	[35]
	Asia	−6.3	[30]
	Italy	−12	[7]

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	Japan	−11.3	[21]
	Nepal	−24	[25]
Maize	Portugal	−17	[25]
	Ghana	+12	[38]
	Africa	−20	[34]
	USA	−50	[42]
	Ethiopia	−4.7	[4]
	China	−46	[39]
	Africa	−32	[37]
	Pakistan	−27	[42]
	China	−30	[41]
	USA	−27	[16]

Source: Ishfaq Ahmed *et al.*

11. Food Security Through Improvement in Preservation, Transportation and Storage Facilities

About 32 crore people in our country suffer from food shortages. India's position in terms of food grains is astounding. Indiaon the one hand is looking for ways to increase agricultural exports and on the other hand 32 crore people are forced to sleep hungry. The number of hungry and malnourished people in India is almost equal to the total population of America. According to a survey report, in most households, people are failing to get the number of calories prescribed per person for consumption, which is 2100 and 2400 calories[, 29, 36]. The same is another aspect of the country, 20-30 percent of fruits, vegetables and food in the country go waste every year due to anomalies. Both starvation and malnutrition can be eliminated if the fruits, vegetables and food grains that are wasted every year through the intervention of the government reach the needy through appropriate channels. Also, food storage facilities and export percentages in the country can be increased. But this is possible only when necessary technical changes will be made in the preservation, transportation and storage. To tackle the food crisis in the future, we have to take initiative from now on.

Conclusion

We discussed farming with hydroponics and aeroponics, genetically modified seeds, kitchen garden and pot culture, cultivation on roofs and walls, quality production from protected farming, organic farming, aggregated farming, changes in the method of irrigation, water conservation in fields, change in sowing time, food security through improvement in preservation, transportation and storage facilities in this article. By changing the nature of

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future farming through all these innovations and technology, will be able to easily meet the food requirement of that time.

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