

National Human Rights Commission
Online Short Term Internship
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Agricultural Productivity and Innovation in India



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INTRODUCTION TO AGRICULTURAL BACKGROUND

- Despite its high output levels, India's agricultural yield is lower than that of other significant producing countries
- According to the Economic Survey 2019-20, the average annual growth rate in real terms in agriculture and related industries has stayed constant over the last six years
- According to the Survey, the yearly growth rate in real terms in agriculture and related industries was 2.88 percent from 2014-15 to 2018-19. In 2019-20, the expected growth rate is 2.9 percent

Methodology

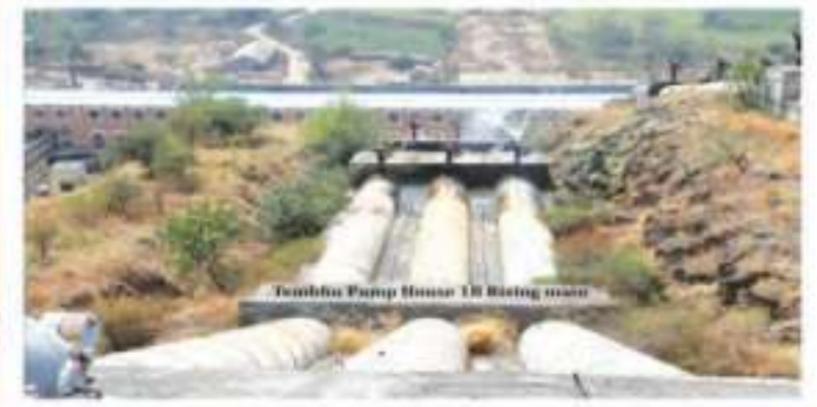
- This research heavily draws its inferences from the secondary data available
- The use of qualitative and quantitative data are used to draw inferences. This research uses a mixed method of research.
- The data analysis by the authors is based on the following five main themes: agriculture Infrastructure; agricultural finance; methods of recovery from the Covid-19 aftermath; land utilization; secondary factors associated with agricultural development

Maharashtra

State policies:

- Shiromani Shri Savata Mali Shetkari Athavade Baajar Abhiyaan
- Chhatrapati Shivaji Maharaj Shetkari Sanman Yojana
 - ₹ 10,913.08 crores was credited to the loan account of 27,13,055 eligible farmers in 2017
 - In 2019, 44.23 lakh farmers got benefits and an expenditure of ₹ 19,843
- Mhaisal and Tembhu lift irrigation schemes

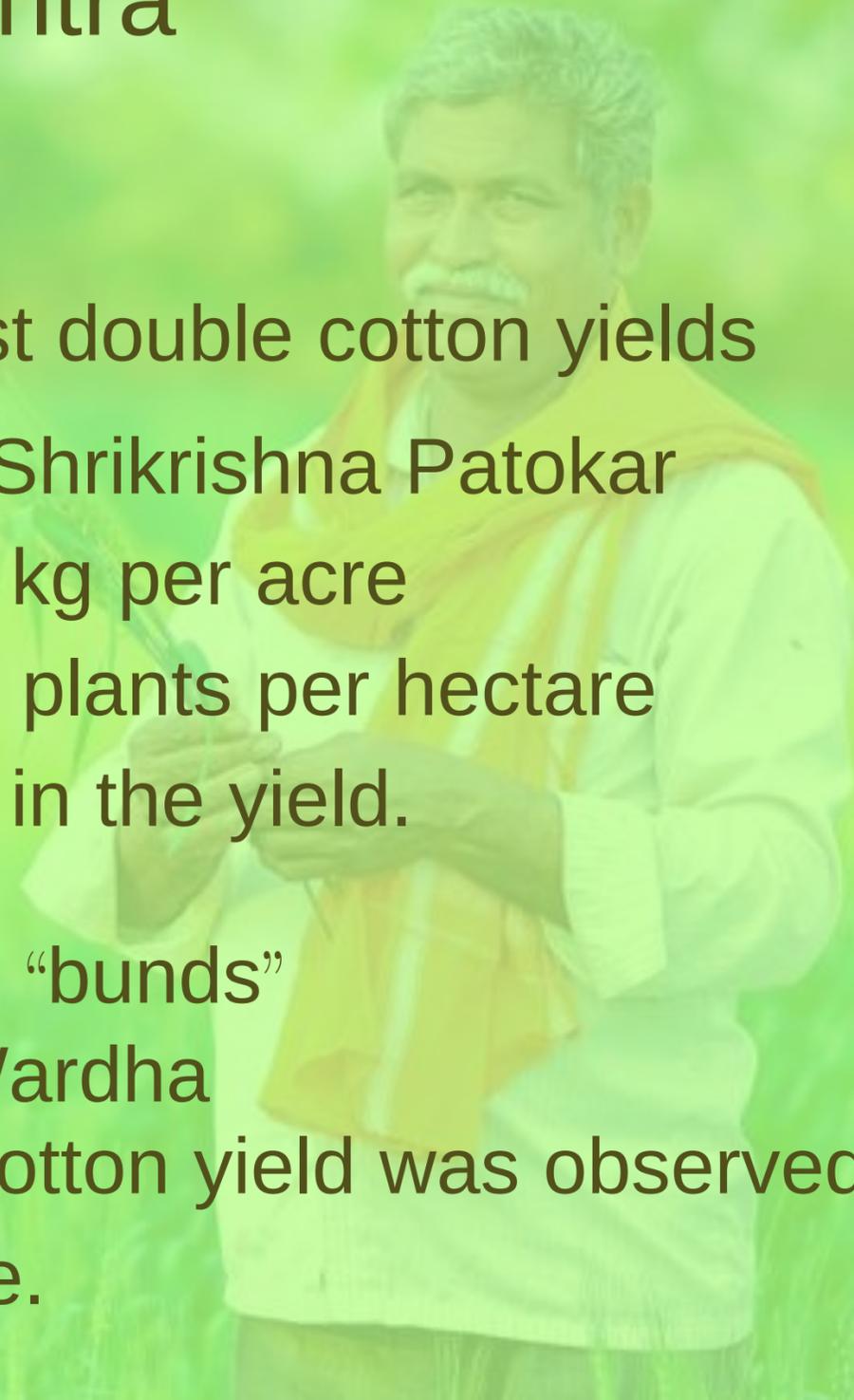
Maharashtra



Maharashtra

Innovations:

- High Density Cotton Planting can almost double cotton yields
 - Rainfed farmer from Akola, Mr Kishore Shrikrishna Patokar
 - Increased seed use from 0.9 kg to 2.25 kg per acre
 - Maintained a plant population of 75,000 plants per hectare
 - As a result, there was an 80% increase in the yield.
- In-situ soil and water conservation with “bunds”
 - Ms Shalinitai Khairnar, a farmer from Wardha
 - Post Bunds formation, an increase in cotton yield was observed, by 150% - from 2 to 4.5 quintals per acre.



Maharashtra



Bunds in a field for water retention

Tamil Nadu

State Policies:

- Mission on Sustainable Dryland Agriculture Scheme - To improve the productivity of millets, pulses, and oilseeds
- Free electricity scheme - To aid impoverished rural households and stabilize food prices by increasing agricultural production
- Rural Youth Agricultural Skill Development Mission - 2500 adolescents would receive skill training in areas such as grafting, layering, and operating horticultural machinery

Tamil Nadu

Innovations:

- Organic liquid manure preparation technique: devised a filtration device with four compartments to counter the soil fertility issue
- Fermented castor solution trap: The fermented castor solution trap was devised to attract root grubs
- Clod Breaker: Clod formation was a regular issue for farmers when it came to field preparation. To address this issue, an animal-drawn clod breaker was created

Bihar

State Policy

- Seed management and organic farming: production of certified seeds, and ensures sustainable farming.
- Land and water conservation: Focuses on soil conservation and prevents water erosion.
- Agricultural education: encouragement and training to use new technologies and mechanization. The knowledge of technology is aimed to be delivered at the door-steps of the farmers.

Bihar

Innovation

- Shashank Kumar, a resident of Bihar, initiated a start-up business named DeHaat, it aims to connect the farmers with the government, which has helped the farmers. Also, it issues free crop advisory every week through the micro-entrepreneur-run centre which operates in the vicinity of farmer's lands.
- Sanjiv Kumar, also a resident of Bihar, developed a special variety of high-yield cauliflower seeds, which is known as Sanjiv Selection (SS). He has been awarded the National Grassroots Innovation Award by the President of India.

Assam

State policies:

- Assam Farmers' Credit Subsidy Scheme
 - Reimburses 25% of the loans taken or repaid by farmers this financial year, with a limit of Rs 25,000.
- Assam Farmers' Interest Relief Scheme
 - Providing a 4% interest subsidy on short-term crop loans up to Rs 2 lakh.
 - short-term crop loans up to a ceiling of Rs 2 lakh will be zero.

Assam

Innovations

- Multiple crops in the rice-fallow area
- Rice straws and potato



Recommendations

- More schemes need to be targeted towards water management and irrigation
- Farmers' rural education can make them independent, leading to grassroots innovations
- There should be an increase in private investment, leading to bigger scale technological innovations
- Schemes like Shiromani Shri Savata Mali Shetkari Athavade Baajar Abhiyaan to be rolled out for control of crop with farmers
- Giving states governments more independence

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Maharashtra:

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RESEARCH PAPER PROJECT (GROUP-05)

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**Topic: Agriculture productivity and innovation in India:
State data and Recommendations**

Guided by: –Mr. Maninder,(JRC)

Introduction

Despite its high output levels, India's agricultural yield is lower than that of other significant producing countries. According to the Economic Survey 2019-20, released on January 31, 2020, the average annual growth rate in real terms in agriculture and related industries has stayed constant over the last six years, affecting farmers' income.¹ According to the Survey, the yearly growth rate in real terms in agriculture and related industries was 2.88 percent from 2014-15 to 2018-19. In 2019-20, the expected growth rate is 2.9 percent. Inefficient irrigation systems and soil degradation due to incorrect use of chemical fertilisers have a negative influence on agricultural productivity, according to the report.²

Research Methodology

Locale

This paper aims to analyse the agricultural productivity of nine agrarian states in India with a focus on multiple factors of productivity. It also identifies different innovations (technological or other) introduced in these states to discover if there is a connection between innovation and increased agricultural productivity. The nine states selected by the authors for comparison and analysis are; Assam, Bihar, Kerala, Maharashtra, Punjab, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Data (Variables)

The prime sources used in this research are the annual reports published by the respective state governments. Additionally, the use of studies done by companies, news reports and other academic papers were used to get more context about the issue. Due to the same, this research heavily draws its inferences from the secondary data available. Use of qualitative and quantitative data is used to draw inferences. Because of the same, this research uses a mixed

¹ Jitendra, *Economic Survey 2019-20: Agriculture growth stagnant in last 6 years*, DownToEarth, (Jan. 31, 2020), <https://www.downtoearth.org.in/news/agriculture/economic-survey-2019-20-agriculture-growth-stagnant-in-last-6-years-69076#:~:text=The%20average%20annual%20growth%20rate,31%2C%202020%2C%20has%20said.>

² Jitendra, *Economic Survey 2019-20: Agriculture growth stagnant in last 6 years*, DownToEarth, (Jan. 31, 2020), <https://www.downtoearth.org.in/news/agriculture/economic-survey-2019-20-agriculture-growth-stagnant-in-last-6-years-69076#:~:text=The%20average%20annual%20growth%20rate,31%2C%202020%2C%20has%20said.>

method of research. The data analysis by the authors is based on the following five main themes:-

1. Agriculture Infrastructure (Farming techniques, Irrigation, Machinery, etc)
2. Agricultural finance
 - a. Government schemes
 - b. Investments from public and private sector
3. Methods of recovery from the Covid-19 aftermath
4. Land utilisation
5. Secondary factors indirectly associated with agricultural development
 - a. Rural public education
 - b. Rural infrastructure (Roads, Transport, Insurance, etc)

Each of the factors was evaluated with respect to the selected states and a preliminary inference was made to evaluate what factors contribute to increased productivity and what kind of innovations can be implemented by the other states as well.

Methodology

A mixed method of research was considered suitable for the same since the objective of this study aims to combine the qualitative and statistical aspects of agricultural productivity. The qualitative factors involve but are not limited to the schemes rolled out by the respective state governments, the types of seeds sowed, the investments made by the public and private institutions, the support and relief provided and or available to the farmers etc. The statistical factors involve annual output as per the respective state governments, changes observed after the implementation of specific schemes and the total amount of financial benefits obtained by the beneficiaries of schemes or innovations.

A holistic analysis of these factors is carried out and along with agricultural productivity, the authors also relate them to how it violates the human rights of the farmers and their families. This involves but does not limit to poor living conditions, no surplus on the yield, frequent accidents of suicides and minimum to low education facilities available to the farming community.

In conclusion, a lot of consideration was put into how this study would be conducted and what kind of methodology will be followed in order to reach an efficient conclusion and suggest recommendations that can be considered by various state governments in order to increase their agricultural productivity and subsequently improve the standard of life of the farmers.

Assam

Agriculture is the dominant land use category in Assam. It accounts for about 54.11 per cent of the total geographical area of the state.³ Including persons dependent on the plantation, more than 80 per cent of the total population of Assam is dependent on agriculture.⁴ With the increase of population and the development of agro-technology, lots of changes take place in the agricultural scenario of the state. The net area is sown as well as the gross cropped area increased significantly in the last few decades. This led to the clearing of forest areas for agricultural use as well. Although the development in agriculture has a tremendous contribution to the economy of Assam, the ecological impacts of the changing land use pattern need to be considered.

The socio-economic condition of Assam largely depends on its agricultural production. Thereby, the Assam department of agriculture has taken up various development measures to ensure growth in crop production. Assam agriculture is now focusing on the horticulture of the state. Horticultural crops in Assam including coconut, citrus, banana, black pepper, and papaya have been placed on the priority list and a range of plantation materials have been imported for these crops to increase their productivity. Sugarcane is claimed to be one of the main cash crops in the Kharif season in Assam. Also, various pesticides and other protection measures are being taken up to assure the safety of the plantation in the state. All these factors have contributed to the state's marked agricultural productivity.

State Policies

The state cabinet has approved the **Assam Farmers' Credit Subsidy Scheme (AFCSS)**, 2018, under which the government reimburses 25% of the loans taken or repaid by farmers this

³ *Agriculture in Assam*, ENVIS Centre: Assam (Status of Environment and Related Issues), (Dec.12,2015)
http://asmenvis.nic.in/Database/Agriculture_839.aspx

⁴ *Agriculture in Assam*, ENVIS Centre: Assam (Status of Environment and Related Issues), (Dec.12,2015)
http://asmenvis.nic.in/Database/Agriculture_839.aspx

financial year, with a limit of Rs 25,000. This scheme covers 4 lakh farmers and involves a financial outgo of Rs 500 crore.⁵

The **Assam Farmers' Interest Relief Scheme (AFIRS)** extends support to farmers who are prompt in repaying their loans, by providing a 4% interest subsidy on short-term crop loans up to Rs 2 lakh. This scheme is aligned with the Government of India scheme under which prompt-paying farmers are extended a benefit on interest subvention of 3%. This effective rate of interest for a farmer in Assam accessing short-term crop loans up to a ceiling of Rs 2 lakh will be zero.⁶

Innovations

- Field test demonstrations in rice environments were selected during rabi season in 2020-21 and 2021-22 for the four innovative cropping systems. Six districts, with an area of 20 bighas each, were selected for the demonstrations. Geospatial technologies including remote sensing, geographical information system (GIS) and global positioning system (GPS), are being used under the Assam Agri-business and Rural Transformation Project (APART) for identifying suitable areas where multi-cropping can be done after rice cultivation. The AAU targeted the identification of the fallow land to increase the cropping intensity to bring a significant increase in agricultural output in low productivity areas and enhance system productivity. Images captured through remote sensing and drones are analyzed with GIS for mapping potential areas and developing various geospatial outputs such as cropping system maps, rice maps, rice-fallow maps, soil moisture suitability maps and flood inundation maps. These outputs are validated on the ground through GPS.⁷
- In Assam, farmers grow two rice crops a year with a short winter period in between. A World Bank project in the area consulted CIP to see if potatoes could be added to the annual cycle. Brijesh Kumar, an associate scientist for CIP, investigated the possibility.

⁵ Bikash Singh, *Assam announces Rs 1,000-crore schemes to boost farm credit*, The Economic Times, (Dec 20c 2018) Assam announces Rs 1,000-crore schemes to boost farm credit - The Economic Times (indiatimes.com)

⁶ Bikash Singh, *Assam announces Rs 1,000-crore schemes to boost farm credit*, The Economic Times, (De 20c, 2018,) Assam announces Rs 1,000-crore schemes to boost farm credit - The Economic Times (indiatimes.com)

⁷ Kangkan Kalita, *Assam: Move for cultivating multiple crops in rice-fallow area to enhance productivity*, The Times Of India, (29 January, 2021): Assam: Move for cultivating multiple crops in rice-fallow areas to enhance productivity | Guwahati News - Times of India (indiatimes.com)

Each rice harvest leaves large quantities of straw that is tall and thick. Ordinarily, crop litter like this might be used for feed, but rice straw is high in silica and lignin, which livestock cannot digest easily. Kumar and his team found that rice straw could be used instead to cover potatoes on the soil surface and insulate them well enough to produce a good harvest in a little less than three months. Farmers have more food with very little work and input. Better yet, the potatoes require no irrigation as the roots can draw water from the residual moisture left after the rice harvest. Farmers have quickly adopted this method because it does not require difficult labour and can be performed by any member of the household. Big, clean tubers can be harvested simply by removing the straw (photo). Farmers have also noted a reduction in pests such as potato tuber moths. To date, 45 farmers have adopted this practice on 28 hectares of land. Because the straw eventually goes back into the soil, the process reduces the overall carbon footprint of rice production and the potatoes do not contend with soil disease because they are grown on the surface.⁸

Bihar

More than 70% of the population in the state of Bihar, which is typically regarded as a centre of extreme poverty and illiteracy, is employed in agriculture and associated sectors. After surrendering the majority of its mineral resources to the state of Jharkhand, Bihar's economy is now based on a thriving agriculture-led economy.⁹ According to a Government of India assessment from 2013, Bihar ranks first among the poorest states in terms of underdevelopment. During 2019-20, it had a combined poverty rate of 33.7 per cent, compared to the national average of 21.9 per cent. Its per capita income was 1/5th of Haryana's and around 1/3rd of India's between 2008 and 2016. In the fields of health and education, the state fared considerably worse.

Agriculture, on the other hand, has improved slightly as a result of increased investments and inventions, though at a relatively modest pace. Bihar is divided into three agro-climatic zones: north-west, north-east, and south, each of which is appropriate for agricultural diversification.

⁸ CIP-International Potato Center, *A simple innovation in Assam is leading to more food between growing seasons*, (Feb 19

2021), <https://cipotato.org/blog/simple-innovation-assam-leading-more-food-between-growing-seasons/>

⁹ Sharma K. Anil, National Council of Applied Economic Research, (Nov 29) *Study on Agricultural Diagnostics for the State of Bihar in India*,

Such diversity also has an impact on the crops grown, as evidenced by Bihar's receipt of the Kisan Karman Award in 2013 for rice output and again in 2016 for maize production. Bihar has a specialization in litchi production, as evidenced by the fact that it generates 70% of the country's total litchi production and roughly 54% of the total area under litchi production.¹⁰ These achievements, however, are hampered by factors such as rainfall variability, high rural population density, drought, and so on. The variations in production are attributable to the fact that around 76 per cent of North Bihar's districts are prone to floods, while the southern regions are prone to severe drought. To address this problem, the government has implemented the Krishi Input Subsidy Scheme. The administration claims to be focusing on providing better incentives and techniques to the people so that the state can thrive not just in wheat and sugarcane production, but also in alternative crops like oilseeds and pulses. People will benefit from more income and higher living standards as a result of this.

State Policies

¹¹The most important policy initiatives that have opened up in several phases is what is called the agricultural roadmap. The First of this was started in 2008-09 to 2011-12 and since then has helped in further accelerating productivity. After long years of lawlessness and neglect, these roadmaps has served as a boon for the holistic development of agriculture. With its key focus on how to increase the productivity level as well as to secure a better livelihood to the farmers by making an improvement in farmer's income. These roadmaps have started to do its job and the sector has, no doubt seen some up gradation. For example- the average annual growth rate in agriculture and allied activities during the pre- agriculture road map (2001-02 to 2007-08) was only about 2 per cent. This number went higher during the time of the First agriculture roadmap (2008-09) to about 3.1 per cent. This initiative registered splendid growth during this period as compared to the pre- registered roadmap period. The agricultural education institutions are directed to organize Kisan Chaupal in every district so that the issues of the farmers could be resolved. According to sources, the total food grain production in Bihar was 178.29 lakh Tonnes in 2012–13, the year when the first Agriculture Roadmap (2007–12) ended. Thereafter, food

¹⁰ Hoda Anwarul, Gulati Ashok, Jose Shyma, Rajkhowa Pallavi (Mar 06,2021)), *Sources and Drivers of Agricultural Growth in Bihar*
https://link.springer.com/chapter/10.1007/978-981-15-9335-2_8,

¹¹ Government of Bihar, (2015), *Report of the taskforce on agriculture*,

grain production in the state touched a record high, in terms of both the total produce and the per hectare yield, in the financial year 2016–17. The yield stands at 185.61 lakh tons, which exceeded the expectations of the State agriculture department by 5 lakh tons.

However, the government clearly remained unsuccessful in sustaining this victory for too long as the growth rate shrunk down to 1.28 per cent during the period of Second agriculture roadmap.

Some programs under road map of 2017-22:

- **Seed Management:** To promote the production of certified seed and also to encourage farmers for the same, a subsidy scheme will be implemented under ‘Bihar state entrepreneurship development program’ certified seed production will be encouraged. Target of 10 lakh quintal is set for managing seed capacity. Humidity control equipment will be installed in most of the warehouses. Seed banks will be developed.
- **Organic farming:** It is being promoted for insuring sustainable farming. There are innovative plans to make organic corridors. Establishment of organic villages, farmers will be provided grants twice a year to encourage organic vegetable production. Agriculture Marketing systems will be implemented in which websites will display real time prices of mandis.
- **Agriculture education:** There is also an ongoing plan to promote distance education. Universities will solve problems of farmers by organizing ‘Kisan Choupal’. And different parts of their jurisdiction will also work in bringing knowledge to the doors of farmers.
- **Mechanization:** Interested farmers will also get subsidies on agricultural machinery via mechanization software.
- **Agricultural Expansion:** Farmers will be trained and exposed to new technologies in the field of agriculture and also benefits of different schemes would be given directly in the farmers' account.

Innovations:

- ¹²Not only the farmers, but many individuals too have come up with an aim to transform the state. A resident of Chhapra district in Bihar, Shashank Kumar has developed a one-stop shop with an aim to uplift the status of the farmers. Troubled by the poor educational and social system in Bihar, Shashank was compelled to leave the state. A graduate from IIT Delhi, he has initiated a start-up business named DeHaat which is serving over 65,000 farmers in Bihar, Uttar Pradesh and Odisha. He found that neither the government, nor the consumers were happy due to inflated prices and rising demands. Through DeHaat, he aims to connect the farmers with the other side which has greatly helped the farmers with sample landholdings.

Additionally, DeHaat aims to address the issue of delivery of agricultural inputs and issuing free crop advisory every week through the micro entrepreneur- run centre which operates in the vicinity of farmer's lands.

- ¹³Along with technological innovations, Bihar has also progressed in scientific research in agriculture. One such example is the development of a special variety of high- yield cauliflower seed by Sanjiv Kumar. Devoting years of his life to agricultural experiments at his village, he has named the seed after him i.e. Sanjiv Selection (SS). For this innovation, he has been awarded the National Grassroots Innovation Award from the President of India which makes him the first person in Bihar to be awarded with this.

¹²Wangchuk Norbu Rinchen, (2019), *Bihar IIT Grad Left Cushy Job to Build One-Stop Shop That Helps 65,000+Farmers!*,

<https://www.thebetterindia.com/178742/bihar-farmer-iit-delhi-innovation-dehaat-startup-india/>

¹³ Thakur Kumar Rajesh, (Mar 22,2019), *The New Indian Express, Bihar man wins prestigious agriculture award for developing high-yield cauliflower seed,*

https://www.newindianexpress.com.cdn.ampproject.org/v/s/www.newindianexpress.com/nation/2019/mar/22/bihari-wins-prestigious-agriculture-award-for-developing-high-yield-cauliflower-seed-1954258.amp?amp_js_v=a6&_gsa=1&usqp=mq331AQKKAFQArABIIACAw%3D%3D#aoh=16510777713099&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&_share=https%3A%2F%2Fwww.newindianexpress.com%2Fnation%2F2019%2Fmar%2F22%2Fbihari-wins-prestigious-agriculture-award-for-developing-high-yield-cauliflower-seed-1954258.html

Kerala

Agriculture in Kerala is one of the major sectors of the economy of the state since it contributes around 50 percent of the gross income of the state. Several crops are cultivated in Kerala. Rice is the main food crop of traditional cultivation. Kuttanad is considered as the granary of Kerala and the landscape here has some distinctive features. Kerala is the land of coconut-palms too. The cultivation of pepper, which goes back through the centuries to link Kerala with many far-flung lands, maintains those links even today. Pepper from Kerala is exported to more than sixty countries. In 1955-56, agriculture was the main economic activity of Keralites and about 53.1 percent of the total working population was engaged in agriculture. The State has witnessed a remarkable transformation in the agricultural sector since its formation in 1956. Cash crops like coconut, rubber, tea, coffee, pepper, cardamom, arecanut, ginger, nutmeg, cinnamon etc and food crops like paddy, tapioca gives the agricultural sector of Kerala a distinct flavor.

In Kerala, out of a total geographical area of 38.86 lakh hectares, net sown area is about 54 per cent. Over the past few years, there has been an increase of nearly a hundred thousand hectares in the total cropped area of the state. The agro climatic conditions in the State suit for the cultivation of a variety of seasonal crops and perennial crops.¹⁴

State Policies:

Rice Development

The scheme on rice development thrusts upon promotion of paddy cultivation in the state through group farming and area expansion programmes like fallow land cultivation, single crop to double crop and upland rice cultivation concentrating on the rice growing agro ecological units with natural endowments for augmenting rice productivity.¹⁵

Development and Promotion of Location Specific Crops

¹⁴ https://www.indianetzone.com/50/agriculture_kerala.htm

¹⁵ <https://keralaagriculture.gov.in/en/2021/05/05/rice-development-2/>

In order to promote the cultivation of minor millets, oil seed crops like groundnut and sesamum and sugarcane in specific AEU (Agro Ecological Units), assistance is provided for procurement of quality seeds, land preparation, irrigation and other cultivation requirements. Promotion of crop production activities in tribal lands so as to ensure food and nutritional security to tribal population focusing on activities including conservation of traditional varieties and traditional practices with proven scientific basis is also included.¹⁶

Vegetable Development

During 2021-22, the Vegetable Development Programme was implemented in the state as part of **Subhiksha Keralam Programme**, with the objective to promote vegetable production in the state in a safe-to-eat manner and to attain self-sufficiency in the sector. The scheme was implemented in a Mission Mode involving all the stakeholders in this sector such as Agriculture Development & Farmers Welfare Department, PACS (Primary Agricultural Credit Society), FPOs (Farmer Producer Organization), Kerala Agricultural University, LSGDs (Local Self Government Department), VFPC (Vegetable and Fruit Promotion Council), HortiCorp and SHM (Soil Health Management). Coordination of all PSUs, ATMA (Agriculture Technology Management Agency), Organic Farming (GAP i.e Good Agricultural Practices, PGS System i.e Participatory Guarantee System), Marketing, infrastructure programmes needs to be ensured for the success of the programme. Homestead cultivation is promoted in all the households in the State for producing Safe to Eat vegetables throughout the state.¹⁷

Innovations:

During the year 2020-21, an amount of Rs. 250.00 lakh was earmarked as support for establishment of Micro Irrigation/ Fertigation/ Open precision farming as additional subsidy to top up the Centrally Sponsored scheme of PMKSY. 25 per cent assistance will be provided from the state plan fund. In order to support the entrepreneurs, it is proposed to develop a network of experts and support groups at state and district level in association with an institution.

Modernisation of Departmental Laboratories

¹⁶ <https://keralaagriculture.gov.in/en/2021/05/05/location-specific-crops/>

¹⁷ <https://keralaagriculture.gov.in/en/2021/05/05/vegetable-development-2/>

The major services offered by the Department of Agriculture to the farming community include Soil Testing for soil fertility assessment and analysis of major inputs like fertilizers including organic, inorganic and biofertilizers, pesticides and seeds for quality control of these inputs. These are critical production components which significantly affect the production and productivity of crops. The existing laboratories of the departments which analyze samples of soil, fertilizers, pesticides, seeds etc. were established years back. Most of the equipments available in these labs purchased are old and are not suited to provide quick and accurate results of data analysis. The soil testing service would be made accessible to farmers in every panchayat. With the support of local governments. The implementation of the programme would be integrated with the soil health management and soil health initiative. The mobile soil testing and stationary soil testing labs, those under agro service centers will be converged in the project implementation.¹⁸

Rural Infrastructure Development Fund

The outlay is for the implementation of projects approved under RIDF. The new and ongoing projects under tranche XX-XXV are to be taken up during 2021-22. It is for the development of infrastructure works in the agriculture sector under the funding support from RIDF of NABARD during 2021-22.¹⁹

Maharashtra

According to the State Economic Survey of 2020-2021, more than 50 per cent of the population in Maharashtra is dependent on the agriculture sector for livelihood²⁰. This itself indicates that ideally, more than half of the population of Maharashtra needs special attention from the state in order to safeguard the lives of people working in agriculture and astute schemes to increase the efficiency and agricultural productivity. The state of Maharashtra tries to do that via various schemes that it offers for the upliftment of farmers and their families.

¹⁸ <https://keralaagriculture.gov.in/en/2021/05/06/modernisation-labs/>

¹⁹ <https://keralaagriculture.gov.in/en/2021/06/14/ridf/>

²⁰ Government of Maharashtra, *Economic Survey of Maharashtra 2020-21, Agriculture and Allied Activities*, http://mls.org.in/pdf2021/budget/budgetpdf/ESM_2020_21_Eng_Book.pdf

State Policies

In the last five years, special schemes have been rolled out by the Government of Maharashtra (GoM) to address the grievances that farmers and their family may suffer from. For example; the **Gopinath Munde Farmer Accident Insurance Scheme (GMFAIS)**. The aim of this scheme was to give financial assistance to the aggrieved family members of the farmers who lost their lives through 13 perils viz. road accident, railway accident, drowning, effect of poison due to pesticides, electric shock or electrocution, lightening, murder, fall from height, snake bite/scorpion bite, Naxalite violence, animal bite (rabies), riots and any other accidents. A compensation of approximately 2 lakh (depending on the nature of injury or death) is provided to the family of the farmer. As of 1st December 2015 to 30th November 2016 a total of ₹ 18.19 cr was provided to farmers.²¹ And under the **Chhatrapati Shivaji Maharaj Shetkari Sanman Yojana**, which was issued in 2017 to waive off the loans of eligible farmers; an amount of ₹ 10,913.08 crore was credited to the loan account of 27,13,055 eligible farmers. By December 2019, 44.23 lakh farmers had been given the benefits of this scheme and expenditure of ₹ 19,843 crore had been incurred.²² Along with the Minimum Support Price Scheme (MSP), the GoM also launched the **Sant Shiromani Shri Savata Mali Shetkari Athavade Baajar Abhiyaan** in the year 2016. Under this scheme, the state aimed to reduce the post-harvest losses by way of direct sale of agricultural produce from farmers to consumers. As of 2019, Under this abhiyaan, 115 weekly markets for farmers functioned and farmers directly sell fruits & vegetables to consumers without any middleman in these markets.²³

It can be seen by the nature of these schemes that the state government has focused on providing financial security to the farmers. According to the numbers provided by the GoM, the financial compensation or the aid given to farmers has doubled in the span of 5 years. This goes to show that the state government was able to keep up with the growing needs of the farmers and inflation. When farmers get financially stable, they can form more capital for themselves. Capital

²¹ Government of Maharashtra, *Economic Survey of Maharashtra 2017-18*, Agriculture and Allied Activities, https://mahades.maharashtra.gov.in/files/publication/ESM_17_18_eng.pdf

²² Government of Maharashtra, *Economic Survey of Maharashtra 2019-20*, Agriculture and Allied Activities, https://www.maharashtra.gov.in/Site/upload/WhatsNew/ESM_2019_20_Eng_Book.pdf

²³ Government of Maharashtra, *Economic Survey of Maharashtra 2019-20*, Agriculture and Allied Activities, https://www.maharashtra.gov.in/Site/upload/WhatsNew/ESM_2019_20_Eng_Book.pdf

formation is one of the crucial factors that is necessary for increasing agricultural productivity; hence supporting farmers financially can have a direct effect on the agricultural productivity of a state.

Innovations:

Along with mechanisations, something that the agriculture sector needs is innovation. There are various types of innovations that farmers or the government can invest in or produce. Most of the innovations that are carried out on farms are “process innovations” that improve production techniques; for example, higher-yielding seeds or more efficient irrigation. Other kinds of innovations are “Product innovations” and “Marketing and organisational innovations” that are created by downstream industries, and include new and improved products, such as healthier foods, or new chemical or pharmaceutical products.

A non-profit organisation that provides business solutions to poverty named TechnoServe, published a study- [“Towards Doubling Cotton Farmer Incomes in Maharashtra”](#) in May 2019. This report provided modification of farming techniques, introduction of intellectual and technical innovations to increase the productivity and quality of cotton crops in Maharashtra. Innovations carried out by various farmers which can be used by others are also published in this report. Maharashtra is the largest cotton growing state by area but has the lowest yields domestically. However, the solutions and suggestions provided by this study and other farmers can be applied by other states as well. Some efficient innovations carried out by multiple farmers and TechnoServe in the western Maharashtra were:

1. High Density Cotton Planting can almost double cotton yields:

As mentioned in the study, Indian cotton farmers planted their crop at a traditional density of 12,000 to 24,000 plants per hectare, realising average yields around 15 quintals / hectare. A rainfed farmer from Akola, Mr. Kishore Shrikrishna Patokar, started implementing High Density Planting with support from Tata Trusts, starting in Kharif 2017. He used a seed planter to plant hybrid cotton seeds on 14 acres of land at INR 1700 per acre. He also increased seed use from 0.9 kg to 2.25 kg per acre and maintained a plant population of 75,000 plants per hectare. As a result, there was an 80% increase in

the yield. The output went from 5 quintals by traditional methods to 9 quintals cotton per acre by the HDP (high density planting) method. There was a 7% increase in costs of cultivation, moving from INR 18,600 to 19,900 / acre.²⁴ The key findings by this innovation were that Hybrid plants can be used in HDP in combination with growth retardants and that mechanisation support is required for efficient HDP.

2. Collective purchasing of farming inputs allows farmers to reduce selected input costs by 10-30%:

The trend among farmers is that they purchase inputs individually which costs them a relatively higher price than that of when purchased collectively. Deola Agro Producer Company Limited, a farmer collective, arranges quality inputs at low costs for farmers. They also supplied inputs to members and nonmembers alike, but only members were given discounted rates. As a result, there was a 25% - 30% reduction on urea prices paid²⁵ during the crop season; farmers saved INR 50 to 110 per 50 kg bag and INR 40-50 per kg saving on purchase of seed and 10% discount availed on pesticides as compared to prevailing market rates.

3. In-situ soil and water conservation with “bunds” leads to higher yields and returns from cotton cultivation:

Agricultural lands in India are poorly protected against water loss and soil erosion. In unprotected fields, soil nutrients are swept away with the flow of rainwater leading to top soil degradation. This significantly reduces cotton yields. Ms. Shalinitai Khairnar, a farmer from Wardha district prepared a graded “bund” in her field with support from the M. S. Swaminathan Research Foundation. Bunds are retaining walls along the boundary of agricultural fields. Their purpose is to contain rainwater in the field itself, which helps in retaining soil moisture for a longer time, reducing soil erosion during heavy rain and protecting fertile soil.

²⁴ Martin Reindl, Punit Gupta, Sairam Subramanian, Ravdeep Kaur and Deepa Rani, *Towards Doubling Cotton Farmer Incomes in Maharashtra*, May 2019, IDH and TechnoServe, 69, <https://www.idhsustainabletrade.com/uploaded/2019/05/Doubling-Cotton-Farmer-Incomes-in-Maharashtra.pdf>

²⁵ Martin Reindl, Punit Gupta, Sairam Subramanian, Ravdeep Kaur and Deepa Rani, *Towards Doubling Cotton Farmer Incomes in Maharashtra*, May 2019, IDH and TechnoServe, 71, <https://www.idhsustainabletrade.com/uploaded/2019/05/Doubling-Cotton-Farmer-Incomes-in-Maharashtra.pdf>



*Bunds in a field for water retention; Image from Science Direct:
<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/bunds>*

Post the formation of Bunds, an increase in cotton yield was observed, by 150% - from 2 to 4.5 quintals per acre. There was an increase in red gram yield by 100% - from 1 to 2 quintals per acre. The net profit from cotton increased from INR 1,500 to INR 12,300 per acre.²⁶

Sources:

1. [Economic Survey of Maharashtra 2017-18](#)
2. [Economic Survey of Maharashtra 2018-19](#)
3. [Economic Survey of Maharashtra 2019-20](#)
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5. [Economic Survey of Maharashtra 2020-21](#)
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Tamil Nadu

Tamil Nadu has fertile soils and agro-climatic zones that are ideal for a wide range of agricultural products. Tamil Nadu produces about 3% of India's foodgrain production, 7% of its

²⁶ Martin Reindl, Punit Gupta, Sairam Subramanian, Ravdeep Kaur and Deepa Rani, *Towards Doubling Cotton Farmer Incomes in Maharashtra*, May 2019, IDH and TechnoServe, 74, <https://www.idhsustainabletrade.com/uploaded/2019/05/Doubling-Cotton-Farmer-Incomes-in-Maharashtra.pdf>

vegetable production, 12% of its fruit production, and 24% of its flower production.²⁷ Agriculture and related activities provide subsistence for about 40% of Tamil Nadu's people and account for 12% of the state's GDP.²⁸ Agriculture's contribution to GSDP has decreased from 40% in the 1960s to 12% in 2010-11.²⁹ Following 8-10 per cent growth in the first half of the decade, the agriculture industry had negative growth in the late 2000s.³⁰ Because of the increasing focus on boosting productivity, the agriculture sector began to grow positively in the early 2010s and is expected to continue to do so.³¹

On the agriculture front, the TN State Government has set a goal of doubling crop production and tripling farmer income by formulating policies and taking innovative methods to ensure equitable, competitive, and long-term agricultural growth.³² To increase their income and provide 'Food Security', the government took a number of steps, including planning road maps through 'Tamil Nadu Vision 2023', the Food Grain Mission, the District Agricultural Plan, State Agricultural Plan, and Agricultural Infrastructure Development Program under the RKVY scheme, and the District and State Irrigation Plan under the PMKSY scheme, among others.³³ Such activities aid in the development of actionable plans, the coordination of efforts, and the improved tactical and strategic focus of restrictions. In 2012, the TN government released a Strategic Plan for Infrastructure Development in Tamil Nadu titled 'Tamil Nadu Vision 2023' where improving agricultural productivity was one of the strategies mentioned in the plan.³⁴

²⁷ Government of Tamil Nadu, *Strategic Plan for Infrastructure Development in Tamil Nadu*, (Mar., 2012), https://spc.tn.gov.in/pdfs/TN_Vision_2023.pdf

²⁸ Government of Tamil Nadu, *Strategic Plan for Infrastructure Development in Tamil Nadu*, (Mar., 2012), https://spc.tn.gov.in/pdfs/TN_Vision_2023.pdf

²⁹ Government of Tamil Nadu, *Strategic Plan for Infrastructure Development in Tamil Nadu*, (Mar., 2012), https://spc.tn.gov.in/pdfs/TN_Vision_2023.pdf

³⁰ Government of Tamil Nadu, *Strategic Plan for Infrastructure Development in Tamil Nadu*, (Mar., 2012), https://spc.tn.gov.in/pdfs/TN_Vision_2023.pdf

³¹ Government of Tamil Nadu, *Strategic Plan for Infrastructure Development in Tamil Nadu*, (Mar., 2012), https://spc.tn.gov.in/pdfs/TN_Vision_2023.pdf

³² Government of Tamil Nadu, *Agriculture Department Policy Note Demand No. 5 - Agriculture 2020 - 2021*, https://cms.tn.gov.in/sites/default/files/documents/agri_e_pn_2020_21.pdf

³³ Government of Tamil Nadu, *Agriculture Department Policy Note Demand No. 5 - Agriculture 2020 - 2021*, https://cms.tn.gov.in/sites/default/files/documents/agri_e_pn_2020_21.pdf

³⁴ Government of Tamil Nadu, *Agriculture Department Policy Note Demand No. 5 - Agriculture 2020 - 2021*, https://cms.tn.gov.in/sites/default/files/documents/agri_e_pn_2020_21.pdf

State Policies

- **Mission on Sustainable Dryland Agriculture Scheme:** From 2016-17 to 2019-20, the State government had started an ambitious project called the Mission on Sustainable Dryland Agriculture (MSDA), which aimed to improve the output and productivity of millets, pulses, oilseeds, and cotton in roughly 25 lakh acres of dryland in a stepwise way.³⁵ Dryland agriculture is a cultivation-dependent approach that solely depends on rainfall.³⁶ Soil moisture conservation techniques and better dryland technologies are being disseminated to dryland farmers through this initiative, allowing them to harvest larger yields in dryland crops like millets, pulses, and oilseeds, consequently improving the agricultural community's socio-economic situations.³⁷
- **Free electricity scheme:** Until 1990, farmers in Tamil Nadu had to pay for their electricity. However, it all changed when M Karunanidhi, the former Chief Minister of Tamil Nadu, promised that free power connections would be provided to farmers in order to boost agricultural productivity and promote farmers' well-being.³⁸ Current chief Minister, Stalin recently gave 100,000 more agricultural households free electricity.³⁹ Agricultural power subsidies are intended to aid impoverished rural households and stabilize food prices by increasing agricultural production.⁴⁰

³⁵ The times of India, *Second phase of MSDA scheme hits ground running*, (Oct. 29, 2018), http://timesofindia.indiatimes.com/articleshow/66405819.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

³⁶ The Times of India, *Second phase of MSDA scheme hits ground running*, (Oct. 29, 2018), http://timesofindia.indiatimes.com/articleshow/66405819.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

³⁷ The Times of India, *Second phase of MSDA scheme hits ground running*, (Oct. 29, 2018), http://timesofindia.indiatimes.com/articleshow/66405819.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

³⁸ The New Indian Express, *Tamil Nadu sets record, provides 1 lakh free power connections to farmers in a year: CM MK Stalin*, (Apr. 16, 2022), <https://www.newindianexpress.com/states/tamil-nadu/2022/apr/16/tamil-nadu%E2%80%8B-sets-record-provides-1-lakh-free-power-connections-to-farmers-in-a-year-cm-mk-stalin-2442759.html>

³⁹ The New Indian Express, *Tamil Nadu sets record, provides 1 lakh free power connections to farmers in a year: CM MK Stalin*, (Apr. 16, 2022), <https://www.newindianexpress.com/states/tamil-nadu/2022/apr/16/tamil-nadu%E2%80%8B-sets-record-provides-1-lakh-free-power-connections-to-farmers-in-a-year-cm-mk-stalin-2442759.html>

⁴⁰ Katrina Jesso and Reena Badiani, *The Impact of Electricity Subsidies on Groundwater Extraction and Agricultural Production*, (2013), <https://economics.ucdavis.edu/events/papers/Jessoe51.pdf>

- **Rural Public Education:** As per the TN Budget Plan, capacity-building training will be provided to students during their graduation with the assistance of agri-business firms and alumni. At a cost of Rs 2.68 crore, the project would be executed.⁴¹ A project called the "Rural Youth Agricultural Skill Development Mission" would be implemented to encourage educated youth to take agriculture to the next level in their home towns.⁴² In the first phase, 2500 adolescents would receive skill training in areas such as grafting, layering, and operating horticultural machinery, at a cost of Rs 5 crore.⁴³ In Chennai, a separate museum dedicated to agriculture will be built to show the next generation the wonders of agriculture. In the museum, videos based on folk and agricultural songs will be shown. This project has been allocated Rs 2 crore.⁴⁴

Policies during covid 19

- **Tamil Nadu supply chain management scheme:** The Tamil Nadu Supply Chain Management (TNSCM) project was implemented by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in collaboration with the Department of Agriculture Marketing and Agribusiness, Government of Tamil Nadu. They recently devised and implemented projects in Tamil Nadu to connect farmers, processors, merchants, and customers directly and quickly. As India strives to aid farmers amid the statewide lockdown due to COVID-19, this could serve as a model that could be expanded in other locations.⁴⁵ Agriculture Production Commissioner and Principal Secretary to the Government of Tamil Nadu, Gagandeep Singh Bedi, claimed that 64 Primary Processing Centers (PPC) are being built in Tamil Nadu at a cost of Rs 482.36

⁴¹ Janardhan Koushik, *TN Agriculture Budget 2021 Highlights: Separate dept for organic farming, new scheme for self-sufficiency in villages*, The Indian Express, (Aug 21, 2021),

<https://indianexpress.com/article/cities/chennai/tamil-nadu-agriculture-budget-2021-highlights-7453718/>

⁴² Janardhan Koushik, *TN Agriculture Budget 2021 Highlights: Separate dept for organic farming, new scheme for self-sufficiency in villages*, The Indian Express, (Aug 21, 2021),

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⁴³ Janardhan Koushik, *TN Agriculture Budget 2021 Highlights: Separate dept for organic farming, new scheme for self-sufficiency in villages*, The Indian Express, (Aug 21, 2021),

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⁴⁴ Janardhan Koushik, *TN Agriculture Budget 2021 Highlights: Separate dept for organic farming, new scheme for self-sufficiency in villages*, The Indian Express, (Aug 21, 2021),

<https://indianexpress.com/article/cities/chennai/tamil-nadu-agriculture-budget-2021-highlights-7453718/>

⁴⁵ Aravazhi Selvaraj, Nedumaran Swamikannu, Ravi Nandi, *Finding the silver lining: Interesting supply chain models emerging during lockdown in Tamil Nadu, India*, ICRISAT, (May, 2020)

<https://www.icrisat.org/finding-the-silver-lining-interesting-supply-chain-models-emerging-during-lockdown-in-tamil-nadu-india/>

crore. Farmers that raise vegetables and fruits around the state would benefit from this programme, which involves Farmer Producer Companies (FPC). FPCs are formed and registered organisations primarily to eliminate middlemen in the marketing process. PPCs extend the shelf life of vegetables and fruits, and the technique is more hygienic than the traditional method. In addition, there is no water waste in the process.⁴⁶

Agricultural Innovations

- **Organic liquid manure preparation technique:** In today's farming system, farmers rely extensively on synthetic fertilisers, herbicides, fungicides, and other external inputs for crop cultivation. When these inputs are used indefinitely, the soil fertility and crop returns suffer. Farmers will become more interested in finding an alternative option as a result of this. Mr G R Sakthivel of Erode District's Talavadi district devised a filtration device with four compartments. The first part was designed to gather cow dung and combine urine. The solution was delivered to the second compartment for initial filtering after thorough mixing. The sedimented solid matter, referred to as slurry, was employed in this compartment for biogas production, and the supernatant solution was then allowed to flow into the next compartment, which contained jaggery for fermentation. The clear enriched filtrated media was collected in the fourth compartment and employed in the drip system for yield. Through the use of recycled cow dung and urine solution and filtration processes, the farmer can save Rs.15,000/- per hectare by reducing labour and fertilisers. The innovation also has a field application with drip irrigation rather than manual operation. The earthworm proliferated successfully in the field as a result of the adoption of this method, which boosted the soil's water-holding capacity.⁴⁷
- **Fermented castor solution trap:** Root grub is a serious pest in sugarcane, cotton, groundnut, coconut, and areca nut crops. The pest invasion causes a significant drop in yield. The fermented castor solution trap was devised by Mr. G R Sakthivel, a farmer from Erode's Talavadi district, to attract grubs. He used 5 kg of castor seeds that have

⁴⁶ Times of India, *Tamil Nadu: Farmer companies take control of 7 processing centres*, (Oct. 24, 2019), <https://timesofindia.indiatimes.com/city/coimbatore/farmer-cos-take-control-of-7-processing-centres/articleshow/71729646.cms>

⁴⁷ P Alagesan and S Saravanakumar, *Innovations Developed by Farmers in Erode District of Tamil Nadu 6(1)*, J Krishi Vigyan, http://iskv.in/wp-content/themes/iskv/volume-pdfs/25430125eb9e21a21d95f7dcae6590e1pages_118-123.pdf

been properly pulverized. Added 5 litres of water and leave the solution undisturbed for 10 days to allow the fermentation process to take place. Meanwhile, 5 mud pots with a capacity of 5 litres each were placed in a 1-acre field. Then fill each pot with 2 litres of fermenting solution and the rest with water. White grub, stem weevil, and Rhinoceros beetle were successfully controlled using a fermented castor solution trap. Rats were also unable to enter the field or were re-infested. The entire process costs only Rs. 500/- per year and is also environmentally friendly. It has been observed that the use of a fermented castor solution trap to manage rhinoceros beetles and other coleopteran pests is more popular among all types of farmers.⁴⁸

- **Clod Breaker:** Mr G RSakthivel was born and raised in the Erode district's Talavadi block, where he has been farming for the past 30 years. Ragi was the main crop grown in this area, and it necessitated meticulous field preparation. Normally, crops are planted as soon as the monsoon arrives. Farmers were unable to obtain the optimal plant population due to poor field preparation. Clod formation was a regular issue for farmers when it came to field preparation. To address this issue, he created an animal-drawn clod breaker made of a wooden log with 10 mm iron pokes. For breaking clods, the machinery must be driven twice in an acre field, and the operation took five hours for a hectare. This device is being used efficiently by many farmers in this region for fine field preparation. This innovation has a cost of Rs.3,000/- according to the equipment.⁴⁹

Uttarakhand

The Geographical region of Uttarakhand is rich in versatile fauna and flora. The main source of earning of people living in rural areas depends on horticulture and agro based activities. Around 14 percent of geographical area is available for cultivation. There is insufficient food security due to small size of land holding, poor fertility and difficult supply chain of agriculture output (IDFC, 2002). Topology of land is not fit for modern agriculture and use of machinery in fields therefore accessibility of arable land per person is low. Uttarakhand is included in the National

⁴⁸ P Alagesan and S Saravanakumar, *Innovations Developed by Farmers in Erode District of Tamil Nadu 6(1)*, J Krishi Vigyan, http://iskv.in/wp-content/themes/iskv/volume-pdfs/25430125eb9e21a21d95f7dcae6590e1pages_118-123.pdf

⁴⁹ P Alagesan and S Saravanakumar, *Innovations Developed by Farmers in Erode District of Tamil Nadu 6(1)*, J Krishi Vigyan, http://iskv.in/wp-content/themes/iskv/volume-pdfs/25430125eb9e21a21d95f7dcae6590e1pages_118-123.pdf

Agroclimatic zone No.-9 and 14. e. As per the information of Directorate of Agriculture, around 30 per cent of forest area is in the category of degraded forests. There are plans to promote cultivation of Jatropha and bamboo on a significant proportion of area under degraded forests. This will help to remove rural poverty in these areas. In addition, 6.81 and 1.25 percent of reported area was under cultivable wasteland and fallow land other than current fallows, respectively in 2008-09. These lands can be brought under cultivation through proper planning and execution. These areas can also be utilized for plantation of fruits, medicinal and aromatic plants. Current fallows comprised less than 1 per cent of the reported area. The net sown area formed only 13.68 percent of the geographical area. Out of this area, 64.94 per cent was sown more than once during 2008-09. It is found low in comparison to agriculturally developed regions like Punjab and Haryana. The progress on this front in the state is low and an increase at around 6 per cent was noticed in crop intensity in the year 2009-10. The percentage of net irrigated area to net sown area in Uttarakhand was around 45 per cent and it has increased by almost 3 per cent during the referred years. Further share of gross irrigated area in gross cropped area also has risen marginally by around 1 per cent during the past decade.

In a nutshell, land use pattern does not show any perceptible change in Uttarakhand between 2000-01 and 2009-10. Cause of low agriculture productivity in hilly region of Uttarakhand are:

1. Small land holding size.
2. Major portion of arable farmland is marginal and fragmented.
3. Problem of irrigation facilities, mostly rain fed.
4. Damage to Livestock and crops by wild animals (Leopards, Monkeys, Wild boars, Porcupines, parrots & other birds etc.)
5. Farm destruction due to soil erosion by landslides and heavy rains, cloud bursting, repeated forest fires etc.⁵⁰

Impact of Covid-19:

The national level the impact of COVID-19 and the resultant lockdown had been quite harsh on agriculture and allied sectors in the majority of districts. Among various subsectors, rabi crops

⁵⁰ Uttarakhand Farm Loan Scheme, <https://www.agriculture.uk.in>(March,2020)

were least affected as its harvesting was on the verge of completion but allied sectors such as poultry, fisheries and pig/goat/sheep sector witnessed a drastic fall in demand due to misplaced rumours leading to declining production as well as declining farm gate prices. However, prices of agriculture inputs were estimated to be rising mainly due to disruption in supply chain and closure of shops and markets. The hill regions are disconnected from the plains due to a poor road network and, thus, fertilizer is limited and expensive, and Covid worsened the situation. This has increased the number of organic activities and farmers growing organic produce. Uttarakhand is the first state of the country to be declared an organic state. Due to this, a great need was felt to constitute an organization to promote and coordinate dispersed organic activities and efforts for organic farming in the state. The Uttarakhand Organic Commodity Board (UOCB) came into existence¹⁶. The role of the Board is to promote organic farming in the state and to provide options in diversifying towards organic farming. One achievement of the UOCB is that 42 commodities have been identified as market-potential produce and information about market demand has been passed on to producer groups through nodal agencies in Kumaon and Garhwal. Another issue that emerges in marketing and making agriculture a commercial venture is branding the products so that they can be sold globally. The same product when produced by different farmer groups under different brand names usually does not reach the international market.

Agriculture Innovations Implemented:

Methods to ward off wild animals from crops: Farmers in India and abroad face serious threats from pests, natural calamities, thefts, damages by animals and other types of crop losses, resulting in lower yields. More pronounced wild animals in lands adjacent to forest areas cause damage during summer, due to food and water shortage in the forests. Interestingly, some workers in chick hatcheries noticed that the deer herds do not come near the places where they dispose their hatchery waste; which contains a lot of unhatched eggs. By observing this, some hatchery workers started spraying the egg contents mixed with water, on their home gardens and noticed that the deer do not come near the plants (sprayed with egg contents), probably due to the pungent odour emitted by the raw egg contents when exposed to the air. Himalayan Nettle Fiber:- The Tree species defined as *Diploknema butyracea* in Botanical Science. It is commonly known

Chyur in Northern parts of India. It is. For the past many years, Government of India has been formulating various plans for making the country self-sufficient in edible and non-edible oils. Whereas, the wasteland development has been one of the thrust areas in the Government plans, one hand, the self-sufficiency in edible and non-edible oils as bio-fuels has been identified as a timely demand on the other. Keeping in view, the above, the plantation of Chyur trees on wastelands throughout the Himalayan sub-tropical belt is need of the hour.

Energy Conservation Project based on LED & Solar Energy: -Electrical energy plays a vital role in day today's life. A light-emitting diode (LED) is a two-lead semiconductor light source.It is a basic pn-junction diode, which emits light when activated.When a fitting voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor

Project on Cultivation of Oyster & Ganoderma Lucidum Mushroom: - Mushrooms have been valued throughout the world as both food and medicine for thousands of years. They are a rich source of nutrition and form a major chunk of health foods.

Project based on Natural Fiber: - Natural fibers are greatly elongated substances produced by plants and animals that can be spun into filaments, thread or rope. Woven, knitted, matted or bonded, they form fabrics that are essential to society. Like agriculture, textiles have been a fundamental part of human life since the dawn of civilization. While the methods used to make fabrics have changed greatly since then, their functions have changed very little: today, most natural fibers are still used to make clothing and containers and to insulate, soften and decorate our living spaces. Plant fibres include seed hairs, such as cotton; stem (or bast) fibres, such as flax and hemp; leaf fibres, such as sisal; and husk fibres and many local plants founds in hills of Uttarakhand. Animal fibres include wool, hair and secretions. Such project will create earnings for villagers from the local resources.

Project based on Herbal Cultivation: - Uttarakhand Government since its inception has projected itself as a herbal state as recognized for its inherited rich biodiversity and ethnic herbal traditions

Handmade Paper Making: - The paper industry is a forest-based industry. Depleting forest cover is a major cause of concern.There lies the tremendous possibility of handmade paper making in India, which with its eco-friendly and environmentally cleaner production technology will be an appropriate sustainable production system.

Azolla- A sustainable feed Substitute for livestock: - The demand for milk and meat has been increasing and animal husbandry as a profit occupation

is expanding. However, there is a substantial decline in fodder production, owing to the decreasing area under forest and grasslands.

Horticulture-Horticulture is one of the critical sectors in the economy of Uttarakhand⁵¹. It provides much needed opportunity for diversification and increased employment in the state where scope of high rate of growth in conventional agriculture is rather limited due to peculiar topography and majority of scattered and marginal holdings. Horticultural development can become an effective tool for accelerating development in the hilly areas as well as boosting the income of farmers beyond the subsistence level that they manage from traditional agriculture crops. Area under horticulture crops can be increased by utilization of cultivable wastelands and the farms belonging to absentee landowners. Among the fruits, mango (21.75 per cent of total area under horticultural crops), apple (18.40 per cent) and citrus (15.28 per cent) occupied top 3 positions in the state during 2010-11.

Bee Keeping Beekeeping has been a traditional practice in the hills for a long time, but it has not been exploited commercially to its potential level. The species of honeybee reared in the state are *Apis mellifera* in the plains and *Apis cerana indica* in the hills. Both the species perform well in the bhabhar areas. The major feed plants are apple, litchi, peach, plum, mustard, etc. The months of July and August are the major dearth months of foraging. The Khadi and Village Industries Commission (KVIC) is the nodal agency to promote beekeeping. In 2020/2021, however, there was a decline in the share of irrigation investment in total private investment in agriculture.

Uttar Pradesh and Uttarakhand (4 percent)..

State policies:

Promoting diversified agricultural and allied livelihoods, including livestock and horticulture	Bee Keeping	Under this scheme, support is provided for bee keeping by storage of bee in cells, collection and processing of honey, etc.
Promoting diversified agricultural and allied livelihoods, including	Garden Rejuvenation Scheme	Under this programme, support is provided for rejuvenating of orchards and plantations which have

⁵¹ Government of Uttarakhand, *Programmes and Schemes in Uttarakhand*, (Mar., 2020), <https://agriculture.gov.uk.in>

livestock and horticulture	Horticulture Department	low productivity
Promoting diversified agricultural and allied livelihoods, including livestock and horticulture	Scheme of Fruit Plants Plantation Horticulture Department	Support towards planting of fruit plants, development of nursery and raising of seedling
Promoting diversified agricultural and allied livelihoods, including livestock and horticulture	Distribution of Water Pump, Sprinkler Set, etc. Agriculture	Under the programme, support is provided as subsidy for procurement of farm machineries such as water pump for irrigation purpose, sprinkler set for drip irrigation, etc.
Rural industrialisation Seed Production	Seed Production Programme / Core Village Scheme Agriculture	Under this component, support is provided for production and cultivation of selective seeds.

Agricultural innovations are primarily concerned with a need for increasing production (of food, fodder, secondary products) as well as enhancing quality (of produce, production process, growing conditions)

Innovation

Intensive Mixed Farming System⁵²

Focus area : Intensive Farming System

Shri Shivvachan Yadav from Uttar Pradesh adopted an intensive farming system on his farm by growing vegetables like potato, tomato, pea, onion, cauliflower, cabbage, radish, sugar beet, carrot and leafy vegetables with paddy, wheat and mustard crops to maximize income from multiple enterprises. Shri Yadav collected 20 varieties of guava and maintains an organic kitchen garden. He is also rearing milch animals, viz., 3 buffalo (Murrah) and 2 cows (Sahiwal) with average milk production of 25 liter per day. Shri Shivvachan Yadav produces potato seed and supply to other farmers in the village. Growing of vegetables is planned based on the needs of

⁵² : Srinivasa Rao, Ch., Prasad, JVNS., Osman, M., Prabhakar, M., Kumara, BH., Singh, AK. 2017. *Farm Innovations in Climate Resilient Agriculture*. Central Research Institute for Dryland Agriculture, Hyderabad, p37

the local markets. He adopts scientific approaches for growing of vegetables based on the package of practices given by the University or KVK.

Impacts

Intensive mixed farming with multiple enterprises is advantageous because it allows farmers to diversify and spread risk, enables recycling and reduces dependence on external inputs, reduces the spread of diseases and pests, leads to high profits, guarantees work throughout the year and enhances farmer's social status. The utilization of equipment, labor and land is very efficient in these systems. The flow of nutrients within intensive farming system is effectively controlled and balanced. The fertility of soil is also maintained in farming systems due to recycling of residues. Mixed farming promotes water conservation and minimizes soil erosion. Presently, there are about 100 farmers in his and neighboring villages who are following Shri Shivvachan Yadav's innovative intensive farming practices.

2).Innovation - Bio-Degradable-Carbonoid-Metabolite (BioDCM)⁵³

Focus area - protect agricultural crops from fungal and bacterial infections.

A team of researchers from IIT Kanpur has developed a novel Nanoparticle-based Bio-Degradable-Carbonoid-Metabolite (BioDCM) that can protect agricultural crops from fungal and bacterial infections. The technology is a protective biological alternative that can be used to enhance crop protection against various diseases in agricultural field, especially for rice crops. It is developed as a bio-degradable nanoparticle system with a metabolite – the end-product of metabolism or the process of conversion of food, extracted from the naturally occurring common soil fungi - *Trichoderma asperellum* Strain.

This extracted metabolite can be used as an effective organic antimicrobial agent and carbonaceous degradable encompassing to provide protection against crop diseases and enrichment of soil.

Impacts:- The invention also helps in overcoming some shortcomings such as less control on bioavailability, pre-mature degradation and absorption by the crops, thus, making it a feasible option for farmers

⁵³ *IIT Kanpur Develops Biodegradable Nanoparticle- 'BioDCM' to Protect Crops*, Retrieved April 26 2022
<https://krishijagran.com/agriculture-world/iit-kanpur-develops-biodegradable-nanoparticle-biodcm-to-protect-crops/?amp=1>

3).Innovation: Moisture Conservation through Mulching in Sugarcane⁵⁴

Focus area : Soil and Water Conservation

Farmers burn the residue of sugarcane crop after harvesting of sugarcane. This is a concern in view of air pollution and also the green house gas emissions due to burning of crop residues. Shri Ranjit Singh is a sugarcane grower from Uttar Pradesh and he used to harvest the sugarcane crop and retain the crop residue as mulch instead of burning. He has noticed that during the month of April to mid-June temperature reaches 46 o C, mulching reduced the frequency of irrigations (6 -7 nos.).Mulching of sugarcane field after harvesting of crop reduced the quantum of water applied and conserved the moisture and reduced the infestation of weeds.

Impacts

This was found beneficial for in-situ moisture conservation as well. Major area of the village is under sugarcane cultivation and the sugarcane residues are subjected to burning. After initiation of Sri Ranjit Singh, farmers convinced and returning crop residue after harvesting of sugarcane crop. About 72% of the farmers stopped burning of the crop residues and practicing mulching. After adopting the mulching technique, the number of irrigations reduced. About 200 farmers have adopted Shri Ranjit Singh's innovative method of mulching in sugarcane crop. The sugarcane trash mulching helped in improving soil health which can be realized with increased number of earthworms in soil. This innovation can be adopted without hampering the ratoon sugarcane cultivation.

Uttar Pradesh

State Policies:

Demand Side Management Program (DSM)⁵⁵ : The objective of the program is to create an appropriate framework for market based interventions in the agriculture pumping sector and carry out pump-set efficiency upgradation projects through Public Private Partnership (PPP) mode.

⁵⁴ supra note 1

⁵⁵ DEPARTMENT OF ADDITIONAL SOURCES OF ENERGY, GOVERNMENT OF UTTAR PRADESH
[HTTP://UPNEDA.ORG.IN/ECP-SCHEMES.ASPX](http://UPNEDA.ORG.IN/ECP-SCHEMES.ASPX)

At the outset of the XIIth five year plan, the objective is to reduce the energy intensity of the agricultural pumps by carrying out efficiency up gradation of agricultural pumps. The approach for meeting the targets would be to build up the process of acceleration of sustainable energy efficiency in the XII plan through; widespread replication through regulatory mechanism which will be coupled with the financial support provided by the GOI for bridging the EEPS pump sets higher cost, capacity building of all stakeholders, few demonstration projects in rural drinking water pumping systems and strategic approach for dissemination of results.

Atma Nirbhar Krishak Integrated Development scheme⁵⁶:

The UP government gave a nod to implementation of Atma Nirbhar Krishak Integrated Development Scheme from 2021-2022. Under this scheme, 1,475 Farmer Producer Organisations (FPOs) will be formed in the next three years in each development block of the state, the UP government said in a statement. Under the scheme, Rs 1 lakh crore will be provided by banks and financial institutions as loans to Primary Agricultural Credit Societies, Marketing Cooperative Societies, FPOs, Self Help Groups, farmers, joint liability groups, multipurpose cooperative societies, agri-entrepreneurs, startups, aggregation infrastructure providers and central/state agency or local body sponsored Public Private Partnership Project. All loans under this financing facility will have interest subvention of 3 per cent per annum up to a limit of Rs 2 crore. This subvention will be available for a maximum period of seven years.

Self-Reliant Farmer Integrated Development Scheme⁵⁷:

Uttar Pradesh Chief Minister Yogi Adityanath launched the Self-Reliant Farmer Integrated Development Scheme. The scheme of Rs.722.85 crore will offer benefit to Over 27 lakh farmers associated with Farmer Producer Organizations (FPOs) which will significantly increase their income over the next five years. The money will also be used to provide facilities and resources to farmers at all levels, from the farm to the market.

The state government has earmarked Rs.100 crore for this scheme in the current financial year. This scheme would result in the formation of 2,725 FPOs, which will directly benefit 27.25 lakh shareholder farmers. The FPOs, according to the official, would assist farmers increase their

⁵⁶ *Atma Nirbhar Krishak Integrated Development Scheme* , Retrieved on April 26,2022
http://upagriculture.com/Default_schemes.aspx

⁵⁷ *Self- Reliant Farmer Integrated Development Scheme*, Retrieved on 25 April, 2022
http://upagriculture.com/Default_schems.aspx

revenue by allowing them to sell their produce directly to traders, companies, and contract farmers.

Farmers will be able to receive the best price for their goods through the FPO. Farmers affiliated with FPOs operating in the state would receive a 4% subsidy on a loan of Rs.5 lakh under the scheme. By building agricultural infrastructure, institutions involved in agricultural development will be able to lower the cost of farming and boost farmer income.

Kisan Kalyan Mission⁵⁸:

Under the 'Kisan Kalyan Mission' various programs were organized for the farmers;

Exhibition of Agriculture and the associate sectors which include the products of livelihood missions and MSME sector units. Farmer meetings will be organized in which scientists, progressive farmers, and the workers associated with the Agriculture Department would be explaining scientific farming. They also provide information about the schemes of the government. Farmers will also be benefitted from various schemes of the agriculture department.

Under this program, the UP government will also felicitate 100 'progressive farmers' in each district of the state. According to the Chief Secretary of the state, in each district, 100 progressive farmers will be chosen as role models and will be felicitated. Their databases will also be prepared by the government. The farmer will also be coached in terms of the latest farming guidelines. It will help the farmers in getting benefit from the various schemes of the center such as PM Kisan Samman Nidhi, Kisan Credit Cards, and PM Fasal Bima Yojana.

Madhya Pradesh

Madhya Pradesh (MP), located at the centre of India, is often called the “Heart of India”. It is a landlocked state, surrounded by Uttar Pradesh, Chhattisgarh, Maharashtra, Rajasthan and Gujarat. Until 2000, it was the largest state in the country in terms of geographical area; however, in November 2000, Chhattisgarh was carved out of the south-eastern part of erstwhile Madhya Pradesh. Currently, MP is the second-largest state in India after Rajasthan and it spreads over a geographical area of about 308 lakh ha, which is about 9% of the total area of the country.

⁵⁸ *Kisan Kalyan Mission*, Retrieved on April 26,2022 <https://www.nibsm.org.in/kisan-kalyan-mission-in-english/>

The average rainfall received by MP is around 95.2 cm during the monsoon season. This accounts for around 91% of the total rainfall in the state. In MP, the eastern parts receive relatively higher monsoon rainfall (105.1 cm) as compared to the western parts (87.6 cm).

State Policies:

Deen Dayal Upadhaya Gram Jyoti Yojana (DDUGJY) is a centrally sponsored scheme, which was initiated in 2014 with a feeder separation component. The scheme makes funds available to state governments to take up works to strengthen the distribution system and the separation of feeders for agricultural and non-agricultural consumers. Under DDUGJY, a sum of Rs. 28.7 billion has been sanctioned for MP so far, of which Rs. 15.8 billion is to strengthen the system and Rs. 8.2 billion is for the segregation of feeders.

The **Yantradoot village scheme** was started initially with district level officers of the Department of Agricultural Engineering periodically demonstrating the use of farm implements to farmers in 25 villages spread across 25 districts in the state and making these implements available on hire for the agricultural community at nominal prices. The scheme aims to make each of these villages into models of agriculturally mechanised villages by using modern farm tools for each stage in the production of crops, starting from soil preparation, for cultivation, removing weeds and destroying insect habitats from the field by deep ploughing, improving the fertility of the soil, maintaining the correct distance between rows of crops, promoting seed treatment and proper harvesting and threshing procedures. This scheme currently has been scaled up to cover 139 villages as yantradoot grams (fully mechanised villages). The state government will provide land on a licence basis for 30 years (extendable by mutual consent for another five years at a time subject to a maximum period of 10 years).

The state government will also provide viability gap funding (VGF) up to a maximum of 20%, if required, in addition to the 20% VGF by the Government of India under the VGF Policy. However, projects availing of the benefit will not be eligible for capital investment and interest subsidy. Moreover, the projects are mandated to be awarded through a transparent bidding process and are eligible for a business guarantee for 10 years.

Punjab

The Punjab state has 5.03 m ha Geographical area out of which 4.23 m ha. is under cultivation. About 75% of its population depends directly on agriculture. Since the advent of the green revolution, the state has made rapid strides in agricultural production. Punjab has been divided into five agro-climatic zones on the basis of homogeneity, rainfall pattern, cropping pattern, etc. The zones are: sub-mountain undulating zone, undulating plain zone, central plain zone, western plain zone and western zone. The cropping intensity has increased from 126% to 186% during the period 1965-66 to 2004-05. The area under wheat has increased by 216% and production by 756%, whereas the area under rice has increased by 895% and production by 3307%. The state has played a prominent role by achieving self sufficiency in food grains by contributing 60% wheat and 40% rice to the central pool.⁵⁹

State Policies:

Adoption Of CRM Machinery In Punjab: For addressing air pollution and subsidising technological management options for in-situ management of crop residue, a Central Sector Scheme "Promotion of Agricultural Mechanization for in-situ management of crop residue in the States of Punjab, Haryana, Uttar Pradesh and NCT of Delhi" was launched in the year 2018-19. The Commission intended to study the farmers' perception about the scheme itself, understand the scheme's implementation in the State and identify the areas for improvement in the scheme. India Paryavaran Sahayak (IPS) Foundation has been working with the farmers in the State on crop residue management for quite some time.⁶⁰

Appraisal Of Direct Seeding of Rice In Kharif 2020: The return of migrant workers to their native states from Punjab during the COVID-19 lockdown created a severe shortage of labour during the Kharif season of 2020. Paddy transplantation operations were likely to be affected diversely with the possibility of a decline in the area under paddy. Therefore, the Government of Punjab encouraged direct Seeding of Rice (DSR) by distributing about 4000 DSR machines at subsidised rates along with large- scale efforts on extension activities to promote this technology.

State Of Protected Cultivation In Punjab: Protected cultivation technology (PCTs) in India is about 30 years old. To promote PCTs in the State on a large scale, the Central Government and

⁵⁹ <https://agri.punjab.gov.in/?q=introduction-punjab>, visited on 27/04/2022

⁶⁰ <https://www.psf.org.in/studies.html>, visited on 27/04/2022

State Governments have come up with various programmes and policies. Because these are new technologies, the State Government has made a significant effort to promote these technologies.

The real push for PCTs came with the launch of the National Horticulture Mission in the year 2005. Till 2019, 1421 different protected structures were installed in the State. The area under PCTs is approx. 3246371 sq. meters (324.64 ha.).⁶¹

West Bengal

The production of food grain has increased to 189.57 LMT in 2018-19 from 148.1 LMT in 2010-11 and the state upholds its leadership in rice production in India. Almost two-thirds populations of the state are directly or indirectly dependent on agriculture & Agri-allied activities and the central pillar of economic growth remains agriculture. The State supports beyond 8% of the national population having only 2.7% of India's geographical area with 72.43 lakh farm holdings (Agri-Census, 2015-16) of which 96% of the farmers are small and marginal and the average size of landholding is 0.76 ha. The cropping intensity is 190% well above the national average of 142% during 2018-19. In the backdrop of new innovations, technologies, and the introduction of flagship programs in agriculture, further enhancement in farm income is needed to elevate the small and marginal farmers⁶².

- **State Policies (Name)⁶³**

Amar Fasal, Amar Gola, and Amar Fasal, Amar Gari: the West Bengal government provides financial assistance to the marginal farmers of Rs. 5,000 to 25,000. So that they can afford their storehouse and vending carts. The project facilitates the farmers who wish to directly sell their products to the end-users. The subsidies are directly credited to the bank accounts of those farmers who own Kisan Credit Cards.

⁶¹ <https://www.psf.org.in/studies.html>, visited on 27/04/2022

⁶² Department of Agriculture, Government of West Bengal. *Agricultural Scenario in West Bengal*. Retrieved from: [» Agricultural Scenario in West Bengal \(matirkatha.gov.in\)](#)

⁶³ Bengal Surges Ahead, Government of West Bengal. (2019), *Schemes*. Retrieves from: <https://wb.gov.in/government-schemes-details-matirkatha.aspx>

Krishak Bandhu: the West Bengal govt introduced the scheme to provide financial assistance to all the farmers for agricultural practices.

Soil conservation: this scheme helps boost sustainable agriculture production in rainfed areas and among poor farmers with fewer resources. This scheme applies to natural resource conservation programs, like rain-water harvesting, stream bank erosion control, in-situ moisture conservation, field channel, clearance of congested drains, dam condition checking, well digging, plantation, periphery cultivation, micro-irrigation, integrated farming system, etc. The fund is drawn from the National Mission for Sustainable Agriculture.

Sech Bandhu: it boosts the irrigation sector of the sector by setting new pump sets, and also keeps the illegal power consumption at bay.

- **State policies (Evaluation)⁶⁴**

Adoption of location-specific cropping sequences, crop diversification with less water-intensive and remunerative crops like pulses and oilseeds, and vegetables, and intercropping practices are the important development indicators for the enhancement of cropping intensity from 184 % to 200 -250 % in all sorts of land in West Bengal.

The creation of soil testing infrastructure facilities at the district level for comprehensive soil analysis and the introduction of soil health cards indicate soil health management and augmentation of crop productivity. The creation of Agri-Export Zones (AEZ) has brought about a paradigm shift in the approach from “production-oriented” to “market-driven” vegetable farming in West Bengal.

- **Innovation**

It is well documented that improved seed quality alone can increase by 20% crop yield. At present approximately 50% of seed requirement in the State is being sourced from other parts of the country. There is a need of developing some rice varieties resistant to arsenic for some districts like North 24 Parganas, Nadia, etc.

⁶⁴ Haldar, A., Pal, P. P., & Singh, S.S. Indian Council of Agricultural Research. (2018). *Doubling Farmers' Income by 2022 in West Bengal*. Retrieved from: <http://www.atarikolkata.org/wp-content/uploads/2018/10/DFI.pdf>

The soil health can be deteriorated because of poor organic carbon content, land degradation, soil erosion, increase or decrease of soil pH, etc. The impressive growth of consumption of fertilizer in India as well as West Bengal in the post-green revolution period ensured an increase in food grain production. Soil testing and the issue of a 'Soil Health Card' to all farmers have to be done to take stock of the soil health status at a regular interval. A scheme like 'Swasth Dhara- Khet Hara' has been launched to maintain the soil health fertility where Soil Health Cards are being issued to the farmers. Based upon soil test results (pH of lands), chemical fertilizers have to be used and a necessary liming program should be taken.

Water resources and the crops suited for them with the corrective measures are needed for introducing alternate crops. The database on soils, water resources, and the crops suited for the area along with technological modules should be at the Panchayat level and treated as a baseline for any agricultural development programs.

There is a huge scope for increasing the rice fallow area for pulse production in West Bengal. As per the estimates of the Department of Agriculture, Government of West Bengal, the total available area under rice fallow is 8.53 lakh ha. The present area under pulses is 2.19 lakh ha and the area of the additional pulse covered under rice fallow is only 0.96 lakh ha from 2016 to 17.

Water-saving technologies under irrigated rice (boro/ aus crops) like System of Rice Intensification (SRI) where feasible may be introduced. The technology has the potential to reduce the irrigation requirements by 30%.

Various research studies have shown that water-saving, electricity-saving, irrigation efficiencies, and yield of crops using drip irrigation are substantially higher than crops irrigated by the conventional flood irrigation method. Steps may have to be taken to promote and propagate a drip irrigation system as an effective measure for the conservation of water in the dry and water-scarce tracts of Purulia, parts of Birbhum, Paschim Medinipur, and Bankura districts.

There is a need of integrating a package of climate-smart agriculture practices into ongoing programs such as weather-based locally specific agro-advisories, contingent crop planning, promotion of low-external input technology, agricultural diversification towards enhanced

climate resilience, and water budgeting, and livelihood diversification. The development and cultivation of climate-resilient crops need to be promoted.

Resource Conservation Technologies (RCTs) need to be promoted for farming such as “no-tillage” as it saves water, labor, and energy, help early sowing, improves soil organic C, reduces soil compaction, increases fertilizer use efficiency, and reduces soil erosion⁶⁵.

BidhanRupali(Olitorius), a jute type, has been developed by Bidhan Chandra Krishi Viswavidyala, which is resistant to flood, early flowering, and is harvestable in 90 days. Bidhan Ricebean-1, a type of rice bean that has been developed by the same university, is salt tolerant. On the other hand, Bidhan Ricebean-2 is salt tolerant, and to some extent, drought-tolerant also. It is resistant to yellow mosaic virus, anthracnose, stem/collar rot, wilt, aphid, foliage beetle, and poor borer under field conditions⁶⁶.

- **Observation⁶⁷**

Well-developed irrigation infrastructure is facilitating higher cropping intensity with potential for further development especially of groundwater resources. The total irrigation potential of the State is 67.43 lakh ha. The main source of irrigation is open/tube wells. The gross irrigation potential so far has been created through the major, medium, and minor irrigation in 55.01 lakh ha of land till the end of March 2009.

Farm power available in the State is 35 kW/ha. By and large, the farmers have adopted the mechanized plowing and for this purpose, they have relied mostly on the custom hiring of tractors. Though 33% of farmers have bullocks and plows, they mainly use bullocks for the transportation of crops. Only 10% of farmers have their tractors and power tillers; 40% of the farmers have diesel pump-sets and 24% of farmers have their own electric pump-sets for irrigating their land. In some villages, irrigation is provided solely by government-operated mini

⁶⁵ Haldar, A., Pal, P. P., & Singh, S.S. Indian Council of Agricultural Research. (2018). *Doubling Farmers' Income by 2022 in West Bengal*. Retrieved from: <http://www.atarikolkata.org/wp-content/uploads/2018/10/DFI.pdf>

⁶⁶ Bidhan Chandra Krishi Viswavidyalaya. (2018). *Varieties Evolved*. Retrieved from: [Varieties Evolved \(bckv.edu.in\)](http://www.bckv.edu.in)

⁶⁷ Bidhan Chandra Krishi Viswavidyalaya. (2018). *Varieties Evolved*. Retrieved from: [Varieties Evolved \(bckv.edu.in\)](http://www.bckv.edu.in)

deep-tube wells. In other cases, the farmers mostly depend on privately owned shallow tube-well for irrigating their agricultural land.

Water harvesting structures (10 % of a farming unit), mini deep tube-well (can irrigate 5 ha of land), percolation tank, farm pond, check dam in streams available in villages, roof water harvesting in hill area, solar energy operated pump, water pump procurement, and distribution have been done utilizing fund from MNREGA and RKVY.

A Micro-irrigation system has been identified to be the best means of giving water to the plants where water use efficiency is maximum. Modern irrigation systems like drip irrigation and sprinkle irrigation have been developed which are being popularized in the farmer's fields.

The Government has launched many websites, portals, phone services, mobile apps, and agriculture Short Message Services (SMS). ICAR has already attempted some pioneering models like mKISAN Portal, KVK Portal, KRISHI Portal, etc. Mobile Apps for farmers have also been developed by ICAR. Through Kisan Suvidha App, farmers are getting information on weather conditions, input dealers, market price, plant protection along with appropriate advisories.

The Government is taking effective and substantial measures to reduce the risk to the agriculture sector through Restructured Weather Based Crop Insurance Scheme (RWBCIS) so that farmers feel secure even during the occurrence of natural calamities.