AGRICULTURAL SITUATION IN INDIA

Since 1948

JANUARY, 2020

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Publication Division
Directorate of Economics and Statistics
Department of Agriculture, Cooperation & Farmers Welfare
Ministry of Agriculture & Farmers Welfare
Government of India
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New Delhi-110 001
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Subscription

	Inland	Foreign
Single Copy	: Rs. 40.00	£ 2.9 or $ 4.5
Annual	: Rs. 400.00	£ 29 or $ 45

Available from
The Controller of Publications,
Ministry of Urban Development,
Deptt. of Publications,
Publications Complex (Behind Old Secretariat),
Civil Lines, Delhi-110 054.
Phone : 23813761, 23813762, 23813764, 23813765
(Email: acop-dep@nic.in)

For submission see last page.

VOL. LXXVI **January, 2020** **No. 10**

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From Editor's Desk

This issue of 'Agricultural Situation in India' talks about the current policy and schemes of the Government; updates on the general agricultural outlook; two academic research articles, on profiling the disadvantaged regions in India from climate and income perspective; and district-wise analysis of trends in area, yield and production of major oilseeds in Punjab; and two agro-economic research study reports on solarisation of agricultural water pumps in Rajasthan; and performance evaluation of Pradhan Mantri Fasal Bima Yojna in West Bengal.

The major farm sector news discussed in this issue are: assistance to female farmers under Mahila Kisan Sashaktikaran Pariyojna (MKSP); providing fast internet connectivity to e-NAM mandis; thrust in export of organic products through various schemes of Government; performance of various agricultural schemes; crop damage in Maharashtra due to unseasonal rains; development of centralized farmers database; mandatory requirement of Aadhaar for PM Kisan Yojna w.e.f. 01st December, 2019; construction of cold storage in Nagaland; Antibiotics for crops to combat certain fungal and bacterial diseases in plants; inauguration of three days "International Seminar on Climate Smart Farming Systems" in New Delhi; the Cabinet's approval on extension of Prime Ministers's Development Package (PMDP) by three years in UTs of Jammu & Kashmir and Ladakh; signing of MoU between ICAR and NABARD to facilitate the action research and up-scaling of various technologies and innovation farmer models; promotion and achievement of various initiatives of Government on e-NAM, Farmers Producers Organistion (FPO), Kisan Seva Kendras; reduction of farm logistics cost; and increase in the rabi sowing area by 35.9 lakh hectares during 2019-20.

So far as the agricultural scenario is concerned, the Wholesale Price Index (WPI) of food grains, pulses, cereals, wheat, paddy and oilseeds increased by 9.35 percent, 16.59 percent, 7.93 percent, 8.02 percent, 4.24 percent and 6.33 percent, respectively, in November, 2019 as compared to that in November, 2018. The cumulative post-monsoon season rainfall in the country has been 32 percent higher than the long period average during 1st October, 2019 to 25th December, 2019. Current live storage in 120 major water reservoirs in the country was 137.13 BCM as against 98.59 BCM of normal storage based on the average storage of last 10 years.

In academic perspective, this issue offers two insightful research papers related to an analysis of major socio-economic and agricultural attributes of disadvantaged regions/districts/states of the country in terms of farm & farmers income and climate variability; and growth trends of area, production and yield of four major oilseeds (rapeseed-mustard, groundnut, sunflower and sesamum) of Punjab. The first article attempts to identify the districts facing dual challenges of the environmental distress and poverty. For this purpose, the study relied on the data related to income of agricultural households from various sources, i.e., crop farming, wages & salary, etc., taken from 70th round of NSSO, for the agricultural year 2012-13. The study reveals that growth of agriculture and allied sector over the past decade reflects a mixed trend in these states/districts. It is suggested that these states/districts need priority attention with respect to basic support services, like timely and adequate credit delivery to the farmers, access to cost effective and continuous electricity supply for farm operations and creating an efficient and effective marketing system. In the second article, the author made an attempt to examine the area, production and yield trends of various oilseeds during the last five decades in Punjab. The primary objectives of the study are to analyze district-wise transformation of area, production and yield among major oilseeds of Punjab and to formulate policy implications for the expansion of oilseeds base in the state. To meet these objectives, secondary data was collected from 'Statistical Abstract of Punjab' pertaining to years 1965-66 to 2017-18. Data was analyzed using various statistical tools such as mean, coefficient of variance, compound growth rate and student's t-test. Based on the secondary data, the findings reveal that in all the major oilseeds, namely rapeseed-mustard, groundnut, sunflower and sesamum, the growth rates of area and production was negative and significant, whereas, growth rates of yield has been found positive and significant in all the oilseeds except sesamum across the various districts of the state. Moreover, the author suggests that there is a need to develop high yielding variety seeds along with technological advancements for oilseed crops. Remunerative prices should be provided to the farmers and extension services should be strengthened for raising awareness regarding oilseeds production in the state.

The two agro-economic research studies talked about in this issue are reports related to solarisation of agricultural water pumps in Rajasthan and performance evaluation of Pradhan Mantri Fasal Bima Yojna in West Bengal. The first research attempts to study the status and prospects of solarisation of agricultural pumps in selected districts of Rajasthan. For this purpose, the data was collected from three distinct groups of farmers, viz., farmers who had adopted Solar Irrigation Pumps (SIPs) with the help of subsidy by the government, farmers who had adopted SIPs without any support in the form of subsidy by the government, and the farmers who had not adopted SIPs. Policy implication of the study reveals that both the central and state governments have policies and incentives to grow the use of solar pumps in the irrigation sector. However, there is need for raising awareness among farming community and for putting project delivery mechanism in place. Further, the study suggests that feasible costing and assistance from state / central government will encourage more farmers to opt for the technology; the farmers were also in need of awareness about insurance and its coverage against risks of damage of SIPs or theft of their solar panels. The second study is an attempt to evaluate the performance of PMFBY in the state of West Bengal in terms of issues related to governance, implementation and uptake behaviour among the farmers and to make some policy suggestions for its better functioning. The specific objectives of the study are: to analyze the governance of PMFBY implementation in West Bengal; to analyze the uptake behaviour among the farmers in West Bengal to recommend suitable policy suggestions for better functioning of PMFBY in West Bengal. The study recommends that the Government and other stakeholders need to generate awareness about the benefits of PMFBY/BFBY among all categories of farmers so that the farmers should take up crop insurance in an informed manner rather than taking it as a free lunch. Therefore, strategies for effective awareness campaign and mechanism for a transparent and accountable system of speedy payment of compensation should be evolved.

P. C. Bodh

Farm Sector News*

Assistance to Female Farmers

The Department of Rural Development, Ministry of Rural Development is implementing Mahila Kisan Sashaktikaran Pariyojana (MKSP) to empower women in agriculture by making systematic investments to enhance their participation and productivity, as also to create and sustain their agriculture-based livelihoods.

Under MKSP, a total number of 36.06 lakh Mahila Kisans have been benefitted through 84 projects in 24 States/UTs in the country, out of which 1.81 lakhs women have been benefitted in the State of Maharashtra. A total central allocation of Rs. 847.48 crore has been made towards implementation of the approved projects, out of which an amount of Rs. 52.15 crore has been allocated for projects in Maharashtra.

The Department of Agriculture Cooperation and Farmers Welfare is also providing additional support and assistance to female farmers, over and above the male farmers under various schemes, namely, Agri-Clinic & Agri-Business Centre (ACABC), Integrated Schemes of Agricultural Marketing (ISAM), Sub-Mission of Agricultural Mechanization (SMAM) and National Food Security Mission (NFSM).

Besides, female farmers can also avail the benefits under all the schemes implemented by the Department as per eligibility.

Sufficient speed of internet connectivity is provided to e-NAM mandis: Union Agriculture Minister

As per the response received from the States, National Agriculture Market (e-NAM) platform is working properly and sufficient speed of internet connectivity has been provided to e-NAM mandis. State Governments have already been advised to explore the possibilities of upgrading the internet connectivity with internet service providers. Close monitoring of the progress through meetings at various levels and visits of the officers to e-NAM mandis is carried out. Also, various steps taken by the Government has led to inter-mandi and inter-state trade on e-NAM platform.

Organic products exported from India reached Rs 5150.99 crore in 2018-19

Government of India has been promoting organic farming in the country through dedicated schemes, namely, Paramparagat Krishi Vikas Yojana (PKVY) and Mission Organic Value Chain Development North Eastern Region (MOVCDNER) since 2015-16. Both the schemes aim at promotion of cluster/ Farmers Producer Organization (FPO) based chemical free, low input cost sustainable organic farming and support farmers from input procurement to market linkages.

The total quantity of organic product produced during 2018-19 under Participatory Guarantee System (PGS)-India and National Programme on Organic Production (NPOP) of Agriculture Processed Food and Export Development Authority (APEDA) is 25087328.65 MT & 2607384.90 MT, respectively. The total value of organic products exported from India is Rs. 5150.99 crore (for 614089.614 MT).

Assistance of Rs 50,000 per hectare/ 3 years is provided, out of which Rs. 31,000 (62%) is directly given to the farmers through DBT for inputs (bio-fertilizers, biopesticides, vermicompost, botanical extracts, etc.) production/ procurement, post harvest management, etc., in PKVY scheme. Farmers adopt low cost Participatory Guarantee System (PGS) of certification for domestic markets.

Assistance of Rs 25000/ ha/ 3 years to farmers is provided for both on-farm & off-farm organic inputs, and seeds/ planting material in MOVCDNER and third party certified organic farming is encouraged for export of niche crops.

Organic farming has also been supported under other schemes, *viz*., Rashtriya Krishi Vikas Yojana (RKVY) and Mission for Integrated Development of Horticulture (MIDH), Network Project on Organic Farming (NPOF) under ICAR.

The major thrust of the Government has shifted from production centric to market linked production so that farmers can get better returns for their produce including organic produce. To further boost production of organic produce, a dedicated

Source: www.pib.nic.in

web portal *https://jaivikkheti.in/* has also been created to connect farmers involved in organic farming with consumers directly for better prices.

Recorded Considerable Impact of Agricultural Schemes

As per the erstwhile Planning Commission's estimates based on the survey conducted by the National Sample Survey Office (NSSO) in 2011-12, 25.7% of rural population is living below the poverty line (BPL) including farm and non-farm rural population. However, separate estimate on the number of farmers living below the poverty line is not available.

Keeping in view the challenges before the farming community, Government of India regularly monitors and evaluates Schemes from time to time through independent agencies/institutes and revamps them based on the feedback.

The outcomes of performance evaluation of some schemes are as follows and many of them have been revamped based on such studies:

Rashtriya Krishi Vikas Yojana- Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR): The concurrent evaluation of implementation of the RKVY was done during 2016-17 by Institute of Economic Growth (IEG) Delhi. Based partially on the recommendations, the scheme was revamped as RKVY-RAFTAAR which is currently in operation for 2017-18 to 2019-20 with major focus on pre & post-harvest infrastructure, besides promoting agri-entrepreneurship and innovations.

National Mission on Micro Irrigation: An Impact evaluation study was conducted in 2014 by Global Agri System and conclusions reached were that due to the operation of the scheme

(i) Irrigation cost reduced by 20% to 50% with average of 32.3%.
(ii) Electricity consumption reduced by about 31%.
(iii) Average productivity of fruits and vegetables increased by about 42.3 % and 52.8%.
(iv) Overall income enhancement of farmers was in the range of 20% to 68% with an average of 48.5%.

Soil Health Card Scheme: Two impact evaluation studies have been conducted for Soil Health Card Scheme. The first study was conducted by the National Productivity Council (NPC) in February 2016 and the second study was conducted by MANAGE, Hyderabad in 2017. Constant improvement has been carried out in scheme design and implementation based on such studies.

Damage to crops in Maharashtra due to unseasonal rains

State Government of Maharashtra has reported that total area of crop damage (more than 33%) due to unseasonal rainfall in the month of October-November, 2019, was 94.53 lakh hectares. Approximately, 103.52 lakh farmers have been affected.

As per memorandum submitted by State Government of Maharashtra 29 districts of the State were affected by floods.

Primary responsibility for disaster management rests with the State Government. Central Government extends all possible logistics and financial support to the States to supplement their efforts to meet the situation effectively. The State Government undertakes assessment of damages and provides financial relief in the wake of natural disasters including floods, from the State Disaster Response Fund (SDRF) already placed at their disposal. Additional financial assistance is extended from the National Disaster Response Fund (NDRF) as per the laid down procedure, which includes an assessment based on the visit of an Inter-Ministerial Central Team (IMCT).

In the instant case, even before the receipt of memorandum from the State Government of Maharashtra, Ministry of Home Affairs constituted IMCT, which visited the affected areas of Maharashtra from 29th August to 1st September, 2019 and again from 14th to 16th October, 2019 for on-the-spot assessment of damages. State Government of Maharashtra has submitted memorandum seeking assistance of Rs. 2110.62 crore from NDRF. Based on the interim report of IMCT on Maharashtra, an interim amount of Rs. 600 crore 'on account basis' has been sanctioned to the State of Maharashtra. In addition, the Central share of SDRF amounting to Rs. 676.125 Crore has also been released to the State Government for management of relief necessitated by notified natural disaster during 2019.

Data Bank of Farmers

The Department of Agriculture, Cooperation and Farmers Welfare has constituted a task force to develop a comprehensive farmers database for better planning, monitoring, strategy formulation and smooth implementation of schemes for the entire country.

This centralised farmers database shall be useful for various activities like issuing soil health cards, dissemination of crop advisories to the farmers, precision farming, smart cards for farmers to facilitate e-governance, crop insurance, settlement of compensation claims, grant of agricultural subsidies, community/village resource centres, etc.

At present, centralised farmers database has not been created in the country. However, under PM-KISAN 90,165,852 farmers have been registered in the country as on 30.11.2019, out of which 5,813,813 farmers were registered in Rajasthan.

Aadhaar for PM Kisan Yojana

Only possession of Aadhaar number was optional for release of 1st Instalment under the scheme for period December, 2018 - March, 2019. For release of second instalment pertaining to the April - July, 2019 and onwards, Aadhaar seeding of beneficiaries data was compulsory, except for the States of Assam, Meghalaya and J&K where Aadhar penetration is miniscule. In view of delay in Aadhaar seeding of beneficiaries data on the part of the State / UT Governments, this condition was relaxed and made applicable for release of 3rd instalment pertaining to the period of August - November, 2019 and onwards, except for the States of Assam, Meghalaya and J&K which were given exemption till 31.3.2020. However, possession of Aadhaar number remained compulsory for release of second instalment. This requirement was further relaxed till 30th November, 2019. The mandatory requirement of Aadhaar seeding of beneficiaries data continues to be applicable for release of all instalments w.e.f. 1st December, 2019 onwards.

As on 30th November, 2019, 7,60,65,061 beneficiaries in the county have been transferred the financial benefit under PM-Kisan Scheme. The total number of farmers in the country is only estimates made on the basis of the Agriculture Census, 2015-16. Agriculture census is conducted on a quinquennial basis following census-cum-survey approach to collect data on number of operational holdings in the country.

Construction of Cold Storages

Department of Agriculture, Cooperation & Farmers Welfare is implementing Mission for Integrated Development of Horticulture (MIDH) for holistic development of horticulture in the country, which includes assistance for development of Post Harvest Management (PHM) including setting up of cold storages. Under MIDH, Rs. 31.50 crore were allocated to the State of Nagaland during 2016-17, Rs. 41.50 crore in 2017-18 and Rs. 32.00 crore in 2018-19 for various horticulture activities including construction of cold storages. However, the State Government of Nagaland has reported that no funds have been utilised for construction of cold storages during this period.

Further, Ministry of Food Processing Industries (MoFPI) is implementing the Scheme for "integrated cold chain and value addition infrastructure" as one of the components of Pradhan Mantri Kisan Sampada Yojana with the objective of reducing post-harvest losses of horticulture & non-horticulture produce and providing remunerative price to farmers for their produce.

Under the scheme, MoFPI has approved one cold chain project in Dimapur, Nagaland during 2017-18 with an assistance of Rs. 8.10 crore which has been completed and is functional. Another cold chain project in Dimapur, Nagaland has been approved during 2018-19 with an assistance of Rs. 9.67 crore, which is under implementation. No cold chain project was approved for Nagaland by MoFPI during 2016-17.

Antibiotics in CROPS

Aureofungin, Kasugamycin, Validamycin and Streptomycin+ Tetracycline combination are antibiotics which are registered under the Insecticide Act 1968 for use as pesticides to combat certain fungal and bacterial diseases in plants.

The use of above pesticides is regulated under the Insecticide Act 1968 and the rules framed there under. While registering the pesticide, the label and

leaflets are also approved which contains the details of crop, disease/pest against which it is recommended, dose rate, directions about use, chemical composition, toxicity triangle, precautions to use and packaging specifications.

Pesticides are toxic substances but they do not pose any adverse effect on human beings, animals and the environment if they are used as per the label and leaflet approved by the registration committee. Pesticides are registered for use in the country by the registration committee only after satisfying about their efficacy and safety to human health, animal and environment.

3 day "International Seminar on Climate Smart Farming Systems" for Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) countries organized in New Delhi

The three day 'International Seminar on Climate Smart Farming Systems' for BIMSTEC countries organized by the Department of Agricultural Research & Education, Ministry of Agriculture & Farmers Welfare and Indian Council of Agricultural Research began on 11th December, 2019 in New Delhi. Participants from all the Seven BIMSTEC Countries, *viz*., Bhutan, Bangladesh, India, Myanmar, Nepal, Sri Lanka, Thailand and BIMSTEC Secretariat is attending the Seminar.

Inaugurating the seminar Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR emphasized that despite climate changes, farmers income can be enhanced effectively by adopting technological interventions. He further stated that the small holding farming is a challenge while applying the farm mechanization technology as a component of climate resilient agriculture. He asserted that India is committed to define the targets for reducing the emissions, to develop technologies and implement those at the ground level in order to mitigate and adapt to challenging agricultural situations.

Mr. Han Thein Kyaw, Director, BIMSTEC Secretariat, Myanmar urged the farmers to adopt the modern technologies in farming and agriculture in accordance with the changing climate scenario in the world. He added that this would help to maintain the nutritional quality of crops and food products.

The seminar was organized as a Government of India initiative as announced earlier by the Prime Minister Shri Narendra Modi at the 4th BIMSTEC Summit at Kathmandu on 30-31st August, 2019. The objective of this International Seminar was to have experience sharing platform to enable improvement of tropical smallholder farming systems for greater productivity and resilience to climate change through ecological approaches. Some of the success stories shall be shared as case studies for the benefit of the BIMSTEC countries. The Seminar would have invited lectures and sharing of experiences, visits to state-of-art facilities and field visits to have first-hand experiences.

The BIMSTEC is a regional organization comprising of seven member states in South Asia and Southeast Asia lying in littoral and adjacent areas of Bay of Bengal constituting a contiguous regional unity. This sub-regional organisation came into being on June 6th, 1997, through the Bangkok Declaration.

Cabinet approved extension by three years and revision of PM's Development Package for Horticulture in UTs of J&K and Ladakh

The Cabinet Committee on Economic Affairs, chaired by Prime Minister Shri Narendra Modi, has given its approval for extension of timeline up to 31.03.2022 and revision/ re-appropriation of approved components of Prime Minister's Development Package (PMDP) for development of horticulture in the UTs of Jammu & Kashmir and Ladakh under Mission for Integrated Development of Horticulture (MIDH).

CCEA approved the following:

(i) To extend the timeline for implementation of PMDP approved in 2016 beyond 31st March, 2019 by 3 years, i.e., up to 31st March, 2022 with provision of further extension of time by a maximum period of 12 months, if required, with approval of Union Minister of Agriculture and Farmers Welfare.

(ii) Revision/Re-appropriation of earlier approved components of PMDP within the approved outlay of Rs. 500 crore between UTs of J&K and Ladakh with the provision of further revision, if required, with the approval of Union Minister of Agriculture and Farmers Welfare within the overall financial limit of Rs. 500 crore.

(iii) Revalidation of unspent amount of Rs. 59.07 crore remaining with undivided State of Jammu & Kashmir including Ladakh.

The action plan under PMDP has therefore been modified within the approved outlay of Rs. 500 crore earmarking Rs. 39.67 crore for UT of Ladakh and Rs. 460.33 crore for UT of Jammu & Kashmir.

The implementation of PMDP in the UTs of Jammu & Kashmir and Ladakh Region is expected to generate an estimated 44 lakh man days employment and will also result in employment in allied sectors such as grading/packing units, Cold Atmosphere (CA)/Cold storage units and transportation sector, etc. As the high density plantation involves technology and regular upkeep of orchards, therefore, it will also result in overall wage enhancement in the horticulture sector due to the increase in the farmers income as a result of the increase in productivity.

Achievements under e-Nam Scheme

As on 8th December, 2019, a total of 1,65,77,210 farmers in the country have been registered on National Agriculture Market (e-NAM) platform.

e-NAM, which aims at integrating mandis on a virtual platform, is a reform linked scheme. States/ Union Territories (UTs) who have carried out three mandatory reforms, namely, (i) single trading license to be valid across the State (ii) single point levy of market fee across the State and (iii) provision for e-auction / e-trading as a mode of price discovery; are eligible for integrating their wholesale regulated markets with e-NAM platform. Based on the proposals received from requisite reformed States/ UTs, the wholesale regulated markets are approved and integrated with e-NAM platform. As per the target, 585 wholesale regulated markets have already been integrated with e-NAM platform and additional 415 wholesale regulated markets have been approved for integration with e-NAM platform.

Promotion of Farmers Producer Organisation (FPOs)

Government of India through Small Farmers' Agribusiness Consortium (SFAC), a registered society under Department of Agriculture, Cooperation & Farmers Welfare, Government of India, is promoting Farmers Producer Organisation (FPOs) by mobilizing the farmers and help them register as companies and providing them with handholding support and training for their sustainability. So far, SFAC has helped 827 FPOs in registering as companies. In addition to above, under Deendayal Antyodaya Yojana- National Rural Livelihood Mission (DAY-NRLM), Ministry of Rural Development, Government of India, is promoting FPOs by mobilizing farmers. So far, 131 registered FPOs have been promoted under the Mission. Further, National Bank for Agriculture and Rural Development (NABARD) is also promoting FPOs in the states and has so far promoted 4234 FPOs.

FPOs are provided assistance under various schemes of Government of India such as Venture Capital Assistance (VCA), Mission for Integrated Development of Horticulture (MIDH) and Agriculture Market Infrastructure Scheme (AMI). Additionally, SFAC and NABARD have facilitated training to Board of Directors and Chief Executives Officers of FPOs to enable them to function effectively.

Farm Logistics Cost Reduction

The Government has taken a number of steps to reduce the distribution logistic cost in farming. The Government has implemented the policy for reimbursement of freight subsidy for distribution of subsidized fertilizers through coastal shipping or/ and inland waterways.

In order to make timely availability of certified/ quality seeds at affordable price to the farmers of hilly/remote areas of North-Eastern States including Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttarakhand and hilly areas of West Bengal, transport subsidy on movement of seeds is provided under Sub-Mission on Seeds & Planting Material (SMSP).

As per union budget announcement, 2018-19, Government has announced for development and upgradation of existing rural haats into Gramin Agricultural Markets (GrAMs). This will provide farmers facility to make direct sale to consumers and bulk purchasers which will reduce the logistic cost.

The Government is providing support to farmers for development of agricultural marketing infrastructure in the country through the scheme of Agricultural Marketing Infrastructure (AMI), which is a sub-scheme of Integrated Scheme for Agricultural Marketing (ISAM). Under AMI Scheme, refrigerated van as a transport vehicle is eligible for subsidy assistance for Integrated Value Chain (IVC) projects.

Mission for Integrated Development of

Horticulture (MIDH) provides assistance for development of post harvest management and marketing infrastructure such as cold storage facilities, ripening chamber, pack houses, reefer vehicles to farmers to improve marketability of their produce.

Further, in order to develop the infrastructure in farming sector including that of distribution logistics, the Government is implementing Rashtriya Krishi Vikas Yojana-Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR) Scheme.

The Government has introduced National Agriculture Market (e-NAM) scheme wherein trading of agriculture and horticulture commodities is carried out by transparent price discovery method for produce of farmers through competitive online bidding system. A logistic module has been provided on e-NAM platform to provide efficient logistic facility for inter-mandi and inter-state trade on e-NAM platform.

The Government has formulated and released model Agricultural Produce and Livestock Contract Farming & Services (Promotion & Facilitation) Act, 2018 which will facilitate reduction in supply chain for optimizing logistics.

Working of Kisan Seva Kendras

As reported by Ministry of Petroleum and Natural Gas- Kisan Seva Kendras (KSKs) are rural retail outlets of Indian Oil Corporation Limited (IOCL) where all customers who come for refuelling are serviced. As per market requirement, Indian Oil Corporation Limited Kisan Seva Kendras (IOCL KSKs) also provide allied facilities like micro ATM, convenience store, fertilizers/pesticides, farm equipments, etc., depending upon the buying habits and preference of the local rural customers.

The number of such Indian Oil Corporation (IOC) Kisan Seva Kendras (rural retail outlets) operating in the country as on 01.10.2019 was 8044. Further, IOCL has advertised 13827 number of KSK locations during the last advertisement issued in Nov/Dec, 2018.

The number of staff deployed at retail outlets depends on various factors like type of market (urban/rural/metro), nature of clientele (2/3W/Car/Commercial vehicles), number of dispensing units installed, the retail outlets working hours, number of shifts, etc. Moreover, the deployment of manpower at retail outlets is being done by the dealers.

ICAR and NABARD signs MoU to facilitate the action research and up-scaling of the various technologies and innovative farmer models

With a view to promote sustainable agriculture and climate resilient farming systems, the Indian Council of Agricultural Research (ICAR) signed a Memorandum of Understanding (MoU) with the National Bank for Agriculture and Rural Development (NABARD) to facilitate the action research (the research carried out with the active participation of farmers to provide solutions for the challenges) and up-scaling of the various technologies and innovative farmer models developed by the ICAR that includes the successful climate resilient practices, models and integrated and hi-tech farming practices in a participatory model through adoptive research on watershed platform. Dr. Trilochan Mohapatra, Secretary (DARE) & Director General (ICAR) and Shri Harsh Kumar Bhanwala, Chairman, NABARD signed the MoU in New Delhi on 13th December, 2019.

Speaking at the ceremony, Dr. Mohapatra emphasized on providing financial support to young agri-entrepreneurs with the help of NABARD. He also accentuated on the capacity building of farmers of the country.

The MoU is for taking up site-specific transfer of technologies under sustainable agriculture, integrated farming system, crop intensification, agro-forestry, plantation and horticulture, animal sciences, agri-engineering, etc., including post-harvest technologies. Further, the ICAR through its large network will support the training and capacity building of channel partners and NABARD officers. The initiative will strengthen the competence of channel partners under the promotional and developmental programmes of NABARD, technology transfer under the climate resilient agriculture, contingency and adaptation planning. The ICAR will also help in the impact evaluation of the NABARD assisted projects, DPR preparation for the climate change projects, farm mechanization, Agri-Incubation Centres / FPOs and resource conservation, etc.

The Indian Council of Agricultural Research (ICAR) is a premier organization in the country with

the mandate of agriculture, research, extension and education leading the country's National Agricultural Research and Extension System with a large network of 113 institutes, 75 SAUs and CUs and 716 KVKs across the country. ICAR with its network developed doable technologies in agriculture and allied sectors of horticulture, livestock, fisheries, etc., and are being disseminated through various national and state level programmes, schemes and KVKs for the benefit of the farmers. HRD and Capacity building are also the core mandate of ICAR.

National Bank for Agriculture and Rural Development (NABARD) premier organization dealing with policy, planning and operations in the field of credit for agriculture and other activities in rural areas.

Rabi Crops Sowing area increases by 35.9 Lakh Hectare

As per preliminary reports received from the States, the total area sown under rabi crops as on 27th December, 2019 stands at 571.84 lakh hectares as compared to 536.35 lakh hectare for corresponding period last year. The progress in rabi sowing has picked up significantly with the improvement of soil moisture in almost all rabi growing states.

Wheat has been sown/ transplanted in 297.02 lakh hectares, rice in 13.90 lakh hectares, pulses in 140.13 lakh hectares, coarse cereals in 46.66 lakh hectares and area sown under oilseeds is 74.12 lakh hectares.

The area sown so far and that sown during last year this time is as follows:

(Area in lakh hectare)

Crops	Area Sown in 2019-20	Area Sown in 2018-19
Wheat	297.02	270.75
Rice	13.90	11.93
Pulses	140.13	136.83
Coarse cereals	46.66	42.12
Oilseeds	74.12	74.72
Total Crops	**571.84**	**536.35**

General Survey of Agriculture

Trends in Foodgrain Prices

Based on Wholesale Price Index (WPI) (2011-12=100), WPI of foodgrains increased by 9.35 percent in November, 2019 over that of November, 2018.

Among foodgrains, WPI of pulses, cereals and oilseeds increased by 16.59 percent, 7.93 percent, and 6.33 percent, respectively, in November, 2019 over that of November, 2018.

Among cereals, WPI for wheat and paddy increased by 8.02 percent and 4.24 percent, respectively, in November, 2019 over that of November, 2018.

Similarly, WPI in case of foodgrains increased by 1.06 percent in November, 2019 over that of October, 2019.

Among foodgrains, WPI of pulses and cereals increased by 4.24 percent and 0.37 percent and oilseeds decreased by 1.19 percent in November, 2019 over October, 2019.

Among cereals, WPI for paddy decreased by 0.37 percent and wheat increased by 2.37 percent, in November, 2019 over October, 2019.

Rainfall and Reservoir Situation, Water Storage in Major Reservoirs

Cumulative Post- Monsoon Season, 2019 rainfall for the country as a whole during the period 1st October, 2019 to 25th December, 2019 has been 32% higher than the Long Period Average (LPA). Rainfall in the four broad geographical divisions of the country during the above period has been higher than LPA by 101% in North-West India, by 64% in Central India and by 17% in South Peninsula but lower than LPA by 7% in East & North East India.

Out of 36 met sub-divisions, 24 met sub-divisions received large excess/excess rainfall, 08 met sub-divisions received normal rainfall and 04 met sub-divisions received deficient/large deficient rainfall.

Current live storage in 120 reservoirs (as on 26th December, 2019) monitored by Central Water Commission having total live capacity of 170.33 BCM was 137.13 BCM as against 91.34 BCM on 26.12.2018 (last year) and 98.59 BCM of normal storage (average storage of last 10 years). Current year's storage is 150% of last year's storage and 139% of the normal storage.

Sowing Position during Rabi 2019

As per latest information available on sowing of crops, around 90% of the normal area under Rabi crops has been sown up to 27.12.2019. Total area sown under Rabi crops in the country has been reported to be 571.84 lakh hectares as compared to 536.35 lakh hectares during the same period last year. This year's area coverage so far is higher by 35.49 lakh ha. than the area coverage during the corresponding period of last year. The cropwise sewing position was as follows:

i. Area coverage under wheat is higher by 26.27 lakh ha. than the corresponding period of last year. Higher area reported in Madhya Pradesh (16.63 lakh ha.), Rajasthan (6.58 lakh ha.), Gujarat (3.76 lakh ha.) and Maharashtra (2.03 lakh ha.).

ii. Area cover under Rabi rice is higher by 1.97 lakh ha. than the corresponding period of last year. Higher area coverage reported in Tamil Nadu (1.44 lakh ha.) and Andhra Pradesh (0.58 lakh ha.) and Assam (0.48 lakh ha.).

iii. Area coverage under Rabi coarse cereals is higher by 4.54 lakh ha. than the corresponding period of last year. Higher area coverage reported in jowar (3.80 lakh ha.), maize (0.33 lakh ha.) and barley (0.44 lakh ha.).

iv. Area coverage under Rabi pulses is higher by 3.30 lakh ha. than the corresponding period of last year. Higher area coverage reported in gram is higher by 5.07 lakh ha. than the corresponding period of last year.

v. Area Coverage under Rabi oilseeds is lower by 0.60 lakh ha. than the corresponding period of last year. This is due to less area coverage in rapeseed & mustard (0.72 lakh ha.).

vi. A statement indicating comparative position of area coverage under major crops as on 27.12.2019 during current Rabi season *vis-a-vis* the coverage during the corresponding period of last year is given in the Table 1.

Economic Growth
1. Global Growth

As per IMF's World Economic Outlook (WEO), October, 2019, the global economic activity remained weak with growth for 2019 downgraded to 3 percent, which is slowest pace since the global financial crisis. Among the major economies, India's growth remained highest in the last five years.

The subdued growth is a result of rising trade barriers, elevated uncertainty surrounding trade and geopolitics, idiosyncratic factors causing macroeconomic strain in several emerging market economies, and structural factors, such as low productivity growth and ageing demographics in advanced economies.

2. India's Economic Growth in Q2 of 2019-20

Real GDP growth in second quarter (Q2) of 2019-20 is estimated at 4.5 percent, lower than 5.0 percent in first quarter (Q1) of 2019-20 (Table 2). The growth of real Gross Value Added (GVA) is estimated at 4.3 percent in Q2 of 2019-20 (Table 2).

The growth rate of GDP at constant market prices was 7.2 percent (first revised estimate) in 2017-18 and 8.2 percent in 2016-17 (second revised estimate). The growth in Gross Value Added (GVA) at constant basic prices for the year 2018-19 is estimated to be 6.6 percent (PE). At the sectoral level, agriculture, industry and services sectors are estimated to have grown at the rate of 2.9 percent, 6.9 percent and 7.5 percent, respectively, in 2018-19 (Table 2).

Real GDP growth in second quarter (Q2) of 2019-20 is estimated at 4.5 percent, which is lower than 5.0 percent in first quarter (Q1) of 2019-20 (Table 3). The growth of real Gross Value Added (GVA) is estimated at 4.3 percent in Q2 of 2019-20 (Table 3).

Agriculture and Food Management
All India production of foodgrains

As per the first Advance estimate for 2019-20, the total production of kharif foodgrains is estimated at 140.6 million tonnes. As per the 4th advance estimates for 2018-19, the total production of foodgrains during 2018-19 is estimated at 285 million tonnes, same as in 2017-18 (final estimate) (Table 4).

Procurement

Procurement of rice as on 30th November, 2019 during kharif marketing season 2019-20 was 17.1 million tonnes while procurement in the previous marketing season (KMS 2018- 19) during corresponding period was 16.0 million tonnes (Table 5). Procurement of Wheat during the Rabi Marketing Season 2019-20 was 34.1 million tonnes while procurement in the previous marketing season (RMS 2018-19) during corresponding period was 35.8 million tonnes.

Off-take

The off-take of rice under the scheme during the month of October, 2019 has been 28.75 lakh tonnes. This comprises 26.8 lakh tonnes under NFSA (off-take against the allocation for the month of November, 2019) and 1.9 lakh tonnes under other schemes. In respect of wheat, the total off-take has been 19.4 lakh tonnes comprising of 17.6 lakh tonnes under NFSA (off-take against the allocation for the month of November, 2019) and 1.73 lakh tonnes under other schemes. The cumulative off-take of foodgrains during 2019-20 is 39.1 million tonnes (Table 6).

Stocks

The total stocks of rice and wheat held by FCI as on 1st December, 2019 was 73.9 million tonnes compared to 63.3 million tonnes as on 1st December, 2018 (Table 7).

TABLE 1: All India Crop Situation-Rabi (2019-20) as on 27.12.2019

(In lakh hectares)

Crop Name	Normal Area	Average Area as on date	Area sown reported			Absolute Change over (+/-)	
			This Year	% of Normal	Last Year	Average as on date	Last Year
Wheat	305.58	279.05	297.02	97.2	270.75	18.0	26.3
Rice	42.77	13.76	13.90	32.5	11.93	0.1	2.0
Jowar	35.75	29.78	26.22	18.2	22.42	-3.6	3.8

TABLE 1: All India Crop Situation-Rabi (2019-20) as on 27.12.2019-Contd.

(In lakh hectares)

Crop Name	Normal Area	Average Area as on date	Area sown reported			Absolute Change over (+/-)	
			This Year	% of Normal	Last Year	Average as on date	Last Year
Maize	17.49	12.60	12.43	71.1	12.09	-0.2	0.3
Barley	6.57	7.19	7.46	113.5	7.03	0.3	0.4
Total Coarse Cereals	59.81	50.22	46.66	78.0	42.12	-3.6	4.5
Total Cereals	408.17	343.03	357.58	87.6	324.80	14.6	32.8
Gram	93.53	88.39	94.96	101.5	89.89	6.6	5.1
Lentil	14.19	15.41	15.18	107.0	15.90	-0.2	-0.7
Peas	9.45	9.34	9.08	96.1	8.81	-0.3	0.3
Kulthi(Horse Gram)	2.04	4.18	4.95	242.8	5.06	0.8	-0.1
Urad	8.61	6.31	5.70	66.2	5.83	-0.6	-0.1
Moong	10.10	3.35	2.55	25.2	3.06	-0.8	-0.5
Lathyrus	4.13	3.58	2.81	68.0	3.04	-0.8	-0.2
Others	3.94	5.33	4.90	124.4	5.23	-0.4	-0.3
Total Pulses	146.00	135.89	140.13	96.0	136.83	4.2	3.3
Total Foodgrains	554.16	478.92	497.71	89.8	461.63	18.8	36.1
Rapeseed &Mustard	60.48	65.47	65.68	108.6	66.40	0.2	-0.7
Groundnut	7.76	3.82	3.56	45.6	3.30	-0.3	0.3
Safflower	1.41	0.78	0.47	33.3	0.34	-0.3	0.1
Sunflower	2.92	1.78	0.84	28.8	0.97	-0.9	-0.1
Sesamum	3.12	0.41	0.37	11.9	0.38	0.0	0.0
Linseed	2.99	3.14	2.91	97.5	3.08	-0.2	-0.2
Total Oilseeds (Nine)	78.82	75.74	74.12	94.0	74.72	-1.6	-0.6
All-Crops	632.98	55.66	571.84	90.3	536.35	17.2	35.5

Source: Crops & TMOP Divisions, DAC&FW

TABLE 2: Growth of GVA at Basic Prices by Economic Activity and GDP at Market Prices (percent)

Sectors	Growth rate at constant (2011-12) prices (percent)			Share in GVA at current prices (percent)		
	2016-17 2nd RE	2017-18 1st RE	2018-19 PE	2016-17 2nd RE	2017-18 1st RE	2018-19 PE
Agriculture, forestry & fishing	**6.3**	**5.0**	**2.9**	**17.9**	**17.2**	**16.1**
Industry	**7.7**	**5.9**	**6.9**	**29.4**	**29.3**	**29.6**
Mining & quarrying	9.5	5.1	1.3	2.3	2.3	2.4
Manufacturing	7.9	5.9	6.9	16.8	16.4	16.4

TABLE 2: Growth of GVA at Basic Prices by Economic Activity and GDP at Market Prices (percent) -Contd.

Electricity, gas, water supply & other utility services	10.0	8.6	7.0	2.5	2.7	2.8
Construction	6.1	5.6	8.7	7.8	7.8	8.0
Services	**8.4**	**8.1**	**7.5**	**52.7**	**53.5**	**54.3**
Trade, hotel, transport storage	7.7	7.8	6.9	18.2	18.2	18.3
Financial , real estate & prof. services	8.7	6.2	7.4	20.9	21.0	21.3
Public administration, defence and other services	9.2	11.9	8.6	13.6	14.3	14.7
GVA at basic prices	**7.9**	**6.9**	**6.6**	**100.0**	**100.0**	**100.0**
GDP at market prices	**8.2**	**7.2**	**6.8**	**---**	**---**	**---**

Source: National Statistical Office.

Note: 2nd RE: Second Revised Estimates, 1st RE: First Revised Estimates, PE: Provisional Estimates.

TABLE 3: Quarter-wise Growth of GVA and GDP at Constant (2011-12) Prices (percent)

Sectors	2017-18				2018-19				2019-20	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Agriculture, forestry & fishing	**4.2**	**4.5**	**4.6**	**6.5**	**5.1**	**4.9**	**2.8**	**-0.1**	**2.0**	**2.1**
Industry	**0.8**	**6.9**	**8.0**	**8.1**	**9.8**	**6.7**	**7.0**	**4.2**	**2.7**	**0.5**
Mining & quarrying	2.9	10.8	4.5	3.8	0.4	-2.2	1.8	4.2	2.7	0.1
Manufacturing	-1.7	7.1	8.6	9.5	12.1	6.9	6.4	3.1	0.6	-1.0
Electricity, gas, water supply & other utility services	8.6	9.2	7.5	9.2	6.7	8.7	8.3	4.3	8.6	3.6
Construction	3.3	4.8	8.0	6.4	9.6	8.5	9.7	7.1	5.7	3.3
Services	**9.4**	**6.8**	**8.0**	**8.2**	**7.1**	**7.3**	**7.2**	**8.4**	**6.9**	**6.8**
Trade, hotel, transport, communication and services related to broadcasting	8.3	8.3	8.3	6.4	7.8	6.9	6.9	6.0	7.1	4.8
Financial, real estate & professional services	7.8	4.8	6.8	5.5	6.5	7.0	7.2	9.5	5.9	5.8
Public administration, defence and other services	14.8	8.8	9.2	15.2	7.5	8.6	7.5	10.7	8.5	11.6
GVA at basic price	**5.9**	**6.6**	**7.3**	**7.9**	**7.7**	**6.9**	**6.3**	**5.7**	**4.9**	**4.3**
GDP at market prices	**6.0**	**6.8**	**7.7**	**8.1**	**8.0**	**7.0**	**6.6**	**5.8**	**5.0**	**4.5**

Source: National Statistical Office.

TABLE 4: Production of Major Agricultural Crops (1st adv. est.)

Crops	Production (Million Tonnes)					
	2014-15	2015-16	2016-17	2017-18 (Final)	2018-19 (4th AE)	2019-20* (1st AE)
Total Foodgrains	**252.0**	**251.6**	**275.1**	**285.0**	**285.0**	**140.6****
Rice	105.5	104.4	109.7	112.8	116.4	100.4
Wheat	86.5	92.3	98.5	100.0	102.2	--
Total Coarse Cereals	42.9	38.5	43.8	47.0	43.0	32.0
Total Pulses	17.2	16.4	23.1	25.4	23.4	8.2
Total Oilseeds	27.5	25.3	31.3	31.5	32.3	22.4
Sugarcane	362.3	348.4	306.1	379.9	400.2	377.8
Cotton#	34.8	30.0	32.6	32.8	28.7	32.3

Source: DES, DAC&FW, M/o Agriculture & Farmers Welfare.

* Kharif crops only; 1st AE: 1st Advance Estimates; 4th AE: 4th Advance Estimates; # Million bales of 170 kgs. each;

**Data for Wheat is not available.

TABLE 5 : Procurement of Crops (Million Tonnes)

Crops	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20*
Rice#	31.8	32.0	34.2	38.1	38.2	44.4	17.1
Wheat@	25.1	28.0	28.1	23.0	30.8	35.8	34.1
Total	**56.9**	**60.2**	**62.3**	**61.1**	**69.0**	**80.2**	**51.2**

Source: FCI and DFPD, M/o Consumer Affairs, Food and Public Distribution.
*Procurement of rice as on 30.09.2019.
#Kharif Marketing Season (October-September), @ - Rabi Marketing Season (April-March).

TABLE 6: Off-take of Foodgrains (Million Tonnes)

Crops	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Rice	30.7	31.8	32.8	35.0	34.4	22.7
Wheat	25.2	31.8	29.1	25.3	31.5	16.4
Total (Rice& Wheat)	**55.9**	**63.6**	**61.9**	**60.3**	**65.9**	**39.1**

Source: DFPD, M/o Consumer Affairs, Food and Public Distribution.
Note: up to August 2019.

TABLE 7: Stocks of Foodgrains (Million Tonnes)

Crops	1st December, 2018	1st December, 2019
1. Rice	14.8	21.3
2. Unmilled Paddy#	26.7	25.9
3. Converted Unmilled Paddy in terms of Rice	**17.9**	**17.4**
4. Wheat	**30.6**	**35.2**
Total (Rice & Wheat)(1+3+4)	**63.3**	**73.9**

Source: FCI.
#Since September, 2013, FCI gives separate figures for rice and unmilled paddy lying with FCI & state agencies in terms of rice.

Articles

Profiling the Disadvantaged Regions in India from Climate and Income Perspective

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Abstract

Over the time, our country has made impressive strides in the agriculture sector, from a food deficient country to a food surplus country, primarily based on the technological advancements initiated during the sixties. Despite this laudable progress, economic indicators do not show any impressive growth in the income of the farmers across the states and districts. It is a grave irony that the human factor behind agriculture, the farmers, continues to exist in misery, despite continuous rise in production and productivity. The very same farmers are now caught in a double gambit, facing the challenges related with environment along with concerns of marketable agriculture produce. The paper is an attempt to identify the districts facing dual challenges of the environmental distress and poverty. The identified districts/regions must be targeted on a priority basis with specific attention to basic support services, like timely and adequate credit transfer to the farmers, access to cost effective and regular electricity supply along with other inputs for farm operations and development of an efficient and effective marketing system. As per the Doubling Farmers' Income (DFI) committee vision, the focus must be on accurate monetization of agriculture produce which must reach the farmers in timely manner rather than just increasing the agriculture produce. This requires an immediate attention on these double stressed regions having huge untapped potential for transforming the face of Indian agriculture in a real sense.

Keywords: *DFI, agriculture, farmers, climate, income, vulnerable.*

1. Introduction

India has made impressive strides on the agricultural front following the technical and scientific advancements initiated during the sixties. The transformation of India from a stage of food deficient to self-sufficient and from a net importer to a net exporter of agricultural commodities is a matter of great pride. In fact, the outcomes have been implausible, as the country now can take pride of producing about 276 million tonnes of food grains in 2016-17. Alongside, the country is one of the top producers of staple cereals (wheat & rice), pulses, fruits, vegetables, milk, meat and marine fish. The impressive agricultural growth and gains since independence can be credited to the Indian farmers' grit and determination.

Notwithstanding this laudable progress, economic indicators do not show any equal growth in income of the farmers across the states and districts. It is an irony that the human factor behind agriculture, i.e., farmers continues to remain in distress, despite continuous increasing productivity and production. The very same farmers are now caught in the vortex of more serious challenges of sustainability and viability of farming. They face the twin vulnerabilities of risks & uncertainties in production environment and unpredictability of market forces. Low and fluctuating incomes are a natural corollary of a farmer under such debilitating circumstances. The average income of an agricultural household during July, 2012 to June, 2013 was as low as Rs.6,426, as against its average monthly consumption expenditure of Rs.6,223 (NSSO, 2014). Further, there exist wide income inequalities

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across the nation with certain states/regions lagging behind others, and contemporary research shows that they are not converging. Proportion of rural people below poverty line, according to the calculations of the Rangarajan Committee (GOI, 2014) is very high in backward states, like Odisha (47.8 percent), Madhya Pradesh (45.2 percent), Jharkhand (45.9 percent), Chhattisgarh (49.2 percent), Bihar (40.1 percent) and Uttar Pradesh (38.1 percent), compared to a national average of 30.9 percent in 2011-12 (Rangarajan & Dev, 2014).

Another contemporary reality of Indian agriculture is its high vulnerability to climate change. Recent projections of average losses in farmers' income to a tune of 15-18 percent due to climate change, is further projected to escalate to a range of 20 to 25 percent in unirrigated areas. It is a matter of serious concern as only 45 percent of farm land is irrigated in the country (Economic Survey, 2018). However, the vulnerability to climate change is also not uniform across the nation, owing to its large geographical area and variations in resource endowments. The resource endowed states, like Punjab and Haryana are less vulnerable to climatic variations due to high adaptive capacities *vis-a-vis* states having poor resource endowments, like Rajasthan, Bihar and Odisha.

2. Methodology

The prime idea of this study is to identify the districts strained both with the concerns of climate threats and low income. Under the project of National Innovations on Climate Resilient Agriculture (NICRA), assessment of vulnerability across different regions of India was conducted so as to identify regions which were supposed to be more sensitive towards climate change (Rao *et al.*, 2013). The factors of sensitivity, exposure and adaptive capacity were used to obtain a district wise vulnerability index on all India bases where higher values pointed towards higher vulnerability and lower values towards lower vulnerability. Though, the index value is not an absolute quantum of damage or risk due to climate change rather it is only a relative degree of risk between different districts. The research would pave the way for the assessment of susceptibility towards climate change and adaptation planning at the district level.

The study relied on the data on income of agricultural households from various sources (crop farming, livestock, wages & salary, and non-farm business) taken from 70th round of National Sample Survey Office, Ministry of Statistics and Programme Implementation, Government of India. This was the largest national representative survey for analyzing the state of agricultural households in India. The data belonged to the reference year July 2012-June 2013, which is an agricultural year. The survey covered 34,907 agricultural households from 4,529 villages extended to rural areas of all states and union territories. The household income from all the four sources was used for computing the inequality. The district-wise income was computed based on household income data.

The average income of an agricultural household during July 2012 to June 2013 was as low as Rs. 6,426. There exist wide income inequalities across the nation with certain states/regions lagging behind others, and the recent research shows that they are not converging (Pal & Ghosh, 2007) and (Dev, 2017). Based on the NSSO data, poorest districts, in terms of lowest farm income derived from crops and farming of animals were identified. There are certain districts which suffer from twin vulnerabilities of poor income and climate vagaries. These vulnerable districts were identified and termed as "double-stresed districts". The overlapped 150 districts identified through both the methods were studied deeply in terms of various socio-economic and other significant criteria. These are double stressed in regions (in terms of low agricultural household income and climate vulnerability) deserve utmost priority for production technology and income enhancing policy interventions of the government. It is against this backdrop, that the present paper delineates the vulnerable districts from climate and income perspective and analyses in depth the key socio-economic constraints that need to be resolved for ameliorating their income status & enhancing their adaptive capacity so as to reduce their climatic vulnerability. Based on these attributes, states were selected and accordingly different parameters related with them were studied. The identified districts/regions must be targeted on a priority basis with specific attention with respect to basic support services, like timely and adequate credit transfer to the farmers, access to cost effective and regular electricity supply along with other inputs for farm operations and development of an efficient and effective marketing system.The analysis would go a long way in identifying sources of vulnerability that are critical to developing appropriate policy

measures in terms of technologies, investments and policies at the district level. The analysis emphasis more on districts considering the fact that most of the developmental planning and programme implementation is done at district level in India.

2.1. Vulnerable districts from climate and income perspective

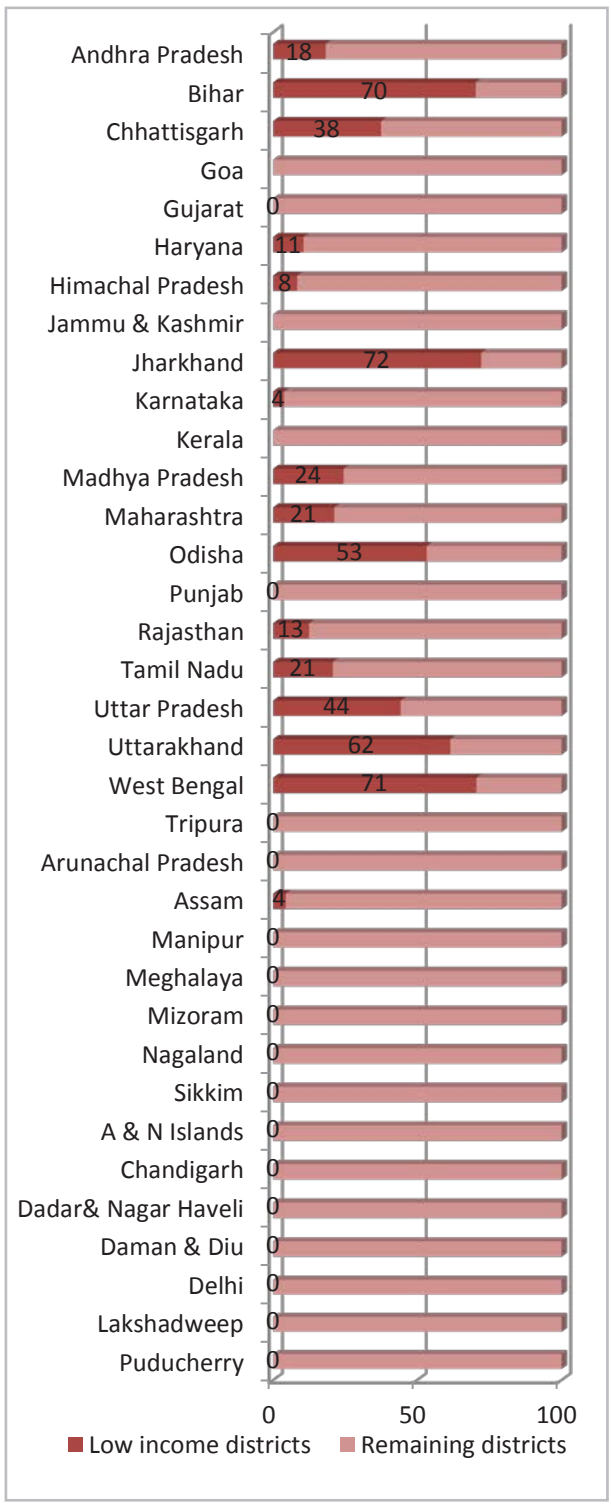
Impending effects of global warming/climate change on agriculture and consequent effects on income and livelihood of farmers has been extensively recognized by scholars across the globe. Several studies have also been conducted in Indian context and significant inverse relation between climate change and farm income has been unanimously established. In one such attempt, Rao *et al*. (2013), assessed vulnerability of agriculture to climate change and variability at district level, considering the fact that most of the development planning and programme implementation are done at district level in India. The vulnerability was assessed with reference to three components, *viz*., exposure, sensitivity and adaptive capacity, and the districts were delineated accordingly. In order to assess vulnerable districts from climate and income perspective, this paper makes a comparison between 150 districts which topped under very high vulnerability status category in Rao *et al*. (2013), with 150 districts showing lowest income status from agriculture as per NSSO (2014).

Figure 1 represents proportion of districts across different states/UTs which are highly susceptible to climate change. It can be seen that most of the districts with very high vulnerability position are in the state of Rajasthan. Interestingly, agriculturally developed states, like Gujarat and Karnataka where proportion of districts falling under low agricultural income category is zero percent and 4 percent, respectively (Fig. 1), are also having major proportion of districts (around 60 percent) under high vulnerability category. Another perspective to look into the income vulnerability is low income from crop and animal farming, i.e., the farm income. The poorest 150 districts in terms of lowest farm income derived from crop and farming of animals as per NSSO (2014) are compared with very high climate vulnerable districts. Interestingly, out of 150, the number of double stressed districts reduced to 29 from the previous 33. A clear inference that can be drawn is that income from farm sources is more prominent than that of non-farm sources in poorer states.

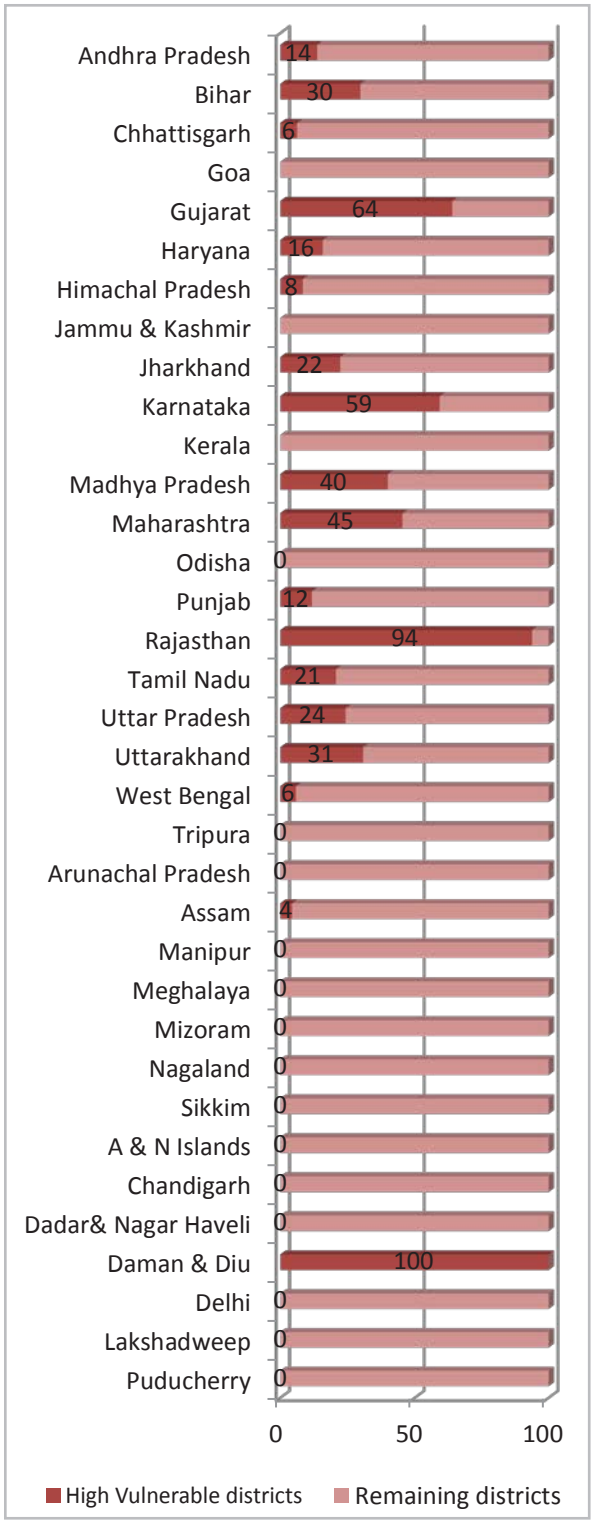
It is observed that percentage of districts falling under category of low farm income in Bihar, Uttar Pradesh and Madhya Pradesh decline when compared with the poor districts based on farmer's income (Fig. 2). It seems that income from crop and livestock is more consistent and prominent than that from non-farm sources, like wages and salary. An enabling environment for people to chip freely in governance ensures more positive outcomes, such as reduction of poverty, famine, and economic development (Singh *et al*., 2014). Special attention needs to be given to these areas in terms of technology package, infrastructure and targeted policy support. On the contrary, income from non-farm sources plays a major role in farmers' income in few southern states like Kerala, Andhra Pradesh and Tamil Nadu, and in hilly states, like Jammu and Kashmir (J&K) and Himachal Pradesh (HP), as indicated by increase in the percentage of districts falling under low farm income status in these states.

Fig.1: Comparison of States/Districts on the basis of Vulnerability and Income Status

A. Distribution of low farmers' income districts



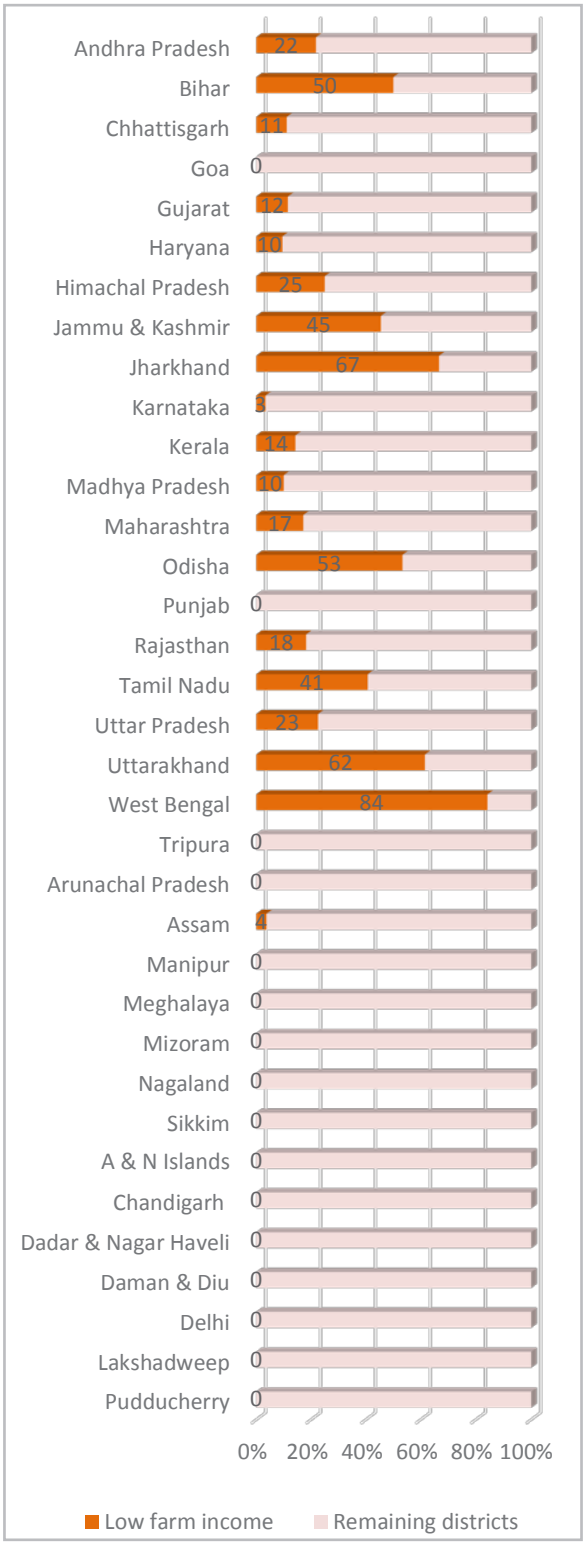
B. Distribution of climate vulnerable districts



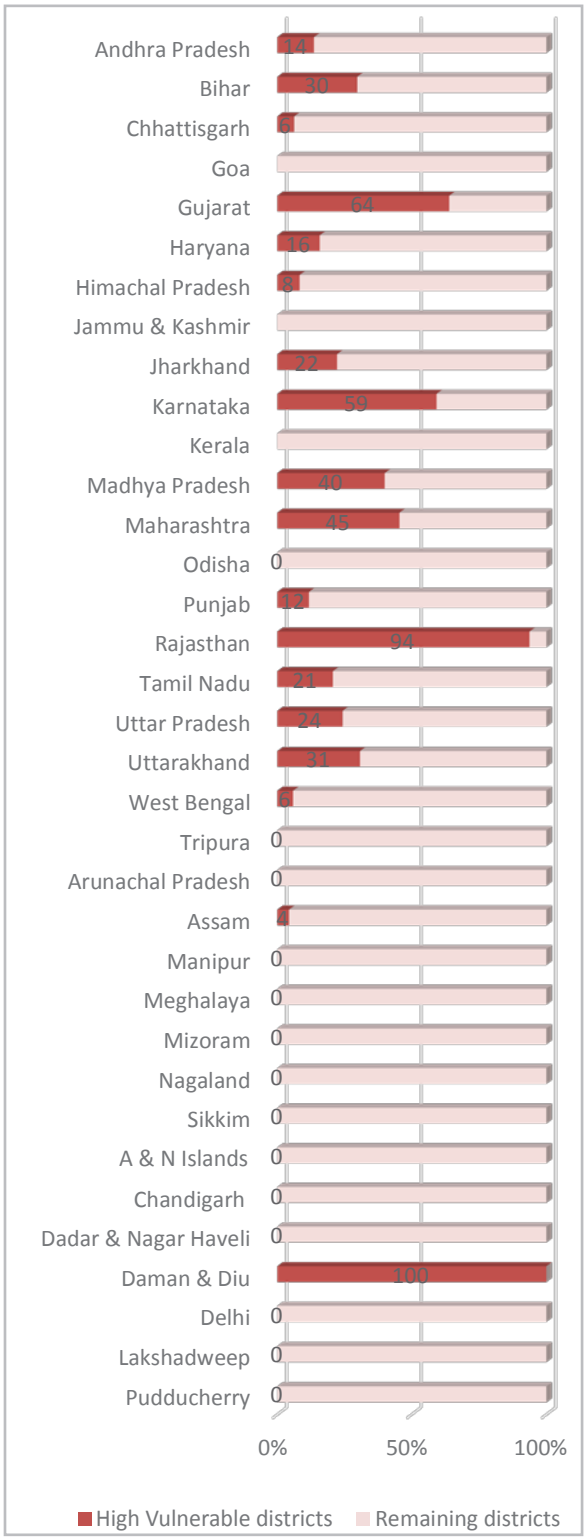
Source: DFI committee estimates.

Fig. 2: Comparison of States/Districts on the basis of Vulnerability and Farm Income Status

A. A. Distribution of low farm income districts



B. Distribution of climate vulnerable districts



Source: DFI committee estimates.

3. Result and Discussion

3.1 Profiling of vulnerable states

This section looks at various attributes of the states which are vulnerable with respect to climate and farmers' income. Based on the number of climatically vulnerable and low income districts emerging in different states, the states have been identified as climate vulnerable and poor income states, respectively. It is noteworthy that the rural population density in the poor income states is far higher than that in climate vulnerable states, except Odisha, these states exceed the national rural average of 296 persons per square km. (Table 1). Literacy rates, both rural and total, in these states, except for Gujarat and Karnataka among climate vulnerable states, and Odisha and West Bengal among poor income states, are also below national average.

TABLE 1: KEY SOCIO-ECONOMIC ATTRIBUTES OF DISADVANTAGED STATES

State	Rural population density (persons per sq. km,)*	Total literacy (%,)*	Rural literacy (%,)*	Share of small holders (%, including marginal farmers)†	Average size of holding (ha.)†	Agriculture household income (Rs.)‡	Dependence on non-farm income (%)‡
Bihar	1005	61.8	59.7	96.9	0.4	3558	43.9
Gujarat	184	78.0	71.7	66.4	2.0	7926	38.6
Jharkhand	323	66.4	62.4	84.1	1.2	4721	44.0
Karnataka	202	75.4	68.7	76.4	1.6	8832	37.4
Madhya Pradesh	175	69.3	63.9	71.5	1.8	6210	23.5
Odisha	230	72.9	70.2	91.9	1.0	4976	45.3
Rajasthan	153	66.1	61.4	58.4	3.1	7350	44.1
Uttar Pradesh	666	67.7	65.4	92.5	0.8	4923	31.0
West Bengal	744	76.3	72.1	95.9	0.8	3980	69.8

* Census of India, 2011; † Agricultural Census, 2011; ‡NSSO, 2014.

The share of small holders in poor income states is quite high with average size of holding ranging from 0.4 hectare in Bihar to 1.2 hectare in Jharkhand (Table 1). Also, except West Bengal, farm is a major source of income in these states. Dependency on non-farm income is quite high (69.8%) in West Bengal, where majority of the farmers have high dependency on wages and salaries.

3.2. Performance of agriculture

The sectoral growth across states has been analysed using the data of gross state domestic product (GSDP) for the two periods, *viz*., 2004-05 to 2010-11 and 2010-11 to 2014-15 (Table 2). Output composition within agriculture sector showed mixed trends. The take-off of agriculture and allied sectors in Madhya Pradesh (17.99 %) and Jharkhand (11.05%) during the recent period (2010-11 to 2014-15) is quite appreciable, and worth emulating by other states. On the contrary, the poor performance of crop and livestock sectors during the same period in Odisha, Rajasthan and Bihar caused slow growth of agriculture and allied sectors. Strategic focus of the stakeholders to revive the growth of agriculture, particularly, that of crop and livestock activities is required in these states. The promotion of allied activities having geographical advantages, for example fisheries in Odisha, would be an effective policy intervention in this direction.

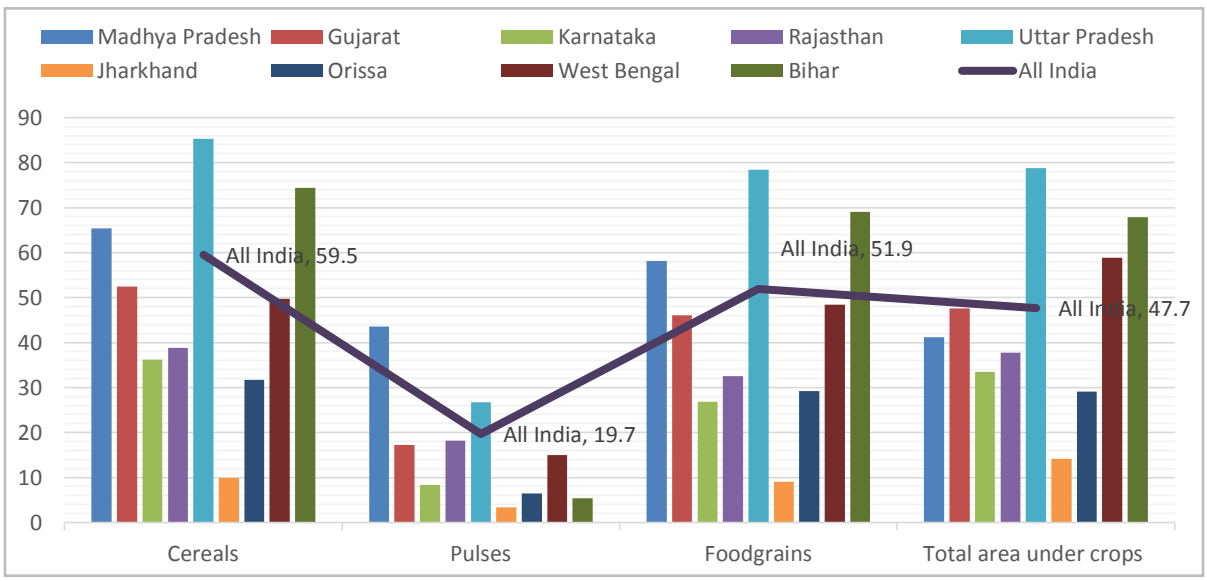
TABLE 2: GROWTH IN GSDP OF AGRICULTURE AND ALLIED SECTORS IN DOUBLE STRESSED STATES (CAGR %)

State	Crops and livestock sector		Fisheries		Agriculture and allied sector	
	2004-05 to 2010-11	2010-11 to 2014-15	2004-05 to 2010-11	2010-11 to 2014-15	2004-05 to 2010-11	2010-11 to 2014-15
Bihar	4.57	3.75	1.79	12.61	3.77	3.74
Gujarat	4.92	5.83	3.53	3.15	4.35	5.47
Jharkhand	6.90	12.79	18.13	12.62	6.48	11.05
Karnataka	6.07	2.97	10.54	2.06	5.97	2.98
Madhya Pradesh	4.61	19.43	1.47	12.85	4.28	17.99
Odisha	4.07	-0.23	4.26	8.95	3.67	0.32
Rajasthan	6.08	1.77	8.80	7.77	5.54	1.77
Uttar Pradesh	2.65	3.82	7.29	3.66	2.67	3.69
West Bengal	2.10	1.86	3.96	3.20	2.39	2.72
All India	**3.64**	**5.10**	**4.57**	**7.21**	**3.52**	**4.94**

3.3. Irrigation status

Empirical evidences across the country suggest existence of direct relationship between irrigation and productivity of crops. Besides, irrigation has demonstrated its potential to shield the crop from the impact of warming, thus, addressing the allusions of climate change. Yet, ironically, most of the cultivated area in the country is still rainfed. Among the double stressed states, majority have below national average of irrigated land (Figure 3). The case of Jharkhand and Odisha is worth noticeable, where the irrigation percentage under total crops is as low as around 14 percent and 29 percent, respectively.

Figure 3: Percentage Coverage of Irrigated Area, 2013-14.



Source: Agriculture Statistics at a Glance, 2016.

It is interesting to note that Madhya Pradesh (MP) has an extensive area of pulses under irrigation, which probably is the reason in making it a leading pulse producing state of the country. Apart from that, irrigated area under cereals and food grains in MP is also well above the national average, propelling the agricultural growth of the state in recent years. The state set a case for other states, particularly for low income states, like Bihar and West Bengal, where cultivation of pulses and cereals under irrigated

environment is limited. Therefore, strategy for bringing more area under irrigation coverage will be imperative for stimulating the agricultural growth and enhancing the resilience to climatic stress, thus enhancing and sustaining the farmers' income. Tapping of different water sources alongwith water conservation should obtain priority attention. More importantly, enhancing water use efficiency should be given emphatic policy support besides research focus, as the cross-country comparison shows that India's water use efficiency is 2-3 times lower than that in the neighbouring nation China (NITI Aayog, 2015). This shows that irrigation coverage can be doubled by achieving the efficiency level in water use. This suggests the need for adopting a comprehensive approach to water management. Important interventions include large scale micro-irrigation system (drip & sprinkles), agronomic practices, like mulching and crop alignment.

Table 3 clearly brought out the fact that the actual area under both drip and sprinkler irrigation system in the double stressed states is far less than the potential area. The state of Andhra Pradesh has set a case by utilizing more than 100 percent of the potential under micro-irrigation (DFI committee report, 2017). Further, empirical studies across the country unanimously reported that micro-irrigation through its efficient cost saving and yield enhancing potential creates a win - win situation for the farmers.

TABLE 3: STATUS OF POTENTIAL AND ACTUAL AREA UNDER MICRO IRRIGATION AS ON 31ST MARCH 2017

(Million hectares)

State	Drip irrigation		Sprinkler irrigation		Total	
	Potential	Actual	Potential	Actual	Potential	Actual
Bihar	0.14	0.01	1.71	0.10	1.85	0.11
Gujarat	1.6	0.55	1.68	0.58	3.28	1.13
Jharkhand	0.04	0.01	0.11	0.01	0.16	0.02
Karnataka	0.75	0.51	0.7	0.53	1.44	1.05
Madhya Pradesh	1.38	0.26	5.02	0.21	6.39	1.05
Rajasthan	0.73	0.21	4.93	1.57	5.66	1.78
Uttar Pradesh	2.21	0.02	8.58	0.05	10.79	0.07
West Bengal	0.95	0.00	0.28	0.05	1.23	0.05

Source: Government of India (2017).

One such impact study of National Mission on Micro-Irrigation in 2014 reported that the usual productivity of fruits and vegetables has increased by about 42.3 percent and 52.8 percent, respectively, mainly because of crop spacing and cautious use of water (Table 4). The overall benefits that accumulated from the micro-irrigation system are reflected in the income augmentation of the farmers. Therefore, it is right time to accelerate the pace of coverage under micro-irrigation, by targeting realisation of 100 percent potential, especially in the disadvantaged states and districts. This can play a critical role in enhancing the farmers' income.

TABLE 4: IMPACT OF MICRO-IRRIGATION ACROSS STATES

State	Increase in productivity (%)		Decrease in cost of irrigation (%)	Electricity saving (%)	Fertilizer saving (%)
	Fruits	Vegetables			
Bihar	15.18	31.62	28.60	40.00	7.59
Gujarat	73.48	68.59	49.30	39.92	42.73
Karnataka	28.20	29.00	24.70	26.75	28.21
Odisha	34.97	28.19	26.50	22.46	20.90
Uttar Pradesh	34.14	30.71	27.60	18.43	22.77
Total	**42.34**	**52.76**		**30.65**	**28.48**

Source: Impact evaluation report by global agri-system.

3.4. Fertilizer use status

Fertilizer along with seed and irrigation constitute key inputs of the agriculture production system, which have played significant role in enhancing production and productivity of the crops since independence. It is expected that these inputs will continue to play major role in meeting the potential demand of food, feed and fibre. Agro-chemicals as fertilizers are not only costly, but tend to have deleterious effect on the soil health in the long run. Hence, balanced nutrient management based on evaluation of soil nutrient status is important. In this regard, it would be beneficial to derive full advantage of Soil Health Card (SHC) scheme of the government, and also adopt Integrated Nutrient Management (INM), under which organic manures are also used extensively.

A recent study by Chand & Pavithra (2015), has estimated the normative ratio of NPK (Nitrogen: Phosphate: Potassium) for India and its states, based on the current cropping pattern (Table 5). The study indicated huge imbalance between the actual and normative use of fertilizer in the country, especially across the disadvantaged states. As the normative ratio varies widely across the states due to the fertility status and current cropping pattern of the concerned states, the fertilizer promotion and policy should be state-specific, with an objective of achieving recommended dosage of NPK use, in synchronization with package of practices.

TABLE 5: ACTUAL AND NORMATIVE RATIO OF NPK USE (2009–11)

States	Actual ratio			Normative ratio		
	N	P	K	N	P	K
Bihar	6.79	1.95	1	2.81	1.5	1
Gujarat	6.89	2.78	1	2.73	0.99	1
Jharkhand	7.20	3.31	1	1.99	1.2	1
Karnataka	2.60	1.69	1	1.6	1.01	1
Madhya Pradesh	8.90	6.14	1	2.41	2.63	1
Odisha	3.79	1.88	1	1.78	1.01	1
Rajasthan	25.08	11.18	1	10.3	5.72	1
Uttar Pradesh	11.14	3.88	1	2.96	1.32	1
West Bengal	1.98	1.29	1	1.85	1	1
All India	**5.04**	**2.35**	**1**	**2.55**	**1.42**	**1**

Source: Chand & Pavithra (2015).

3.5. Access to support and infrastructure

Government support in terms of infrastructure and other facilities is crucial, in not only making agriculture a profitable enterprise for farmers but also in enhancing their adaptive capacity, and thereby, reducing their susceptibility to climate change. The Government has embarked upon a laudable mission of doubling farmers' income by 2022. This entails adoption of income approach in preference to production focused policy, and the implication is the need to address all issues along the entire agricultural value system. Important interventions needed are higher credit availability, enhanced capital investments (in land development, farm machinery, roads, electricity, markets, etc.) for agriculture and more efficient post-harvest management (storage, transportation, and marketing), besides effective risk management.

Constructive role of credit in raising agricultural productivity is well-documented. While, short-term loans generally help in reaping better output through timely and adequate use of farm inputs, medium and long-term credit help in establishment of farm assets such as construction of farm houses, deepening of wells and bore wells, and purchasing of machineries like tractors. In short, access to credit positively influences investment decisions of the farmers in agriculture. Table 6 depicts the share of indebted agricultural households across the disadvantaged states, which in turn portrays shares of the households that accessed credit through various institutions. The credit access among the farmers of these states, except

for Karnataka, Rajasthan and Odisha, is below the national average of around 52 percent. The situation is far more serious in Jharkhand, where only around 28 percent of the agricultural households accessed credit. This indicates the need for strengthening of credit institutions in these poorly served states by addressing the key constraints faced by these institutions, besides increasing awareness among the farmers regarding availability of different types of institutional farm credits in these states. Expanding credit, especially in the visibly emerging states, like Bihar and MP that are converging faster with the high productivity states, can substantively help in realizing better income to the agricultural households.

TABLE 6: ACCESS TO GOVERNMENT SUPPORT AND BASIC INFRASTRUCTURE

State	Indebted agricultural households (%)*	Proportion of unelectrified rural households (As on 30-04-2017)†	Number of regulated market per lakh gross cropped area (As on 31.03.2015)‡
Bihar	42.5	55	-
Gujarat	42.6	0	3.2
Jharkhand	28.9	60.3	12
Karnataka	77.3	12.6	4.2
Madhya Pradesh	45.7	40.4	2.2
Odisha	57.5	45.7	8.4
Rajasthan	61.8	24.5	1.7
Uttar Pradesh	43.8	51.5	2.4
West Bengal	51.5	0.9	5
All India	**51.9**	**26**	

Source: *Based on Key Indicators, SAS 2012-13, †Deendayal Upadhyaya Gram Jyoti Yojana (Scheme of Govt. of India for rural areas), ‡Directorate of Marketing and Inspection.

The status of electricity in the rural areas of these states is also below par particularly in Jharkhand, Bihar and Uttar Pradesh where more than 50 percent of the rural households are still without electricity. Strategic efforts of the state government in co-ordination with central government and private players would be crucial to emulate the case of Gujarat and West Bengal, where almost all the rural households have access to electricity. Well-organized marketing system and other supportive infrastructure are crucial for the growth of the agricultural sector as they provide outlets and incentives for increased production. They facilitate more cost-efficient input and output management. An efficient and effective marketing system can facilitate the farmers-producers to acquire the true value of their produce, and help in earning higher net returns. This will lead to better profile & better farm incomes, and create a virtuous cycle of higher savings, higher farm investments and enhanced productivity & returns.

The committee on DFI (2018) has recommended a new market architecture comprising 22,000 number of retail agricultural markets in close proximity to farm gates, alternate primary wholesale agricultural markets (APMCs in both cooperative and private sectors), and facilitative agro-export system. A robust market structure that promotes transparency and competition in price discovery on farmers produce is a pre-requisite to monetisation in favour of the farmers. Reforms in agricultural marketing deserve emphasis. In this context, the states must adopt the Model Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act, 2017; electronic National Agricultural Market (eNAM), an online trading platform; and establishment of Gramin Agricultural Markets (GrAMs). The pace of adoption needs acceleration for quick results.

3.6. Double Stressed Districts

For a more focussed policy intervention on priority basis, the double stressed districts in terms of farm & farmer's income and climate vulnerability are enlisted hereunder (Table 7). These districts are highly susceptible and disadvantaged in terms of double stress instigated from low income as well as high climate variability.

TABLE 7: DOUBLE STRESSED DISTRICTS IN TERMS OF CLIMATE VULNERABILITY AND INCOME

State	Based on climate variability and farm income	Based on climate variability and farmers' income
Assam		Karbi-Anglong.
Bihar	Madhubani, Araria, Bhagalpur Gopalganj, Saran, Saharsa, Siwan.	Kishanganj, Madhubani, Araria, Darbhanga, Supaul, Bhagalpur, Saran, Saharsa, Siwan.
Chhattisgarh	Bijapur.	
Gujarat	Surendranagar.	
Himachal Pradesh	Hamirpur.	
Jharkhand	Godda, Sahibganj.	Godda, Sahibganj.
Madhya Pradesh	Ratlam, Mandla.	Dindori, Ratlam, Sidhi.
Maharashtra	Jalna, Aurangabad.	Aurangabad.
Rajasthan	Nagaur, Jaisalmer, Pali, Udaipur Dungarpur, Banswara.	Jaisalmer, Dungarpur, Banswara, Udaipur.
Tamil Nadu	Ramanathapuram.	Perambalur, Dharmapuri, Ramanathapuram.
Uttar Pradesh	Banda, Deoria, Ballia.	Chitrakut, Banda, Hamirpur Ballia, Deoria, Shravasti.
Uttarakhand	Chamoli, Bageshwar, Almora.	Bageshwar, Tehri, Garwal, Almora.
West Bengal		Malda.

Source: DFI committee, 2017.

Special programmes need to be designed to support these disadvantaged districts. It would be appreciable if State Agriculture Universities (SAUs), Krishi Vigyan Kendra (KVKs) and ICAR centres adopt these districts and work in coalition with state agricultural extension agencies and line departments. They need to prepare a long term road map for transformation of agriculture based on comprehensive agricultural value system. This further needs to be segregated into annual/seasonal action plans and should be monitored closely. New production technologies & management practices that respect integrated farming system principles will have to be encouraged. More importantly, sustainability and marketing linkages will need attention. The supportive infrastructure comprising roads, irrigation, electricity, storage, transportation must be taken care of. Considering that a large percentage of arable land will continue to be rainfed agriculture, appropriate rainfed technologies must be identified & promoted.

It would also be necessary to consider the implications of climate change, in terms of impact on seasons and yield, and adopt both coping and adaptation interventions. The farmers need to be supported through capacity building and appropriate farm technologies & practices.

4. Conclusion and Suggestions

This paper presents in-depth picture of major socio-economic and agricultural attributes of disadvantaged regions/states/districts of the country in terms of farm & farmers' income and climate variability. On the basis of research done, following conclusions can be drawn:

First, these states suffer from intertwined problem of high population density and low literacy. Smallholders' share in climate vulnerable states is very less as compared to low income states. This is because of adverse impact of climate being relatively more on small holding farmers. Income from farm sources is more prominent in poorer states than that of non-farm sources.

Second, growth of agriculture and allied sectors

over the past decade reflects a mixed trend in these states. However, impressive performance of the sector in MP and Jharkhand during recent period (2010-11 to 2014-15) is emblematic across all the disadvantaged states/districts. There is need to identify the crucial factors behind these inspiring growth figures and those should be replicated for accelerating the holistic growth of agriculture and allied sectors in all these disadvantaged states and districts.

Third, some of the activities that need focused policy support encompass soil & water conservation, area-specific rainfed agricultural technology, increasing area under irrigation by tapping all sources including small irrigation structures, promoting water use efficiency through micro-irrigation systems, crop alignment, balanced nutrient management, integrated nutrient management and efforts to reduce cost of inputs through better technology & management practices. Balancing the use of fertilizer as per the normative ratio will be another critical step in minimizing the cost of production, and enhancing as well as sustaining the agricultural production and income from the farm. Suitable coping and adaptation measures to negotiate climate change induced risks must also be incorporated.

Fourth, these states need priority attention with respect to basic support services, like timely and adequate credit delivery to the farmers, access to cost effective and continuous electricity supply for farm operations and creating an efficient and effective marketing system. Given that financial resources are always under stress due to competing alternate demands, the disadvantaged states will need to prioritise the disadvantaged districts and converge resources from different streams and focus on their efficient use in strict accordance with the roadmap adopted.

Fifth, as of now, the density of population engaged in agriculture is high causing disguised unemployment and under-employment. Robust manufacturing & service sectors can absorb the surplus labour in agriculture, and can support efforts to increase average income of the agricultural households even in disadvantaged districts.

Finally, enhancing the farmers' income to achieve the doubling mission requires a complete transformation of agricultural units to agricultural enterprises. This necessitates the prior attention on these double stressed regions which are having huge untapped potential for transforming the face of Indian agriculture. It will also contribute in reducing the existing inter-district and inter-state disparities and will be a firm step towards equitability. As concerted efforts are made to improve productivity, gross output and gross returns, while reducing cost of production the critical importance of the growth of manufacturing & service sectors cannot be underestimated.

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Trends in Area, Yield and Production of Major Oilseeds in Punjab: District-wise Analysis

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Abstract

Due to the advent of green revolution in mid-sixties, the agricultural landscape has undergone a major change from a well diversified cropping pattern to monoculture of paddy-wheat rotation in the state of Punjab and resulting into various ecological, hydrological, environmental degradations. The cultivation of various other crops including oilseeds has almost disappeared from the cropping map in the state. In the present study, efforts have been made to examine the area, production and yield trends of various oilseeds during the last five decades in Punjab. Statistical tools such as mean, coefficient of variance, compound growth rate and student's t-test were applied to check the significant difference in the trends in area, production and yield using compound growth rates. It has been observed that in all the major oilseeds, namely rapeseed-mustard, groundnut, sunflower and sesamum, the growth rates of area and production was negative and significant, whereas, growth rates of yield has been found positive and significant in all the oilseeds except sesamum across the various districts of the state. The policy measures such as developing high-yielding variety seeds, ensuring remunerative procurement prices, building requisite market infrastructure and strengthening extension services can go a long way to broad-base the production of oilseeds in Punjab.

Keywords: *Punjab, oilseeds, production, yield, area, cultivation.*

1. Introduction

Punjab has emerged as a most agriculturally advanced state of the country with the passage of time and it has earned the crown of 'food bowl' of India, due to its marvelous performance in production of cereals during last five decades. Undoubtedly, Punjab had played a very notable role in making India self-sufficient in production of food grains with its enthusiastic execution of green revolution but being an early adopter of this revolution this state has not only became a victim of it but also facing a de-arrangement of agricultural balance.

Execution of green revolution in the state may have added a very supercilious feather in the achievement basket of the state in early stages but with passage of time it transited the situation into a matter of concerns for many agriculturists. The shift in production of cereal crops changed the diversified cropping pattern of the state into monoculture of wheat and paddy. Due to this switch, several crops were got affected and cropping pattern of the state changed (Singh *et al.,* 2017). This conversion led to the decline in production and area under oilseeds in the state. Area under oilseeds was about 4 percent of total cropped area in 1961, which came down to 0.53 percent in 2017 (Sekhon, 2014). A decline of about 82.27 percent in area under oilseeds was observed in last five decades indicating the disappearance of oilseeds cultivation from the cropping map of the state. This decline in area and production of oilseeds at national as well as state level became a matter of concern for the government. The gap between demand and supply of oilseeds was widening year by year. To cover-up this gap Indian government was paying huge amount to import edible oils and oilseeds (Grover *et al.,* 2007a). This gap widened up in 2016 when demand for oilseeds was 24 million tonnes, of which only 9 million tonnes was met from domestic production and rest of this demand was fulfilled by paying around Rs.65000 crore, constituting around 2.5 percent of India's total import bill (Ghoshal, 2017). To counter this problem, Government of India has launched several programmes since 1980s , one of such programmes is National Mission on Oilseeds and Oil Palm (NMOOP) which is under progress in the state of Punjab also.

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In 2017-18 for the implementation of NMOOP, Government of India (GOI) and Punjab contributed share in the ratio of 60:40 to promote oilseeds and oil palm. Out of total sanctioned amount about 97 lakh of rupees have been sanctioned with the objective to reduce the area under cereal crops and to utilize the land after paddy and potato cultivation and to bring back the diversification scenario in state.

1.1. Objectives of the study

To analyze the changing production trends of major oilseeds, a district-wise analysis has been undertaken with following objectives:

i. To analyze district-wise transformation of area, production and yield among major oilseeds of Punjab.

ii. To formulate policy implications for the expansion of oilseeds base in Punjab.

2. Methodology

To analyze the growth trends of area, production and yield of four major oilseeds (rapeseed-mustard, groundnut, sunflower and sesamum) of Punjab, secondary data was collected from Statistical Abstract of Punjab pertaining to years 1965-66 to 2017-18. Data was analyzed using various statistical tools such as mean, coefficient of variance, compound growth rate and student's t-test.

Following equation was used for estimation of compound growth rates (CGRs) of area, production and yield of various crops:

$$Y = ab^t$$

Where, Y= dependent variable
a = constant term
b = (1+r), regression coefficient
r = (b-1)*100, compound growth rate in percentage
t = time variable

and student's t-test was also applied to check significant difference in the trends in area, production and yield using compound growth rates.

3. Results and Discussion

A district-wise analysis of growth rates and variability among area, production and yield of major oilseeds (rapeseed-mustard, groundnut, sunflower and sesamum) grown in Punjab during the last five decades, i.e., 1965-66 to 2017-18 has been presented in Tables 1 to 4. Table 1 focuses on the change in growth rate in production trends and variability over the years among various districts as well as in Punjab as a whole. Growth rate trends of production were declining in almost all districts of Punjab except Kapurthala, Hoshiarpur, Gurdaspur and Ludhiana having positive growth rate of 3.02%, 3.42%, 0.99% and 1.09%, respectively. In case of area, only Kapurthala and Hoshiarpur shown a positive increase of 1.46 and 1.34 percent, respectively. Growth rates in terms of yield were observed positive and significant in almost all districts of Punjab, but it was highly positive and significant in Rupnagar (6.33%). Despite of increase in productivity, production was negative in almost all districts and at state level also due to continuous fall in area under crop (Goyal, 2017). The highest decline in area was observed in Faridkot, followed by Amritsar and Bathinda but yield was positively significant in these districts. In case of coefficient of variation of production variables, it was highest in area and lowest in yield. It was observed that variation in area was highest in Amritsar (162.01%) and lowest in Gurdaspur (27.08%). Variability in terms of production and yield was highest in Faridkot (104.57%) and Kapurthala (112.00%), whereas it was lowest in Gurdaspur (33.36 %) and (30.04%), respectively. Thus, variation in area was turned out to be more as compare to yield in rapeseed-mustard crop amongst various districts of the state. On the state level, decline in area and production was significant, on the contrary, it was positive and significant in yield due less increment in production than area. In case of variability, it turns out to be comparatively more in area and production than in the yield.

TABLE 1: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF RAPESEED-MUSTARD CROP IN PUNJAB, 1965-66 TO 2017-18

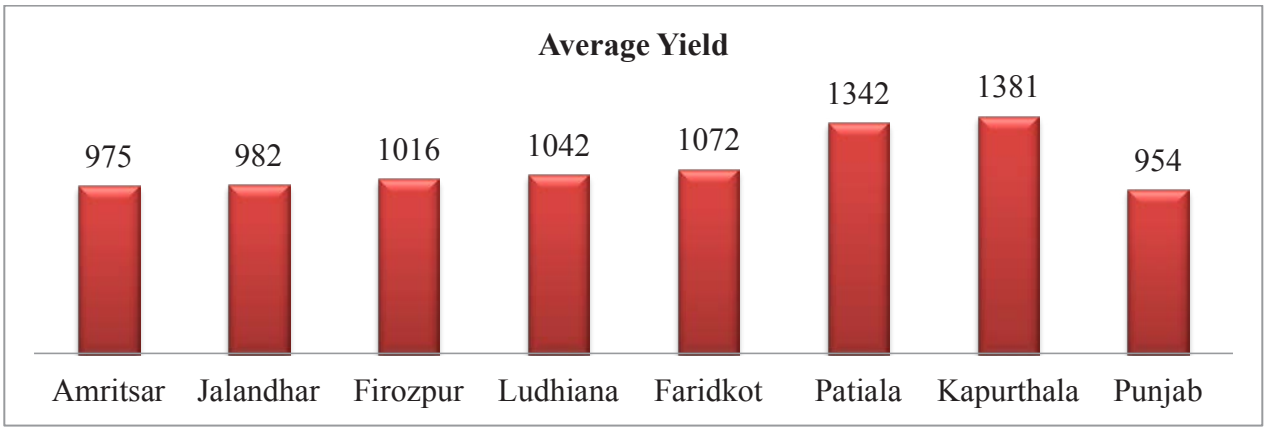
District	Variable	Mean	CV (%)	CGR (%)
Amritsar	Area	18.91	162.01	-7.30*
	Production	13.30	94.94	-5.60*
	Yield	975.21	35.99	1.84*
Bathinda	Area	19.12	78.34	-6.05*
	Production	14.01	65.51	-3.90*
	Yield	943.77	39.80	2.29*
Faridkot	Area	7.62	110.07	-10.63*
	Production	6.34	104.57	-9.04*
	Yield	1072.29	31.06	1.80*
Firozpur	Area	16.28	62.15	-5.59*
	Production	15.08	68.65	-3.73*
	Yield	1016.02	35.54	1.97*
Gurdaspur	Area	3.27	27.08	-0.71*
	Production	2.81	33.36	0.99**
	Yield	876.22	30.04	1.70*
Hoshiarpur	Area	2.84	42.10	1.34**
	Production	2.42	67.46	3.42*
	Yield	943.44	108.44	1.61*
Jalandhar	Area	2.99	62.46	-2.39*
	Production	2.80	67.79	-0.41
	Yield	981.68	33.92	2.03*
Kapurthala	Area	0.96	68.53	1.46**
	Production	1.09	77.23	3.02*
	Yield	1381.30	112.00	1.54**
Ludhiana	Area	2.19	51.50	-0.70
	Production	2.26	62.02	1.09***
	Yield	1041.73	39.84	1.80*
Patiala	Area	3.88	76.02	-4.34*
	Production	2.78	78.40	-1.62*
	Yield	1342.47	76.93	-1.47*
Rupnagar	Area	2.36	90.63	-0.15
	Production	1.81	92.93	1.71*
	Yield	881.54	101.35	6.33*
Sangrur	Area	5.38	72.33	-4.09*
	Production	4.31	60.67	-2.31*
	Yield	934.52	30.70	1.85*
Punjab	Area	84.05	51.57	-3.10*
	Production	71.93	44.76	-1.21*
	Yield	954.20	29.39	1.96*

Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Area in'000 ha, Production in '000 tonnes and Yield in Kg/ha.

*, **, *** indicate significance at 1, 5 and 10 percent level, respectively.

Fig.1: High Yield Intensive Districts of Rapeseed-mustard in Punjab, 1965-66 to 2017-18 (kg/hectare)



Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Figure 1 depicts the high yield intensive districts in comparison to state's average yield. It was found that there are seven such districts out of total twelve sampled, namely Amritsar, Jalandhar, Firozpur, Ludhiana, Faridkot, Patiala and Kapurthala. Among these districts the average yield of Kapurthala (1381 Kg/ha) was highest. This figure gives us a clear picture of those districts on which we can concentrate to increase the production of rapeseed-mustard by increasing its area under crop because of their high yielding potential.

Production trends of groundnut and its variation overtime has been analyzed and presented in Table 2. It was observed that production trends of groundnut were gradually declining over time. Growth rate of production was negative in almost all districts except in Hoshiarpur having positive and significant increase of 0.81%. It was found that growth rate of area was negative and significant in almost all districts of Punjab which reflects the decline in area under the crop over the years in the state (Grover *et al.*, 2007b). The highest and significant decline in area was observed in Ludhiana (-17.50) district whereas, it was lowest in case of Hoshiarpur -0.05% indicating the minimum decline under area during the last five decades. The growth rates of yield were also declining among almost all districts of the state (Grover *et al.*, 2007b). The highest and significant decline of -2.30% in yield was observed in Patiala. But, on the other hand, it turned out to be positive in Faridkot, Hoshiarpur, Ludhiana and Rupnagar districts with 0.63%, 0.86%, 0.31% and 0.51% increase, respectively. On the contrary, it was observed that the growth rate of area was lower than production and yield of the crop at all India level (Gayathri, 2018). Coefficient of variation in area was quite higher in Jalandhar and Rupnagar and lower in Hoshiarpur at about 126 percent and 34 percent, respectively. In case of yield, variability was quite low in comparison to area and production, as it turns out to be the highest in Faridkot (58%) and lowest in Kapurthala (23%). In Punjab, growth rate in area and production was negative and significant while, it was in reciprocated position in case of yield.

TABLE 2: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF GROUNDNUT CROP IN PUNJAB, 1965-66 TO 2017-18

District	Variable	Mean	CV (%)	CGR (%)
Bathinda	Area	0.97	104.42	-5.39*
	Production	1.03	125.13	-6.04*
	Yield	982.42	37.84	-0.69
Faridkot	Area	0.54	103.86	-0.76*
	Production	0.49	114.55	-6.98*
	Yield	917.00	58.00	0.63

TABLE 2: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF GROUNDNUT CROP IN PUNJAB, 1965-66 TO 2017-18 -CONTD.

District	Variable	Mean	CV (%)	CGR (%)
Firozpur	Area	0.57	160.4	-6.91*
	Production	0.85	194.78	-8.00*
	Yield	1279.52	94.83	-1.16***
Hoshiarpur	Area	2.56	34.11	-0.05
	Production	2.51	30.66	0.81***
	Yield	1069.14	37.48	0.86*
Jalandhar	Area	7.12	126.36	-15.74*
	Production	7.00	134.10	-15.76*
	Yield	921.74	25.38	-0.03
Kapurthala	Area	5.69	100.34	-15.38*
	Production	6.39	104.34	-16.01*
	Yield	1011.40	22.69	-0.74*
Ludhiana	Area	21.46	122.79	-17.50*
	Production	21.16	130.31	-17.24*
	Yield	1070.51	51.40	0.31
Patiala	Area	10.82	115.26	-17.53*
	Production	10.99	120.54	-19.42*
	Yield	839.42	37.85	-2.30*
Rupnagar	Area	3.80	126.04	-14.98*
	Production	3.06	128.94	-14.55*
	Yield	869.63	23.25	0.51***
Sangrur	Area	13.83	102.13	-13.99*
	Production	13.38	99.36	-14.00*
	Yield	1019.28	26.19	-0.01
Punjab	Area	58.66	121.90	-10.64*
	Production	57.69	123.99	-9.87*
	Yield	1085.85	31.56	0.86*

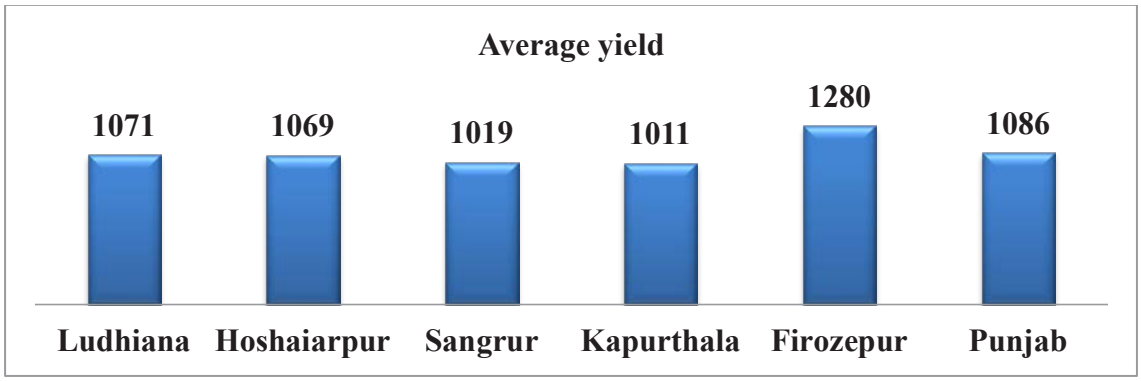
Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Area in'000 ha, Production in '000 tonnes and Yield in Kg/ha.

*, **, *** indicate significance at 1, 5 and 10 percent level, respectively.

Figure 2 highlights high yield concentrated district for the groundnut crop. It was found that only Firozpur district was yield intensive as compared to Punjab's average yield. In addition, some other districts have shown average yield, close to state's average yield such as Ludhiana, Hoshiarpur, Sangrur and Kapurthala. Among these districts Ludhiana (1071 Kg/ha) turned out as much closer to Punjab's average yield (1086 Kg/ha) during the last five decades. This figure gives us a clear indication for broad-base of production of groundnut by putting special attention on this identified yield intensive pocket in the state.

Fig.2: High Yield Intensive Districts of Groundnut in Punjab, 1965-66 to 2017-18 (kg/hectare)



Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Table 3 depicts the trends of growth rate and coefficient of variation in area, production and yield of sunflower crop in selected districts of Punjab. It is understood from the table that growth trends of production and area was positive only in Fatehgarh sahib and Gurdaspur districts (Singh *et al.*, 2009a). It indicates that area under sunflower cannot be increased to desired level owing to its less profitable character in comparison to its competing crop. It was observed that production growth rate was highly negative and significant in Faridkot (-53.94%) and Firozpur (-40.95%), on the contrary, it was positive in Gurdaspur (3.95%) and Fatehgarh sahib (5.06%) only. In case of yield, it was positive and significant only in Hoshiarpur, Kapurthala, Ludhiana and Patiala, whereas, it was highly negative and significant in Gurdaspur (-13.86%) and in Firozpur (-5.44%). The variability in area was highest (169.97%) in Amritsar, whereas lowest (55.29%) in Firozpur. In case of yield variation, it was lowest in Jalandhar (9.36%) and highest in Gurdaspur (187.42%). At state level, growth rates of area and production was negative and significant, whereas, in case of yield it was positive and significant. Variability in production and area was much higher than that in yield in state as well as among districts.

TABLE 3: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF SUNFLOWER CROP IN PUNJAB, 1993-94 TO 2017-18

District	Variable	Mean	CV (%)	CGR (%)
Amritsar	Area	3.44	169.97	-16.29*
	Production	6.33	153.08	-18.65*
	Yield	2442.59	145.31	-2.82
Faridkot	Area	6.10	92.49	-51.29*
	Production	8.21	93.01	-53.94*
	Yield	1224.83	14.41	-5.43*
Fatehgarh sahib	Area	0.98	57.67	5.12
	Production	1.78	63.02	5.06
	Yield	2046.19	96.05	-0.06
Firozpur	Area	3.29	55.29	-37.55*
	Production	4.33	60.28	-40.95*
	Yield	1206.21	19.45	-5.44**
Gurdaspur	Area	1.74	85.58	20.68
	Production	3.07	69.83	3.95
	Yield	5035.54	187.42	-13.86

TABLE 3: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF SUNFLOWER CROP IN PUNJAB, 1993-94 TO 2017-18-CONTD.

District	Variable	Mean	CV (%)	CGR (%)
Hoshiarpur	Area	6.27	119.22	-11.70*
	Production	10.72	119.84	-11.28*
	Yield	1728.49	12.58	0.48*
Jalandhar	Area	6.47	79.63	-8.55*
	Production	10.87	85.72	-8.94*
	Yield	1615.20	9.36	-0.42***
Kapurthala	Area	2.47	91.33	-9.50*
	Production	3.92	92.24	-9.05*
	Yield	1608.24	12.94	0.50***
Ludhiana	Area	1.77	57.55	-2.96**
	Production	3.04	53.01	-1.57
	Yield	1750.05	14.68	1.44*
Patiala	Area	2.90	136.06	-8.78*
	Production	4.26	130.27	-7.33*
	Yield	1590.12	16.14	1.59*
Punjab	Area	28.20	109.30	-8.86*
	Production	45.06	107.62	-8.32*
	Yield	1630.72	13.96	0.59*

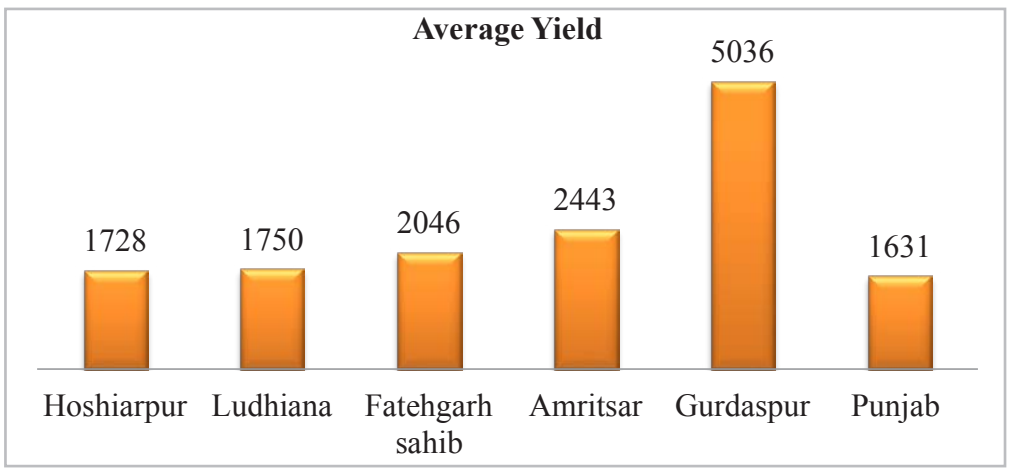
Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Area in'000 ha, Production in '000 tonnes and Yield in Kg/ha.

*, **, *** indicate significance at 1, 5 and 10 percent level, respectively.

Figure 3 focuses on high yield intensive districts of sunflower crop in comparison to state's average yield. It was observed that half of the sampled districts were turned out to be yield intensive in comparison to Punjab's average yield. Gurdaspur was the most yield intensive district in the state of Punjab. This figure clearly indicates the possibility of increase in area under sunflower by putting special efforts on these districts.

Fig.3: High Yield Intensive Districts of Sunflower in Punjab, 1993-94 to 2017-18 (kg/hectare)



Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Table 4 highlights the changing growth rates and coefficient of variation of trends of area, production and yield of the sesamum crop. It is understood from the table that growth rate in production and area of sesamum was negative and significant in almost all the districts of the state (Singh *et al.*, 2009b), except Firozpur, Kapurthala and Jalandhar. The production growth rates were highly negative and significant in Tarn Taran (-11.79%), Gurdaspur (-7.28%) and Ludhiana (-3.85%). High decline in growth rate of area was also observed in above mentioned districts with -10.32%, -6.97% and -4.99%, respectively. In case of yield, the growth rates were positive and significant in Firozpur, Kapurthala, Jalandhar, Ludhiana and Patiala districts, on the contrary, it was negative in Gurdaspur, Rupnagar, Tarn Taran, Hoshiarpur and Amritsar. Highly positive and significant growth rates in yield was observed in Patiala (1.50%) followed by Ludhiana (1.20%), whereas it was highly negative in Tarn Taran (-1.62%). The coefficient of variation was higher for area and production in comparison to yield. The maximum variability in production and area was noticed in Jalandhar (135.14%) and Patiala (150.75%) followed by Kapurthala (117.84%) and Ludhiana (126.93%), while it was minimum in Tarn Taran (53.40%) and Hoshiarpur (47.22%). In case of yield variation, it ranged from 17% to 154% in all the districts of Punjab while, it was highest in Firozpur (153.28%) and lowest in Tarn Taran (17.32%). Same as previous crops, i.e., rapeseed-mustard and groundnut, variation was more in production and area as compare to yield in various districts of the state for sesamum crop also. At state level also growth rate of production and area was more negative and significant than yield and in case of variability, it was also more in area and production than yield (Grover *et al.*, 2007a).

TABLE 4: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF SESAMUM CROP IN PUNJAB, 1965-66 TO 2017-18

District	Variable	Mean	CV (%)	CGR (%)
Amritsar	Area	3.74	67.71	-1.11
	Production	1.49	69.96	-2.08*
	Yield	392.75	21.28	-0.99*
Firozpur	Area	1.43	85.98	2.60*
	Production	0.94	209.85	2.50**
	Yield	615.11	153.28	0.6
Gurdaspur	Area	4.66	71.73	-6.97*
	Production	1.50	74.76	-7.28*
	Yield	316.68	21.62	-0.33
Hoshiarpur	Area	0.87	47.22	-2.10*
	Production	0.27	53.54	-2.51*
	Yield	319.26	29.47	-0.42
Kapurthala	Area	0.33	119.01	3.06*
	Production	0.13	117.84	3.82*
	Yield	429.08	35.40	0.73**
Jalandhar	Area	0.60	125.03	1.39
	Production	0.26	135.14	1.72***
	Yield	467.57	40.00	0.32
Ludhiana	Area	0.23	126.93	-4.99*
	Production	0.11	117.98	-3.85*
	Yield	530.2	35.27	1.20*

TABLE 4: DISTRICT-WISE TRENDS IN AREA, PRODUCTION AND YIELD OF SESAMUM CROP IN PUNJAB, 1965-66 TO 2017-18-CONTD.

District	Variable	Mean	CV (%)	CGR (%)
Patiala	Area	0.17	150.75	-5.52*
	Production	0.08	108.06	-4.09*
	Yield	620.71	30.37	1.50*
Rupnagar	Area	0.74	88.42	-4.23*
	Production	0.24	93.09	-4.26*
	Yield	321.41	27.60	-0.04
Tarn Taran	Area	1.23	50.58	-10.32*
	Production	0.48	53.40	-11.79*
	Yield	367.37	17.32	-1.62
Punjab	Area	13.67	39.51	-1.85*
	Production	4.92	39.74	-2.15*
	Yield	360.58	12.56	-0.30*

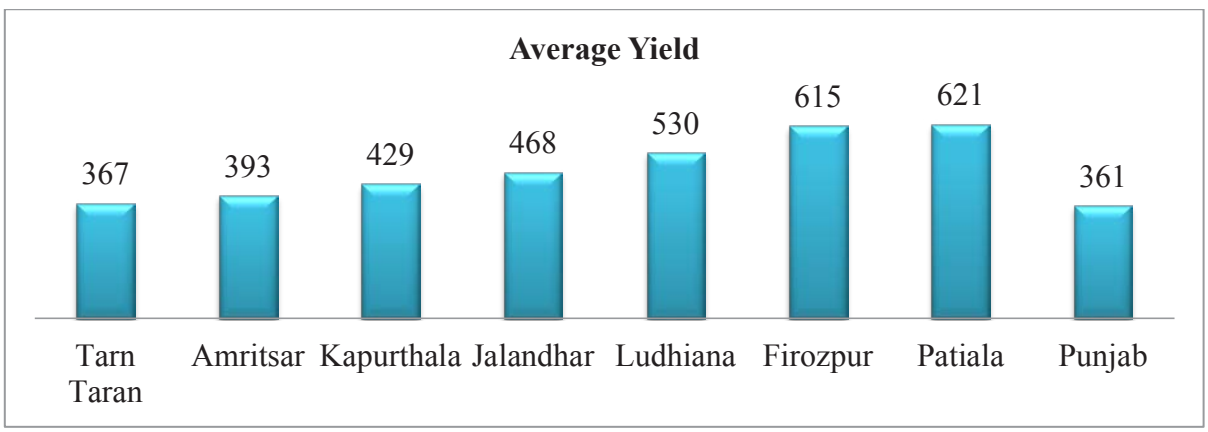
Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

Area in'000 ha, Production in '000 tonnes and Yield in Kg/ha.

*, **, *** indicate significance at 1, 5 and 10 percent level, respectively.

Figure 4 demonstrates the high yield intensive districts of Punjab for sesamum crop during the last five decades. It was found that majority of districts from the sampled districts, i.e., 7 out of 10 were having average yield more than the state's average yield. Patiala and Firozpur observed for having highest average yield of 621 and 615 kg/ha in comparison to 361 kg/ha of Punjab as a whole.

Fig.4 : High Yield Intensive Districts of Sesamum in Punjab, 1965-66 to 2017-18 (kg/hectare)



Source: Statistical Abstract of Punjab, 1965-66 to 2017-18.

4. Conclusion and Policy Implications

From the above study, it can be concluded that growth rates of production were positive and significant in Kapurthala, Hoshiarpur, Gurdaspur and Ludhiana, whereas it was positive and significant in Hoshiarpur and Kapurthala for area. Growth rates in yield were positive and significant in almost all districts of Punjab, in case of rapeseed-mustard but, Kapurthala and Patiala were observed to be highest yield intensive districts of Punjab. In case of groundnut, growth trends for production were declining in

almost all districts of Punjab, except Hoshiarpur district as it showed 0.81% increase in production, but in case of area, it was negative and significant in all district of Punjab. Highest decline in area under groundnut was noticed in Ludhiana and Jalandhar. Growth rates of yield were positive in Faridkot, Hoshiarpur, Ludhiana and Rupnagar districts. But in case of intensity, Firozpur was the most yield intensive district of Punjab having the average yield of 1280 Kg/ha. However, Ludhiana, Hoshiarpur, Sangrur and Kapurthala also turned out to be yield intensive pocket having average yield close to state's average yield. Growth rate of area and production was positive only in Fatehgarh sahib and Gurdaspur districts of Punjab, in case of sunflower crop. In case of yield, it was positive in Hoshiarpur, Kapurthala, Ludhiana and Patiala. Gurdaspur was observed as high yield intensive district having average yield of 5036 Kg/ha. In case of sesamum crop growth rates of production and area were positive and significant in Firozpur, Kapurthala and Jalandhar. Yield intensity was more in Patiala as compared to state's average yield and growth rates were also positive and significant. Variation in area and production was higher in almost all the sampled districts for oilseeds in comparison to yield. This study gives a clear indication to pay special attention towards the high yield intensive districts of respective crops in the state so as to broad-base the production trends of oilseeds across the state.

It was found from the study that production base of selective oilseeds has narrowed overtime and to broad-base it, there is need to implement following policies:

i. There is a need to develop high yielding variety seeds.

ii. Technological development of oilseed crops at par with cereal crops.

iii. Remunerative prices should be provided for the oilseed crops so that it can help in decreasing the burden of import on the country.

iv. Strengthening of extension services for raising awareness regarding oilseed production in the state.

v. Requisite marketing infrastructure should be provided to the farmers.

vi. Yield intensive pockets were identified in the study such as, Amritsar, Jalandhar, Firozpur, Ludhiana, Faridkot, Patiala and Kapurthala in rapeseed-mustard. Ludhiana, Hoshiarpur, Sangrur and Kapurthala in case of groundnut. Hoshiarpur, Ludhiana, Fatehgarh sahib, Amritsar and Gurdaspur in case of sunflower. Tarn Taran, Amritsar, Kapurthala, Ludhiana, Firozpur and Patiala for sesamum. Special attention should be paid to these yield intensive pockets to broad-base of production of oilseeds in the state.

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Agro-Economic Research

Solarisation of Agricultural Water Pumps in Rajasthan*

S. S. KALAMKAR AND H. SHARMA

1. Introduction

India relies heavily on agriculture and irrigation is used in about 49 percent of India's cultivated area, while the rest relies on monsoon rain. Thus, sound and expanded irrigation is critical for improving crop production and raising yields. For over 50 years until 2010, India ranked first with the largest irrigated area in the world. Irrigation in India today is almost entirely reliant on electric and diesel pumps. Irrigation pumps used in agriculture account for about 25 percent of India's total electricity use, consuming 85 million tons of coal annually, and 12 percent of India's total diesel consumption, more than 4 billion litres of diesel. Of the nearly 30 million irrigation pumps in use throughout the country, about 70 percent run on grid electricity, 30 percent are powered by diesel, and only 0.4 percent is solar. The demand for irrigation far exceeds the available pumping capacity. Rapidly growing population, coupled with unreliable precipitation patterns and extreme temperatures wrought by climate change impose additional pressure on agricultural productivity in the country. Therefore, improving access to irrigation, while reducing greenhouse gas emissions, has become our national priority.

A complex set of factors including global warming, competitive land use and lack of basic infrastructure is creating new challenges for India's vast agrarian population. The ever increasing mismatch between the demand and supply of energy in general and electricity in particular, is posing challenges to farmers located in remote areas and making them vulnerable to risks, especially for the small and marginal farmers. Indian farmers and the government are facing several challenges with regard to irrigation. Electricity in India is provided at highly subsidized low tariffs, mostly at flat rates, and this has led to widespread adoption of inefficient pumps. Farmers have little incentive to save either the electricity, which is either free or highly subsidized, or the water being pumped, resulting in wasting both. Although, the government heavily subsidies agricultural grid connections, grid electricity in rural India are usually intermittent and fraught with voltage fluctuations, the waiting time for an initial connection can be quite long. Despite the power shortages, coal shortages and increasing trade deficit, put food security of nation at the risk.

The generation of solar energy and irrigation for agriculture could be intricately related to each other. This is because India is a country that is fret with an irregular and ill-spread monsoon. Hence, irrigation is a pre-requisite for sustaining and increasing agricultural output. This is particularly true for the western states of India where rainfall is often scanty, uneven and irregular (especially Gujarat and Rajasthan) whereas perennial rivers are absent. The role of canal irrigation becomes very crucial in this scenario. However, in the absence of sufficient and reliable canal water supply, the only other option that remains with the farmers is that they irrigate their fields with the help of ground water withdrawn through either electricity or diesel-driven pumps. Provision of power for irrigation and other farm operations, therefore, is a high priority area for the States. However, providing farmers reliable energy for pumping is as much of a challenge as is making the availability of sufficient water. The high operational cost of diesel pump sets forces farmers to practice deficit irrigation of crops, considerably reducing their yield as well as income.

Currently, India has 26 million groundwater pump sets, which run mainly on electricity that is primarily generated in coal-fired power plants, or run by diesel generators. The scarcity of electricity coupled with the increasing unreliability of monsoon forces the farmers to rely on costly diesel-based pumping systems for irrigation. However, the costs of using diesel for powering irrigation pump sets are often beyond the means of small and marginal farmers. Consequently, the lack of water often leads to damaging of the crop, thereby, reducing yields and income. In this scenario, environment-friendly, low-maintenance, solar photovoltaic (SPV) pumping

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systems provide new possibilities for pumping irrigation water. Solar powered pumps are emerging as an alternative solution to those powered by grid electricity and diesel. Diesel and electric pumps have low capital costs, but their operation depends on the availability of diesel fuel or a reliable supply of electricity. Saving of 9.4 billion litres of diesel over the life cycle of solar pumps is possible if 1 million diesel pumps are replaced with solar pumps. Using solar power for irrigation pumps can cut a carbon footprint of Indian agriculture and bolster the country's role in the war against climate change.

Solar power could be an answer to India's energy woes in irrigated agriculture. Solar power generation on the farm itself through installation of solar PV (photovoltaic) panels; and using it to extract groundwater could just be the solution for the above concerns. Solar pumps come with a user-friendly technology and are economically viable. They are easy to use, require little or no maintenance, and run on near-zero marginal cost. Solar power is more reliable, devoid of voltage fluctuations and available during the convenient day-time. India is blessed with more than 300 sunny days in the year, which is ideal for solar energy generation, aptly supported by promotional policies of the Government of India.

The Ministry of New & Renewable Energy (MNRE) has been promoting the Solar-Off Grid Programme since two decades. The programme size has increased manyfolds with the advent of Solar Mission, giving much impetus to various components of the programme in which solar pumping is one of the major component. Solar Pumping Programme was first started by MNRE in the year 1992. From 1992 to 2015, 34941 numbers of solar pumps have been installed in the country. This number is minuscule, if we compare with the pumps in agricultural sector. High costs of solar modules during these years resulted in low penetration of solar pumps. However, in recent times the module costs have started decreasing and are presently hovering around one fourth of the price in those days. As a result, the programme has become more viable and scalable. Therefore, present study was undertaken with aim to study the important issues concerning large scale adoption of solar irrigation pumps, its economics/ feasibility and problems in adoption of same.

Literature suggests that application of solar energy in irrigation could have myriad benefits. The primary benefit is that it is 'free'. However, the generating apparatus comes with high initial fixed costs like that of capital equipment, costs of installation, depreciation, interest, protection from theft, vandalism, etc. Nevertheless, the marginal costs are indeed 'near zero' (operation, maintenance, repairs). The costs of expansion in irrigated area like that of hose pipes for transporting water across fields is also much lesser compared to operating a diesel pump or getting another electricity connection. Hence, solar pumps could not only provide cheaper irrigation but also expand irrigated area and thus increase the returns on agriculture. It could also extend the farming beyond the kharif season (monsoon) by harnessing ground water and thus aid the diversification of crops. Solarisation could also unshackle the farmers from the shortage of electricity supply and its inconvenient timings. They would be able to irrigate not only their own land, but also become irrigation service providers to their neighbouring farmers and also supplementing their own incomes in the process. Solarised pumps could promote conjunctive irrigation by promoting ground water extraction in flood-prone regions like north Bihar, coastal Orissa, north Bengal, Assam and eastern Uttar Pradesh. The government has acted positively in this matter and during the last five years, considerable progress has been made in the installation of Solar Pumps.

2. Methodology

In light of the above, this study attempts to study the status and prospects of solarisation of agricultural pumps in selected districts of Rajasthan. The data were collected from three distinct groups of farmers, viz., farmers who had adopted Solar Irrigation Pumps (SIPs) with the help of subsidy by the government, farmers who had adopted SIPs without any support in the form of subsidy by the government, and the farmers who had not adopted SIPs. The first group was of 100 sample farmers (25 from each of the four districts under study, i.e., Jaipur, Bikaner, Udaipur and Sriganganagar) who had installed SIPs with the support of subsidy from the government (beneficiary farmer households). The second group consisted of 5 sample farmers from four districts who had installed SIPs on their own without any support in the form of subsidy (non-beneficiary farmers). The third group included 20 sample farmers (5 each from the four districts under study) who had not yet adopted solarised irrigation (non-adopters). They were still using other conventional fuels for powering their irrigation pumps when they were visited by the researchers. The total sample consisted of 125 selected

farmers can be seen in Table 1.

TABLE 1: SAMPLING FRAMEWORK IN RAJASTHAN STATE

Sr. No.	Selected District	Beneficiary farmers	Non-solar adopter	Non-beneficiary farmers	Total
1.	Jaipur	25	05	01	31
2.	Bikaner	25	05	01	31
3.	Udaipur	25	05	01	31
4.	Sriganganagar	25	05	02	32
	Total	**100**	**20**	**05**	**125**

2.1. Policies supporting Solar Power Irrigation in Rajasthan

The state of Rajasthan has 10 percent of India's land, 5 percent of its population and only 1 percent of its water resources, causing inadequate supply of irrigation water vis-a-vis agriculture area. Acute water shortage, erratic rainfall and recurring droughts in every district have exacerbated the situation. Over 60 percent of the population depends for livelihood on agriculture or horticulture, often marred by low productivity due to unreliable, inadequate or non availability of irrigation. About 70 percent irrigation is done through wells or tube-wells energized mainly by grid-power or diesel generators. Approximately 60,000 farmers are waiting for grid-based electricity connections for irrigation. Extension of electric-grid is not feasible in far-flung areas. Moreover, ground water has deteriorated rapidly in the last two decades. Out of 249 blocks, nearly 200 are in the highly critical zone. Almost 90 percent of groundwater withdrawal in the State is utilized through flood or furrow-irrigation methods with mere 35 to 45 percent water-use- efficiency.

Rajasthan is blessed with one of the best solar insolation on earth (6-7 kWh/m2/day) combined with maximum sunny days in a year, about 325, which makes it one of the most attractive destinations for harnessing solar energy for various purposes, especially irrigation. It was thus envisaged that an integrated solar water pump scheme formulated by combining various stand-alone government schemes would be indeed beneficial for the region as well as its farmers. Subsidies available under various programs were clubbed and the State committed to grant the total subsidy of up to 86 percent of the capital cost. The departments of agriculture, finance and energy of the State, and Union government's Ministries for Agriculture and Farmers Welfare (MoA) and New and Renewable Energy (MNRE) worked in tandem along with various stakeholders to make it seamless and successful project.

Rajasthan has been pioneer in promoting solar water pumps by adopting suitable policies with an aim to increase solar pump coverage in the state. The solar pump scheme for irrigation began in Rajasthan in 2010 – a combination of the Jawaharlal Nehru National Solar Mission (JNNSM), Rashtriya Krishi Vikas Yojana (RKVY), the water harvesting structure (WHS) scheme under the National Horticulture Mission (NHM), and various other State resources. Under the scheme, farmers are provided with subsidies from RKVY and the Ministry of New and Renewable Energy (MNRE). In the inception year, a subsidy figure of 86% (30% from MNRE and 56% from RKVY) was brought through calculations of a base price for the manufacturing and installation of a solar water pump set. The remaining 14 percent, equivalent to the cost of pump set, was to be paid by the farmer, which would amount to about Rs. 56000-63000. In 2010-11, 50 farmers were targeted, which was scaled up to 500 in 2011-12, and 10,000 in 2012-13, eventually covering all 33 districts of the State. There are three, very transparent eligibility criteria for the subsidy –(1) the farmer should own at least 0.5 Ha of land; (2) the land should have a diggi/farm pond or other water storage structure; (3) drip irrigation system should be installed in a portion of the farm. Progressively, the scheme was amended to include the usage of mini-sprinklers as criteria for areas where land holdings are relatively smaller and diggi construction is unfeasible or impractical. This inclusion widened the scope for the popularization of efficient irrigation methods, increasing the water use efficiency in many regions significantly. On the other hand, the subsidy figure was reduced from 86 percent to 70 percent to an even lower 60 percent over the years, and this reduction in the subsidy amount

is presently the major cause for farmers backing out from the scheme. Farmers who already have electric connections for irrigation shall be provided with a smaller figure of subsidy, amounting to about 30% of the total cost of the solar pump set. This calls for a study of the efficacy of the scheme and a detailed evaluation of the impact that these solar water pumps have actually had on farmers already using them, to enable us to ascertain why we should be moving towards this green, efficient, cheap, and emission-free energy source, and/or explaining how the scheme may be further improved for a much wider acceptance and preference among those that require such alternative solutions desperately.

Despite water scarcity, Rajasthan is actively pushing for solar pumps. Its horticulture department provides 86 percent subsidy on pumps, while the rest is borne by the farmer (Table 2). Government of Rajasthan brought a new momentum in the space of solar irrigation pumps by introducing 3 HP DC submersible pumps under 86 percent subsidy scheme launched in 2011-12. There was also a 2 HP DC submersible pump option, but there have been few takers for it. The initial estimates of costs at the state level were Rs. 6.16 lakh for 3 HP pump and almost Rs. 18-20 lakh for 10 HP pump. Government of Rajasthan's policy of subsidizing solar pumps is helping to increase the numbers but there is some evidence that the current subsidy is discouraging cost reduction. Farmers are viewing solar pumps as an all purpose solution to their energy needs and the government has came out with the suitable policy towards same (Table 3). The top five districts having highest coverage of solar pumps are Bikaner, Jaipur, Sri Ganganagar, Hanumangarh and Sikar.

TABLE 2: ACHIEVEMENTS OF SOLAR IRRIGATION PUMP IN RAJASTHAN

Year	Project	No. of District Covered	Target	Achieve-ment	Pump Capacity (WP)	Subsidy (%)	Funding Source
2008-09	Government Farms	7	14	14	1800	100	RKVY
2010-11	Pilot Project	6	50	34	2200/3000	86	JNNSM, RKVY
2011-12	First major jump	14	500	1649	2200/3000	86	JNNSM, RKVY
2012-13	Second major jump	33	2200	4280	2200/3000	86	JNNSM, RKVY State
2013-14	Third major jump	33	10000	10000	2200/3000	86	JNNSM, RKVY, State
2014-15	fourth major jump	33	2900	9919	2200/ 3000	30, 60, 75	JNNSM, NCEF, State
2015-16	Fifth major jump	33	4702	6170	2200/ 3000	30,60, 75	JNNSM, NCEF, State
2016-17	Sixth major jump	33	7500	n.a.	n.a.	30,60, 75	JNNSM, NCEF, State
2017-18	Major jump	33	500	n.a.	n.a.	50, 55, 65, 70	JNNSM, NCEF, State
2018-19	Major jump	33	7500	n.a.	n.a.	50, 55, 65, 70	JNNSM, NCEF, State

Note: n.a. implies Not Available.

The solar pump subsidy was only available to farmers who had farm ponds (diggi), did horticulture in at least 0.5 hectare (ha) land and used drip irrigation. The farmer also had to own a minimum of 0.5 ha of land. Further the farmers who owned up to 2 ha of land could apply for 2200 Wp pump and those who had more than 2 ha of land could apply for 3000 Wp pump. The eligibility criterion for solar power pump has been changing every year.

TABLE 3: BASE RATE FOR SPV SOLAR PUMP PROJECT IN RAJASTHAN (2017-18 AND 2018-19)

Sr. No.	Details	DC/ AC Mounting	Head (mtr.)	Base Rate (in Rs. Per set)			
				3 Hp	5 Hp	7.5 Hp	10 Hp
1	2	3	4	5	6	7	8
1	SPV surface pump	DC Static	20	236250	0	0	0
2		AC Static	20	230492	307999	0	0
3	SPV submersible pump	DC Static	20	252266	344000	509839	650090
4		AC Static	20	230265	306390	465560	593250
5	Additional cost	Head Over 20 m	50	5412	5412	5412	5412
6			75	9020	9020	9020	9020
7			100	12000	12000	12000	12000
7		Manual Tracker		2706	2706	2706	2706
8		Auto Tracker		8118	8118	8118	8118
9	SPV Domestic Lighting System 37 Wp/ 40 Ah Battery / 9 W x 2 fixture			4681	4681	4681	4681
10	Fencing			6765	9020	11275	13530

Source: GOR, Jaipur.

Farmers have to apply to the Horticulture Department along with a demand draft of Rs. 10000, land ownership record, a tri-partite agreement among the farmer, preferred empanelled supplier and the horticulture department, a quotation from the selected empanelled firm, and a technical drawing of the structure. Once all the applications are collected at Tehsil level, these are verified for compliance with the eligibility criteria. If the applications are more than the quota, a lottery is conducted in the presence of District Collector. A seniority/waiting list is created. If a farmer's name features in the lottery list, he/she has to deposit his 14 percent share minus Rs.10000 with the select firm. Based on the confirmation of the receipt of farmer's share, work orders are issued by the Horticulture Department of the State Government.

3. Findings from Field Survey Data

i. Data were collected from 125 sample households comprised of 100 households those who have installed solar irrigation pump with support of subsidy (beneficiary farmer household), 5 sample households who have installed solarizied irrigation pump on their own (without any subsidy non- beneficiary farmer household) and 20 sample households who have not yet got subsidy nor installed solar irrigation pumps on their farm (non adopters-control group).

ii. It was observed that except few respondents from beneficiary category, all other selected households from all groups (beneficiary, non-beneficiary and non-adopter category respondents) were male. This indicates farming decisions and adoption of new technology on farm related decision were taken by males, thus dominance of male could be seen despite the fact that female contribution is highly significant in the farming and dairying.

iii. The average age of all the respondents of selected respondents was around 50 years while average family size of household in case of beneficiary households (6.91 person) was relatively larger than non-beneficiary and non adopters households (5.4 and 5.3 members, respectively). Out of total adult family members in the family, more than 70 percent were actively participating in the farming.

iv. Education status of selected respondents indicate that the average education level up to 8 years, while non beneficiary households were relatively more educated (around 11 years) than other groups. The figures on average level of education of respondents indicate lower level of education among selected respondents.

v. The religion-wise distribution of selected respondents indicate that out of total selected households, about 94 percent households belongs to Hindu religion while remaining were from Muslim and Sikh religions. Among the three groups of respondents, same trend was observed except relative high share of Sikh religion among non-beneficiary households as about one fifth of non- beneficiary households were from Sikh religion. In case of social caste distribution, on an average, dominance of other backward class category households was observed followed by households from general category and scheduled caste category. The other backward caste followed by open category comprised beneficiary household group, while opposite composition of households was observed in case of non beneficiary households. Besides, Open and OBC category households, scheduled caste households were also among selected households under non-adopters group. Thus, at overall level, backward class category respondent dominated the sample followed by general category and then scheduled caste, while very meager share was of scheduled tribe respondents

vi. The details on economic characteristics of the selected households indicate that more than 90 percent of total beneficiary and non-adopter households were having farming as their principal occupation while three fourth of total non-beneficiary households had service as their principal occupation. Animal husbandry and dairying followed by agriculture labour was subsidiary occupation of beneficiary and non-adopters, while crop cultivation followed by agriculture labour was subsidiary occupation of non-beneficiary households. The main occupation of the selected households was agriculture comprising cultivation of land as a farmer along with supportive allied activity of animal husbandry and dairying.

vii. The average years of farming experience of the respondents was around 29 years, which shows that most of the respondents were in farming business since their young age. The income level of both beneficiary and non-beneficiary households as around 98 percent and 50 percent non-adopter of households were categorized above poverty line. The trend was observed in case of dwelling structure where about 98 percent households of beneficiary member had pucca structure while in non- beneficiary and non adopter category only 60 percent and 45 percent household had pacca house structure.

viii. On an average, land holding size of selected beneficiary households was 1.21 ha categorizing them as small land holders' group, while non-adopters had much lesser land holding of 0.91 ha as marginal land holders. Corresponding figure for non-beneficiary households was 6.10 ha, indicating larger size of holdings as medium size land holders. Moreover, we also found that who were having solar water pump had taken land on leasing-in while none of them leasing out the land. Non-beneficiary farmer households had taken larger size of land on leased-in (0.75 hectare) as compared to beneficiary households (0.01 ha), this might be because the non beneficiary farmers are comparatively wealthy farmers and have more capital than the other two groups.

ix. Out of the total operational land holdings with selected households, almost all land under operation of non-beneficiary household was under irrigation, while in case of beneficiary households, about 80 percent land was under irrigation coverage. The non-adopter households could irrigated their three fifth of total operational holdings with available sources of irrigation. Thus, despite of having the large size of land holdings, non-beneficiary had sufficient water and sources of irrigation to irrigate the crop. Due to such sound background of having all land coverage with irrigation, the

assured returns must have pushed the farmers to invest in installation of solar pumps on their farm with their own expenditure, i.e., without any subsidy.

x. After solarisation, changes in cropped and irrigated area were observed in case of selected beneficiary households. The share of area sown in gross cropped area during kharif and summer season has shown meager increase. Area under irrigation by type of irrigation method has shown some changes after solarisation as compared to situation prevailed during pre-solarisation period of beneficiary farms. The area irrigated by flood method of irrigation has declined by about 30 percent which must be due to the adoption of sprinkler and drip method of irrigations. The area under rainfed condition has also shown declined trend. Overall the total gross cropped area has increased about 17 percent after solarisation. The transformational impact of irrigation is evident in solar water pump scheme, where solar pumps were used to expand the coverage of the scheme from 40 to 50 hectares. More than 50 percent beneficiary household area transformed from gravity-fed irrigation to sprinkler and drip irrigation with additional solar booster pumps deployed to pump water into a storage reservoir.

xi. The changes in net sown area, gross cropped area and cropping intensity of sample non-beneficiary households indicate that after solarisation, significant growth in gross irrigated area and gross cropped area was recorded, that too increase in irrigated area was more than cropped area. Due to which cropping intensity has changed by around 13 percent points after solarisation as compared to before solarisation year. The increase in area under irrigation may be due to assured and quality power supply through solar during convenient timings during day time for irrigation.

xii. In case of non-beneficiary households, area irrigated by flood method of irrigation has declined by about 28 percent. Also rainfed area has declined by 43 percent after solarisation. While area irrigated through the use of micro irrigation equipments such as sprinkler and drip has recorded significant increase. Overall the total gross cropped area has increased about by 26.04 percent after solarisation. As increase in gross cropped area was higher for non-beneficiary than the beneficiary may be due to the fact that non beneficiary farmers are economically strong and diesel pump owners, had shifted to solar pumps to avail benefits such as zero operational costs, ease of use throughout the day and cost savings on diesel.

xiii. In case of non-adopter, cropping intensify was 166 percent mainly because of more than four fifth of total cropped area having irrigation coverage.

xiv. Before solarisation of irrigation pumps, out of selected solar water pumps users, only 37 percent of beneficiary household had grid connection facility available on their farm while all the non-beneficiary farmers had grid connectivity to their irrigation pumps on farm. In case of rate charged towards the use of electricity, almost two third pumps of beneficiary households were metered and remaining were charged on flat rate basis. While in case of non- beneficiary households, all irrigation pumps had meter and were charged on meter use basis. Average irrigation expenditure per household per year was estimated to be between Rs. 3200-3500/-. Despite the fact that agriculture require more hours of electricity supply to carry out agricultural operations (irrigation, threshing, etc), selected respondents households reported that they used to get hardly 6 hours of power supply in a day, which indicate the pressure built on respondents to make use of new technology of solar energy.

xv. The selected households had multiple sources of water available for irrigation and also used multiple method of irrigations such as drip and sprinkler irrigation. The average water depth was estimated to around 200 feet and water was lifted through diesel and electric pumps. The average distance of canal/river water was about 1 kms from the field. Around two third of the selected households had water storage facility on the farm, while no one has made attempt to recharge the groundwater through adoption of any innovative technique or practice. The main problem was observed with the availability of electricity to farm connection which is hardly made available though grid for eight hours in a day that to

at inconvenient times, irrespective of season. Thus, in order to irrigate the crop during day time with uninterrupted power supply, the solar irrigation pump is the most suitable option available which selected households have installed on their farm.

xvi. Changes in cropping pattern of sample beneficiary households indicate that due to about 17 percent increase in gross cropped area after solarisation, area under fruits and vegetables, wheat and maize crop has significantly increased during rabi and summer season. The change in cropping pattern was relatively in favor of irrigated crops. During kharif season, major crops grown were paddy, maize, groundnut, cotton, soyabean, while wheat and gram were sown during rabi season. Due to availability of irrigation facility, crops such as maize, moong, vegetables and fruits were grown during summer season.

xvii. Most of the households, who were previously growing little more than subsistence crops of bajra, maize, soyabean in kharif season and wheat, gram and mustard in rabi season, could grow food crops, earn income and benefit. After solarisation, the numbers of crops grown have also increased. During survey, respondents have reported that farm yields have increased to an average of 2 to 4 quintal per hectare. Irrigation enables farmers to grow three crops per annum and rotate crops to grow a diversity of nutritious and cash crops, such as vegetables and fruit crops and flowers also. This indicates that solarisation helps to increase the area under cultivation during the summer season or under the perennial with commercial crops like vegetables.

xviii. While in case of non-beneficiary households, kharif season was the major season. Crops were grown in all three seasons (kharif, rabi and summer) before solarisation as well because of the fact that they were economically sound and thus can make full use of water through diesel and electricity pump. While after solarisation, the share in area of traditional crops such as jowar, moong, moth, guar and bajra has decreased and area under other horticulture crops like vegetables and fruits crops has increased. After solarisation, gross cropped area of the non-beneficiary households has increased by 25 percent. It was also observed that after solarisation, the numbers of crops grown during a year has been increased, as seen in case of beneficiary households. In Kharif season, the major crops grown were cotton, soyabean and bajra while during Rabi season, wheat, gram and rapeseed & mustard crops were grown. The fodder and vegetables crops were grown by the non beneficiary farmers during summer season. The increase in share of area under commercial crops, fruits, vegetables and perennial crops indicate the benefit of solar energy availability with selected non-beneficiary households for irrigating the crops.

xix. In case of non-adopters (control group) households, major crops grown during Kharif season were bajra, moong, moth, groundnut, guar and other minor crops while wheat, gram, rapeseed and mustard were major crops grown during Rabi season. It was very pleasant to note here that significant area during summer season allotted under fodder crops indicates the scarcity of fodder in the selected area.

xx. The details on possession of irrigation pumps of selected households indicate that solar pumps essentially are a collection of solar PV panels, AC or DC pumps and the associated electronics that have been optimized for high efficiency operations. All non-beneficiary households have used submersible DC pumps while in case of beneficiary households, 54 percent households had DC pumps on their farm. As a technology, while AC technology is now catching up, DC technology is considered to be more suitable given the wider operating range and higher efficiencies reported by beneficiary.

xxi. The details about the installation of solar panels and availability of power with selected beneficiary and non-beneficiary households indicate that land area covered by the solar pump installed was around 4.8 ha in case of beneficiary households while same was 4.4 ha in case of non-beneficiary households. All the selected households had solar panels on farm. About two third of installed solar PV panels were with automatic rotation system while remaining were with manually rotation system. On an average 4-6 poles were installed with mean number of stand poles between 12-15, having panel average size of 3 feet by 5 feet. Mean area covered by each stand pole was around 5 feet by 5 feet. No installed

solar panel have meter to record the power generated and used. About 37 percent solar plants of beneficiary households and 5 percent of non beneficiary households were connected to grid. None of the farmers had installed the solar power storage cell. The solar power generated mostly been used for agriculture purpose while few of beneficiary households used for household purposes as well. None of the selected households had used solar power to sell irrigation water to neighbouring farmer, thus no additional income through sale of water was reported.

xxii. About two third of beneficiary households mentioned that to avoid hassle of irrigating crop irrigation during night hours was the major reason for adoption of solar irrigation pump. More than 50 percent of selected households strongly reported that they adopted the solar water pump due to costly diesel, followed by non-availability of electricity connection, unreliability of electricity supply/ inconvenient grid supply timings, high electric bill. Few of the beneficiary households wanted to try renewable technology as it is environment-friendly while few wanted to take advantage of subsidy being offered for installation of solar pumps on farm. While in case of non-beneficiary households, major three reasons quoted were saving electric bill followed by costly to run electric pumps and inconvenient time of electric supply/costly diesel. Thus, findings about the reasons for adoption of the solar water irrigation pump under different category suggests that high cost of electricity along with inconvenient hours of electricity supply and high cost of diesel has pushed the farmers to adopt pollution free power generation thorugh solar.

xxiii. The process of installation of solar pump took almost 6-7 days while average number of visits of representative of agency was more in case of non-beneficiary (about 5 visits) compared to beneficiary households (about 3 visits). The company-wise distribution of solar panels indicates that Jain Irrigation Company had supplied major share of pumps (as solar pump supplier) in both groups. The other major suppliers were Shakti, Lubi, Tata Solar, Waaree, etc. More than 95 percent of selected respondents had received training/ demonstration about operating solar pump from solar water pump through supplier agency while about more than 98 percent of beneficiary and non beneficiary household had satisfied with support services provided by agency and quality of solar panels. More than 90 percent respondents had insured the solar pump.

xxiv. Storage tanks in different sizes were used to store the water that was pumped. The water that was stored in the tank could be used for irrigation when needed. There were different types of agricultural irrigation method used. More than 90 percent beneficiary households had used solar with MIS while 100 percent non-beneficiary households had used MIS and Solar pump without subsidy. All solar water pump users advise others to adopt solarisation of irrigation pumps with the information of the government policies in the solar irrigation sector, particularly, in regard to solar subsidies and economic benefit of solar irrigation pump.

xxv. To supplement the intermittent and inadequate canal supply, many farmers have also dug tubewells. The depth of water level was around 210 feet in case of beneficiary households during both the periods, while same had slightly increased to about 235 feet in case of non-beneficiary users. The depth of groundwater was stagnant possibly may be due to farm pond as recharger for ground water on beneficiary farm.

xxvi. More than 90 percent beneficiary and non beneficiary farmers had great experience of solar, i.e., ease of operation, ease to maintenance, less labour and supervision required and the timings for irrigation are very convenience, used of fertilizer decrease with increase of micro irrigation after solarisation. Some of the selected respondents using electric pumps were dissatisfied with use of electric pump due to its unreliable power supply, depleting water tables and high expenditure on diesel.

xxvii. About 79 percent of farmers had given first preference to lack of fund for non-adopting water pump followed by hesitation to invest/ lack of confidence/ risk averse (66.05%), less land, unviable for investment on solar pump

(57.40%), opposition from family members (56.55%), followed by unviable for investment on solar pump, subsidy is insufficient, ground water is at great depth, unsuitable for solar and came to know about it much later.

xxviii. About 70 percent non-adopter household has suggested that the criteria of subsidy should be relaxed and need to increase subsidy rate. About 40 percent respondents had suggested that the portability of grid connectivity to solar irrigation pumps should be made and awareness about solar irrigation pump scheme need to be increased.

4. Policy Implications

i. Both the central and state governments have policies and incentives to grow the use of solar pumps in the irrigation sector. However there is need for raising awareness among farming community and for putting project delivery mechanism in place.

ii. Presently, cost of solar pump appears to be high for individual farmer. Large scale adoption and production will lead to cost cutting. Community based projects can reach out to marginal farmers and other low-income group individuals.

iii. Feasible costing and assistance from state / central government will encourage more farmers to opt for the technology. With partnership of state energy departments, Vidyut Vitaran Nigams, and private partners, technology can be disseminated at large scale.

iv. Portability of grid connectivity to solar irrigation pumps should be made and awareness about solar irrigation pump scheme need to be increased.

v. Majority of the beneficiary farmers suggested that solarized irrigation could be expanded if the SIPs were made more user-friendly in terms of their requirement of space, technical features as well as financing, including that for insurance.

vi. Solar cooperatives need to be established and individual SIPs in group under cooperative structure can be connected with the grid in order to evacuate the surplus power generated there from into the grid, it could not only prevent the wastage of solar power but also provide the farmers with a supplementary source of income by way of selling solar power.

vii. The farmers were also in need of awareness about insurance and its coverage against risks of damage of SIPs or theft of their solar panels.

viii. Also, the procedure for availing subsidy should be simplified and the criteria for eligibility should be relaxed so as to include more farmers as beneficiaries.

xi. Clearly, more needs to be done in the direction of convincing the farmers about the advantages of solarized irrigation so that they would come forward to adopt in large numbers, regardless of the subsidy on offer or the initial capital costs thereof.

x. There is a need of innovative policies for governing ground water level in a sustainable way. There is a need for metering agriculture water use and total water extraction by farmers using solar, electric or diesel pump.

Performance Evaluation of Pradhan Mantri Fasal Bima Yojana (PMFBY) in West Bengal*

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1. Introduction

Any successful crop insurance scheme, worldwide, requires government support and finance. According to a recent World Bank survey on crop insurance performed in 65 countries, premium subsidy by the government was found to be the most common strategy to support agricultural insurance market. While crop insurance is essentially a commercial activity, it is common to see that governments also play a role, as governments have an interest from the perspective of maintaining productivity and safeguarding the well-being of the farming community. Against this backdrop, introduction of Pradhan Mantri Fasal Bima Yojana (PMFBY) was a welcome step. As compared to previous crop insurance schemes, PMFBY holds a special place due to its wide coverage and for the innovativeness of its designs. The present study is an attempt to evaluate the performance of PMFBY in the state of West Bengal in terms of issues related to governance, implementation and uptake behaviour among the farmers and to make some policy suggestions for its better functioning.

1.1. Objectives of the study

The specific objectives of the study are:

1. To analyze the governance of PMFBY implementation in West Bengal
    i. To examine the functioning of different stakeholders dealing with PMFBY in West Bengal
    ii. To study the progress of PMFBY in West Bengal
2. To analyze the uptake behaviour among the farmers in West Bengal
3. To recommend suitable policy suggestions for better functioning of PMFBY in West Bengal.

2. Methodology

The present study is conducted in the state of West Bengal during 2017-18 and divided into two parts, namely, Governance and implementation of PMFBY in West Bengal; and Understanding uptake behaviour. Both the components are carried out more or less simultaneously using mixed method of data collection. While the first part is based on secondary information and feedbacks collected from various stakeholders associated with implementation of PMFBY in the state of West Bengal; the second part is based on field surveys in three districts of West Bengal. The reference year for the study is agricultural year 2016-17, i.e., Kharif-2016 and Rabi-2016-17. The PMFBY was implemented in all the districts of West Bengal, except Kolkata, since its inception and has been rechristened as 'Bangla Fasal Bima Yojna (BFBY) as it was offered free of cost to the farmers and the state government borne the entire financial liability on account of farmers' share of premiums in addition to its own share. However, all other guidelines and norms remained unaltered. It was offered to all categories of farmers in the state and provided support to four major crops in Kharif and eleven crops in Rabi.

3. Major Findings

The major findings of the study are summarized below.

i. As far as promoting crop insurance among the farmers in West Bengal is concerned, the scheme is a huge success as more than 3.06 million farmers were enrolled in the very first season of its implementation, registering an annual growth of 216.1% over the previous year against 5.6% at national level.

ii. In terms of area coverage too, the PMFBY made an impressive growth in West Bengal with 28.85% area covered during Kharif-2016 and 12.44% during Rabi-2016-17, much higher than

*Agro-Economic Research Centre, Visva-Bharati, Santiniketan, West Bengal.

#Note: Detailed research report can be accessed from official website of respective Agro-economic Centres

the national average in both the season.

iii. Agriculture Insurance Company of India Ltd. (AIC) played a very active role in bringing more than 0.54 million new non-loanee farmers in Cluster-IV, under the purview of PMFBY in the very first season. The total number of enrolment by AIC was around 1.3 million (nearly 42% of state total) and that too just from a single cluster allotted to them.

vi. The salient features of successful implementation of PMFBY in West Bengal are timely notification with wide coverage of crops; timely constitution of different committees at state/district/ block level; following e-tendering & cluster approach in bidding process; and providing crop insurance at free of cost to the farmers.

v. Though the performance of PMFBY, in terms of coverage, is quite satisfactory, the implementation of the scheme suffers from several weaknesses.

vi. Huge enrolment under PMFBY in West Bengal was mainly supply driven rather than demand driven. Since it was offered free of cost and mandatory for loanee farmers, the Gram Panchayat (GPs) took special initiatives for mass enrolment, hence, the coverage under PMFBY was very high in West Bengal. In fact, voluntary enrolment was only 30% among the loanee farmers and 40% among the non-loanee farmers.

vii. Further, the coverage is particularly restricted in irrigated areas growing paddy, jute and potato as compared to rain-fed and hilly regions. Poor adoption rate among the non- loanee farmers is also a matter of concern, as they constitute more than 70% of farming community in the state.

viii. The governance and implementation was more or less in accordance with the stipulated operational guidelines, from pre-notification to enrolment phase. But the main problems was in conducting Crop Cutting Experiments (CCEs) and settlement of claims which delayed by more than 6 to 12 months, as government failed to submit yield data and premium subsidy on time. This provided Implementing Agencies (IAs) an excuse to delay or deny compensation.

ix. While submission of yield data was delayed mainly due to failure in conducting huge number of CCEs, the delay in release of premium subsidy was mainly due to limited budget provisions.

x. Another important reason for delay in payment was due to doubtful claims and incomplete documents submitted by the farmers during both enrolments as well as during reporting loss/claim.

xi. Though government officials claims a good level of awareness about PMFBY, the result of field survey show a complete lack of awareness among the sample farmers. In fact nearly 70 % of the non-insured farmers had not even heard the name of PMFBY.

xii. Even the farmers who heard the name of PMFBY or BFBY were not aware of the various features of the scheme. There was sheer lack of awareness about specific features of the scheme among 95% respondents.

xiii. IAs, barring AIC, have been found not to play an active role and their presence at local level was very poor. The GPs and banks played a crucial role in increasing the number of enrolment but not so during settlement of claims or explaining the features of the scheme.

xiv. From the very first season of PMFBY, e-bidding was mandatorily practiced using clustering of district approach. But there was apprehension regarding lack of transparency in the e-bidding process.

xv. The actuarial premium rates (APR) were quite high during Rabi 2016-17 as compared to Kharif-2016. In many cases, it was below the threshold level of 2% during Kharif, but as high as 38.61% during Rabi. With the APR being quite high, IAs have found a good business opportunity under PMFBY, in West Bengal with overall claim to premium ratio being 57.73%.

xvi. While, PMFBY promised use of smart-phones, remote sensing images, Geographic Information System (GIS) data, and drone technologies to carry out faster assessment of

crop losses, the Bureau of Applied Economics and Statistics (BAES) & Department of Agriculture, Cooperation and Farmers Welfare (DoA) failed to use such smart technologies to effectively reduce the number of CCEs.

xvii. So far as claim settlement is concerned, the performance of PMFBY in West Bengal is particularly very poor where insurance companies collected Rs.730 crores in premium and the estimated claim settled till July, 2017 was less than Rs. 1 crore, which increased to Rs. 421 crores by the end of January, 2018. Therefore, during first year of implementation, PMFBY has proved to be a scheme most efficient when it comes to collection of premium, but not at all so in payment of claims.

xiii. Inspite of not having any claim, 80% respondent farmers consider the scheme better than any previous crop insurance schemes they availed but two-third of them expressed their dissatisfaction regarding poor implementation of the scheme.

xix. The most demanded suggestion was for a more pro-active role on the part of GPs in dissemination of adequate information and help in claim settlement process. Other major suggestions were, simplification of enrolment and claim settlement process, need for direct contact with the IAs, timely payment of compensation, etc.

4. Policy Recommendations

The policy recommendation calls for an integrated approach involving all the stakeholders with multi-pronged emphasis on the larger issue of improving governance, implementations, and impact of PMFBY scheme in the state. Several initiatives have already been taken, during post 2016-17 periods, by the concerned stakeholders. Few more policy suggestions are:

1. Awareness drive: Government and other stakeholders need to generate awareness about the benefits of PMFBY/BFBY among all categories of farmers, so that the farmers should take up crop insurance in an informed manner rather than taking it as a free lunch. Therefore, strategies for effective awareness campaign and mechanism for a transparent and accountable system of speedy payment of compensation should be evolved.

2. Technological intervention like digitalization of land records to ensure genuine enrolment and faster claim settlement process; encourage online enrolment and claim settlement through Common Service Centres (CSC); use of smart technologies in effectively reducing the number of CCEs and to improve its reliability; and development of a dedicated, interactive and user friendly portal with regional languages.

3. Rational policy initiatives like introducing a nominal processing fee for enrolment through CSCs, which may be reimbursed to their account if all documents submitted for enrolment and claims found in order; introduction of no claim bonus for cash crops and horticultural crops, and for non-loanee farmers; expanding the role of GPs beyond enrolment; setting up own insurance firm by the state government in order to check the oligopolistic behaviour by the private IAs; and extending free insurance cover under BFBY to horticultural crops too, in order to promote crop diversification in the state.

4. To ensure transparency and accountability, the government must encourage long term bid under e-tendering; and improve monitoring and grievance redressal mechanism. There should be strict compliance of timelines with regard to submission of yield data by the DoA and timely compensation to farmers.

5. Improving delivery mechanism by ensuring presence of IAs at GP level and direct contact with the farmers; capacity building in terms of technological infrastructure and manpower; monitoring claim settlement process; and simplification of procedures.

COMMODITY REVIEWS

Foodgrains

Procurement of Rice

The total procurement of rice during kharif marketing season 2018-19 up to 26.11.2019 is 44.40 million tonnes as against 38.10 million tonnes during the corresponding period of last year. The details are given in Table 1. A comparative analysis of procurement of rice for the period of marketing season 2019-20 (up to 26.11.2019) and the corresponding period of last year is given in figure 1. The percentage share of different states in procurement of rice has been given in figure2.

TABLE 1: PROCUREMENT OF RICE

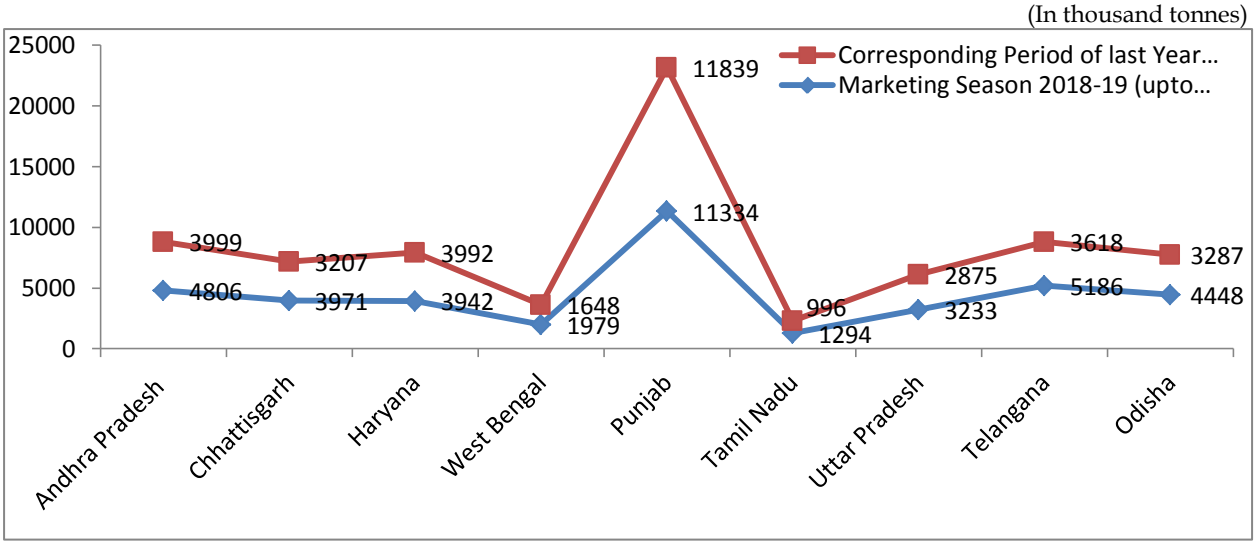
(In Thousand Tonnes)

State	Marketing Season 2018-19 (upto 26.11.2019)		Corresponding Period of last Year 2017-18	
	Procurement	Percentage to Total	Procurement	Percentage to Total
1	2	3	4	5
Andhra Pradesh	4806	10.8	3999	10.5
Chhattisgarh	3971	8.9	3207	8.4
Haryana	3942	8.9	3992	10.5
West Bengal	1979	4.5	1648	4.3
Punjab	11334	25.5	11839	31.1
Tamil Nadu	1294	2.9	996	2.6
Uttar Pradesh	3233	7.3	2875	7.5
Telangana	5186	11.7	3618	9.5
Odisha	4448	10.0	3287	8.6
Madhya Pradesh	**1395**	3.1	**1100**	2.9
Others	**2809**	6.3	**1542**	4.0
Total	**44396**	100.0	**38103**	100.0

Source: Department of Food & Public Distribution.

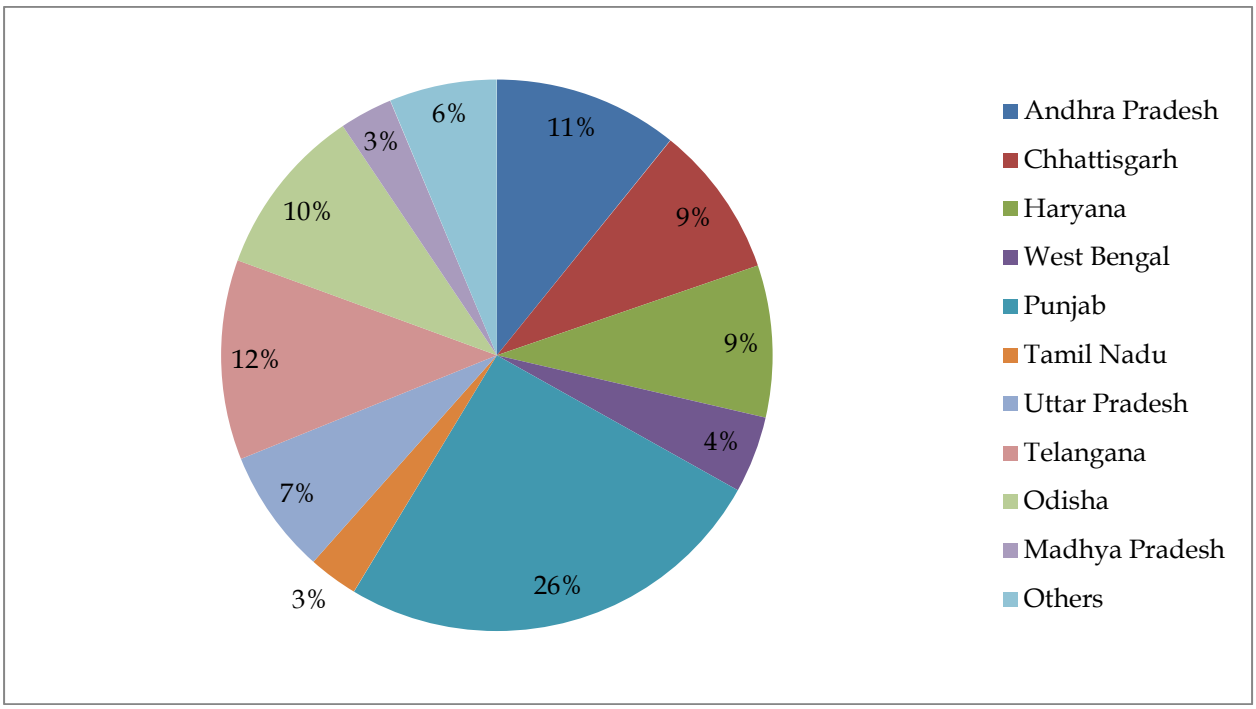
Figure 1: State-wise Procurement of Rice

(In thousand tonnes)



Source: Department of Food & Public Distribution.

Figure 2: Percentage Share of Different States in Procurement of Rice during Marketing Season 2018-19 (up to 26.11.2019).



Source: Department of Food & Public Distribution.

Procurement of Wheat

The total procurement of wheat during rabi marketing season 2019-20 up to 04.07.2019 is 34.13 million tonnes as against 35.37 million tonnes during the corresponding period of last year. The details are given in Table 2. The figure 3 depicts the comparison of procurement of wheat during the marketing season 2019-20 (up to 04.07.2019) with the corresponding period of last year. In figure 4, we have shown the share of different states in procurement of Wheat.

TABLE 2: PROCUREMENT OF WHEAT

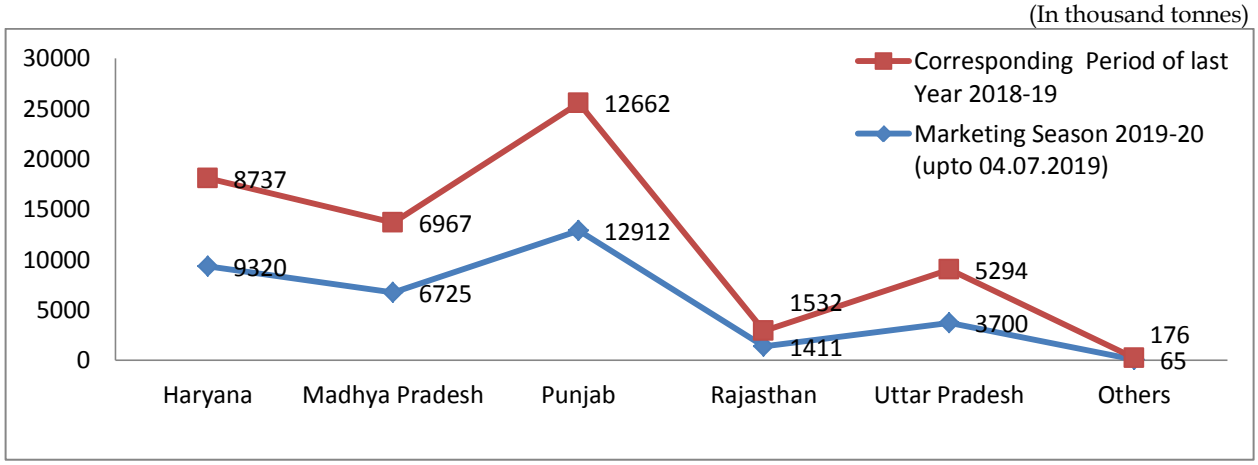
(In Thousand Tonnes)

State	Marketing Season 2019-20 (upto 04.07.2019)		Corresponding Period of last Year 2018-19	
	Procurement	Percentage to Total	Procurement	Percentage to Total
1	2	3	4	5
Haryana	9320	27.3	8737	24.7
Madhya Pradesh	6725	19.7	6967	19.7
Punjab	12912	37.8	12662	35.8
Rajasthan	1411	4.1	1532	4.3
Uttar Pradesh	3700	10.8	5294	15.0
Others	65	0.2	176	0.5
Total	**34133**	**100.0**	**35368**	**100.0**

Source: Department of Food & Public Distribution

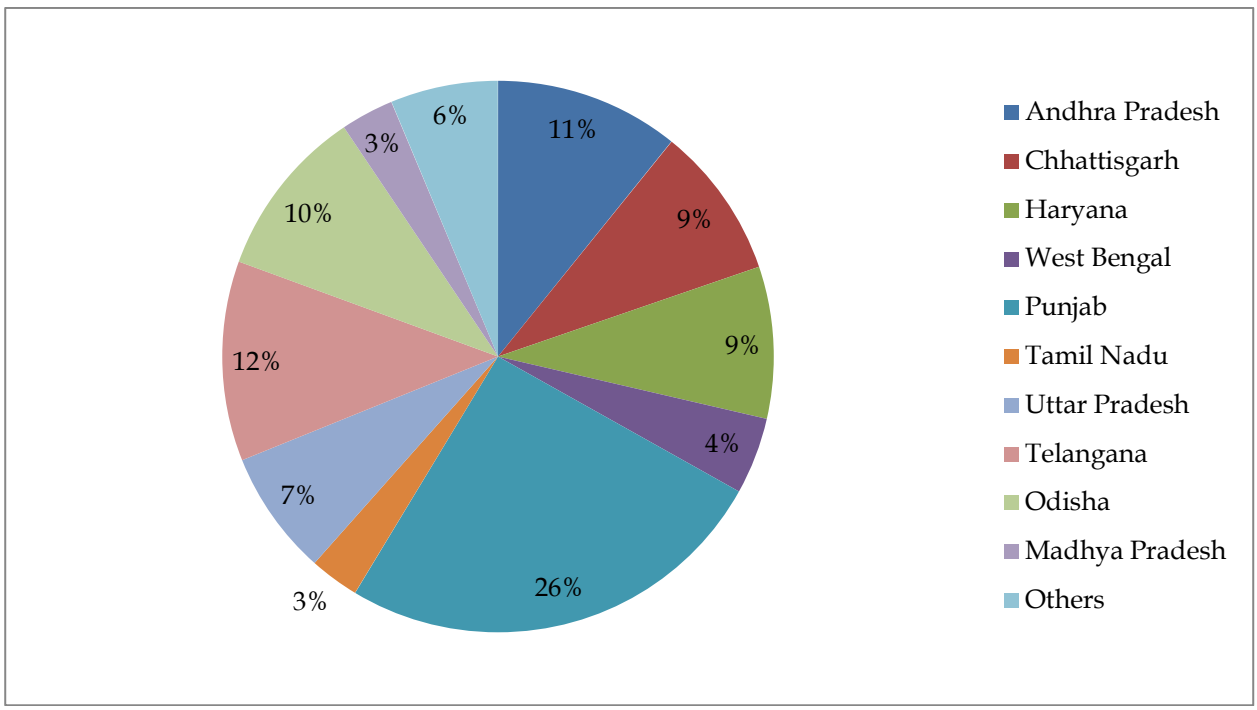
Figure 3: State-wise procurement of Wheat

(In thousand tonnes)



Source: Department of Food & Public Distribution.

Figure 4: Percentage Share of Different States in Procurement of Wheat during Marketing Season 2019-20 (up to 04.07.2019).



Source: Department of Food & Public Distribution.

Commercial Crops

Oilseeds

The Wholesale Price Index (WPI) of nine major oilseeds as a group stood at 149.6 in November, 2019 showing 1.19 percent decrease over the previous month. However, it increased by 6.33 percent over the previous year.

The WPI of individual oilseeds showed a mixed trend. The WPI of rape and mustard seed (1.10 percent), gingelly seed (sesamum) (0.56 percent), niger seed (0.46 percent), safflower (0.62 percent) and soyabean (0.62 percent) increased over the previous month. However, the WPI of groundnut seed (-5.51 percent), cotton seed (-3.73 percent) copra (-1.10 percent), sunflower (-0.08 percent) decreased over the previous month.

Manufacture of Vegetable and Animal Oils and Fats

The WPI of vegetable and animal oils and fats as a group stood at 119 in November, 2019 which shows an increase of 2.23 percent over the previous month. Moreover, it also increased by 2.23 percent over the corresponding months of the previous year. The WPI of mustard oil (2.97 percent), soybean oil (1.25 percent), sunflower oil (1.25 percent) and cotton seed oil (1.07percent) increased over the previous month. However, the WPI of copra oil (-1.23 percent) decreased over the previous month. WPI of groundnut oil and rapeseed oil showed no change over the previous month.

Fruits & Vegetable

The WPI of fruits & vegetable as a group stood at 199.4 in November, 2019 showing an increase of 2.73 percent over previous month and an increase of 28.15 percent over the corresponding month of the previous year.

Potato

The WPI of potato stood at 206.3 in November, 2019 showing an increase of 10.32 percent over the previous month. However, it decreased by 8.51 percent over the corresponding months of the previous year.

Onion

The WPI of onion stood at 478.7 in November, 2019 showing an increase of 34.16 percent over the previous month and an increase of 172.30 percent over the corresponding months of the previous year.

Condiments & Spices

The WPI of condiments & spices (group) stood at 153 in November, 2019 showing an increase of 2.82 percent over the previous month and an increase of 16.26 percent over the corresponding months of the previous year. The WPI of black pepper increased by 0.65 percent, chillies (dry) increased by 5.21 percent and that of turmeric decreased by 0.17 percent over the previous month.

Raw Cotton

The WPI of raw cotton stood at 109.9 in November, 2019 showing a decrease of 3.17 percent over the previous month and a decrease of 10.36 percent over the corresponding months of the previous year.

Raw Jute

The WPI of raw jute stood at 204.1 in November, 2019 showing an increase of 2.41 percent over the previous month and an increase of 10.44 percent over the corresponding months of the previous year.

Wholesale Price Index of commercial crops is given in Table 3. A graphical comparison of WPI for the period of November, 2019 and October, 2019 is given in figure 5. In figure 6, we have shown the comparison of WPI during the November, 2019 with the corresponding month of last year.

TABLE 3: WHOLESALE PRICE INDEX OF COMMERCIAL CROPS

(Base Year : 2011-12=100)

Commodity	latest November, 2019	month October, 2019	year November, 2018	% Variation over the Month	Year
Oilseeds	149.6	151.4	140.7	-1.19	6.33
Groundnut Seed	140.6	148.8	125.3	-5.51	12.21
Rape & Mustard Seed	146.5	144.9	146.6	1.10	-0.07
Cotton Seed	147.0	152.7	139.5	-3.73	5.38
Copra (Coconut)	189.1	191.2	191.2	-1.10	-1.10
Gingelly Seed (Sesamum)	178.8	177.8	160.8	0.56	11.19
Niger Seed	175.4	174.6	141.1	0.46	24.31
Safflower (Kardi Seed)	196.0	194.8	150.5	0.62	30.23
Sunflower	121.5	121.6	117.5	-0.08	3.40
Soyabean	161.8	160.8	141.6	0.62	14.27
Manufacture of Vegetable and Animal Oils and Fats	119.0	116.4	116.4	2.23	2.23
Mustard Oil	128.3	124.6	127.0	2.97	1.02
Soyabean Oil	113.7	112.3	111.8	1.25	1.70
Sunflower Oil	113.1	111.7	110.3	1.25	2.54
Groundnut Oil	119.7	119.7	114.3	0.00	4.72
Rapeseed Oil	115.1	115.1	112.4	0.00	2.40
Copra Oil	168.4	170.5	177.5	-1.23	-5.13
Cotton Seed Oil	113.3	112.1	107.9	1.07	5.00
Fruits & Vegetables	199.4	194.1	155.6	2.73	28.15
Potato	206.3	187.0	225.5	10.32	-8.51
Onion	478.7	356.8	175.8	34.16	172.30
Condiments & Spices	153.0	148.8	131.6	2.82	16.26
Black Pepper	124.6	123.8	139.8	0.65	-10.87
Chillies (Dry)	155.4	147.7	125.0	5.21	24.32
Turmeric	114.7	114.9	117.4	-0.17	-2.30
Raw Cotton	109.9	113.5	122.6	-3.17	-10.36
Raw Jute	204.1	199.3	184.8	2.41	10.44

Figure 5: WPI of commercial crops during November, 2019 and October, 2019

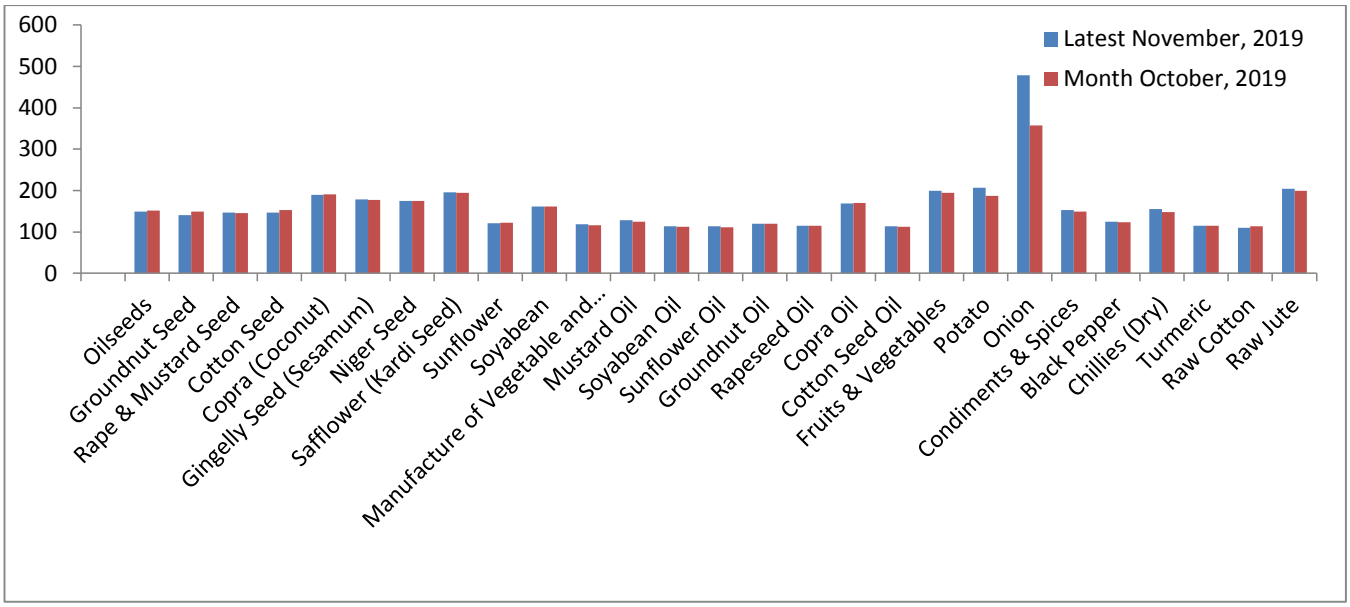
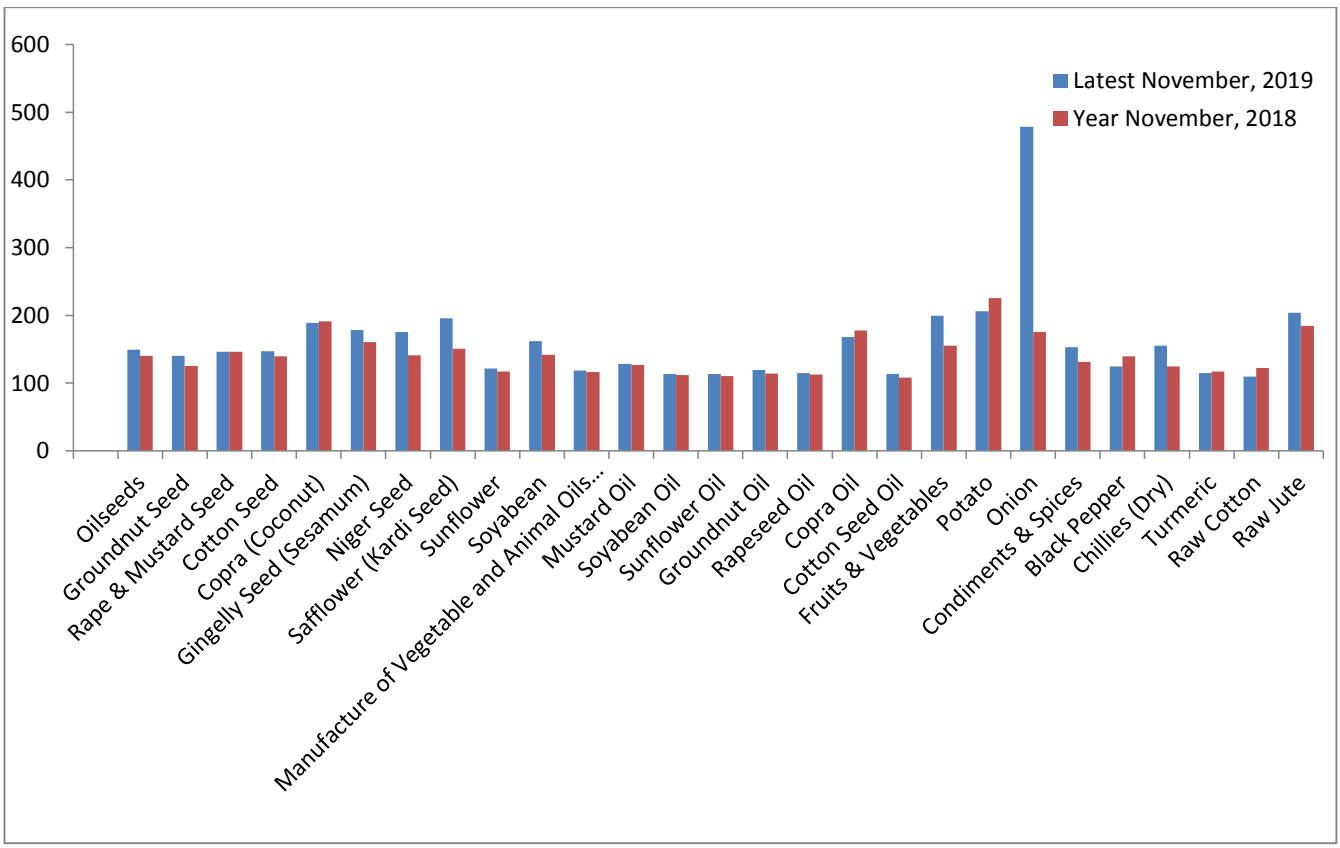


Figure 6: WPI of commercial crops during November, 2019 and November, 2018



Statistical Tables

Wages

TABLE 1. DAILY AGRICULTURAL WAGES IN SOME STATES (CATEGORY-WISE)

(In Rs.)

State	District	Centre	Month & Year	Daily Normal Working Hours	Field Labour		Other Agri. Labour		Herdsman		Skilled Labour		
					M	W	M	W	M	W	Carpenter M	Black Smith M	Cobbler M
Andhra Pradesh	Krishna	Ghantasala	Aug, 19	8	500	300	300	NA	NA	NA	NA	NA	NA
	Guntur	Tadikonda	Aug, 19	8	383	350	400	NA	325	NA	NA	500	NA
Telangana	Ranga Reddy	Arutala	April, 19	8	450	266	500	NA	NA	NA	400	400	NA
Karnataka	Bangalore	Harisandra	April, 19	8	360	350	360	350	350	NA	400	350	NA
	Tumkur	Gidlahali	April, 19	8	380	360	380	360	350	NA	400	360	NA
Maharashtra	Bhandara	Adyal	Jan, 19	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chandrapur	Ballarpur	Jan, 19	8	300	200	300	200	300	NA	350	300	150
Jharkhand	Ranchi	Gaitalsood	Feb, 19	8	239	239	239	239	239	239	330	330	NA

TABLE 1.1. DAILY AGRICULTURAL WAGES IN SOME STATES (OPERATION-WISE)

(In Rs.)

State	District	Centre	Month & Year	Type of Labour	Normal Daily WorkingHours	Ploughing	Sowing	Weeding	Harvesting	Other Agri Labour	Herdsman	Skilled Labours		
												Carpenter	Black Smith	Cobbler
Assam	Barpeta	Howly	May,19	M	8	300	NA	250	250	200	NA	275	280	NA
				W	8	NA	NA	175	170	150	NA	NA	NA	NA
Bihar	Muzaffarpur	Bhalui Rasul	June, 19	M	8	300	300	300	300	300	300	450	450	NA
				W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Shekhpura	Kutaut	June, 19	M	8	NA	NA	NA	NA	NA	NA	500	500	NA
				W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chhattisgarh	Dhamtari	Sihava	Nov,19	M	8	250	200	NA	180	180	200	300	200	200
				W	8	NA	175	NA	150	150	170	NA	150	NA
Gujarat*	Rajkot	Rajkot	Oct, 19	M	8	256	256	260	256	238	200	481	481	469
				W	8	300	300	260	250	238	196	NA	NA	NA
	Dahod	Dahod	Oct, 19	M	8	294	294	163	163	163	NA	400	350	300
				W	8	NA	250	163	163	163	NA	NA	NA	NA

TABLE 1.1. DAILY AGRICULTURAL WAGES IN SOME STATES (OPERATION-WISE)-*CONTD.*

(In Rs.)

State	District	Centre	Month & Year	Type of Labour	Normal Daily Working Hours	Ploughing	Sowing	Weeding	Harvesting	Other Agri Labour	Herdsman	Skilled Labours		
												Carpenter	Black Smith	Cobbler
Haryana	Panipat	Ugarakheri	May, 19	M	8	400	400	400	400	400	NA	550	400	NA
				W	8	NA	300	300	350	300	NA	NA	NA	NA
Himachal Pradesh	Mandi	Mandi	June,18	M	8	350	300	300	300	300	300	400	400	250
				W	8	NA	300	300	300	300	300	NA	NA	NA
Kerala	Kozhikode	Koduvally	Aug, 19	M	4-8	960	850	NA	800	980	NA	900	NA	NA
				W	4-8	NA	NA	650	650	700	NA	NA	NA	NA
	Palakkad	Elappally	Aug, 19	M	4-8	NA	600	NA	600	700	NA	750	NA	NA
				W	4-8	NA	NA	300	300	300	NA	NA	NA	NA
Madhya Pradesh	Hoshangabad	Sangarkhera	Aug, 19	M	8	250	NA	200	NA	250	150	400	400	NA
				W	8	NA	NA	200	NA	200	NA	NA	NA	NA
	Satna	Kotar	Aug, 19	M	8	300	300	300	300	300	300	500	500	500
				W	8	NA	300	300	300	300	300	NA	NA	NA
	Shyopurkala	Vijaypur	Aug, 19	M	8	NA	300	NA	NA	NA	300	400	400	NA
				W	8	NA	300	NA	NA	NA	300	NA	NA	NA
Odisha	Bhadrak	Chandbali	June, 19	M	8	350	350	350	350	383	300	500	400	400
				W	8	NA	300	300	300	308	250	NA	NA	NA
	Ganjam	Aska	June, 19	M	8	300	250	250	300	325	250	500	500	500
				W	8	NA	220	220	250	267	220	NA	NA	NA
Punjab	Ludhiyana	Pakhowal	May, 19	M	8	500	NA	NA	NA	425	NA	480	480	NA
				W	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rajasthan	Barmer	Kuseep	Sep, 19	M	8	NA	NA	500	300	NA	500	500	350	NA
				W	8	NA	NA	NA	300	NA	300	NA	350	NA
	Jalore	Sarnau	Sep, 19	M	8	400	NA	300	NA	NA	NA	500	300	NA
				W	8	NA	NA	300	NA	NA	NA	NA	300	NA
Tamil Nadu*	Thanjavur	Pulvarnatham	Sep, 19	M	8	NA	300	NA	312	397	NA	540	450	NA
				W	8	NA	NA	141	176	126	NA	NA	NA	NA
	Tirunelveli	Malayakulam	May, 19	M	8	NA	NA	NA	500	610	NA	400	400	NA
				W	8	NA	200	200	187	NA	NA	NA	NA	NA

TABLE 1.1. DAILY AGRICULTURAL WAGES IN SOME STATES (OPERATION-WISE)-CONCLD.

(In Rs.)

State	District	Centre	Month & Year	Type of Labour	Normal Daily WorkingHours	Ploughing	Sowing	Weeding	Harvesting	Other Agri Labour	Herdsman	Skilled Labours		
												Carpenter	Black Smith	Cobbler
Tripura	State Average		Aug, 19	M	8	331	331	297	276	275	275	350	319	NA
				W	8	NA	331	250	229	225	241	NA	NA	NA
Uttar Pradesh*	Meerut	Ganeshpur	July, 19	M	8	300	300	300	300	300	NA	500	NA	NA
				W	8	NA	250	250	250	250	NA	NA	NA	NA
	Aurraiya	Aurraiya	July, 19	M	8	NA	300	300	NA	300	NA	500	NA	.NA
				W	8	NA	300	300	300	300	NA	NA	NA	NA
	Chandauli	Chandauli	July, 19	M	8	300	300	NA	NA	300	NA	500	NA	NA
				W	8	NA	NA	NA	NA	300	NA	NA	NA	NA

M - Man
W - Woman
NA - Not Available
NR – Not Reported
* States reported district average daily wages

PRICES

TABLE 2. WHOLESALE PRICES OF CERTAIN AGRICULTURAL COMMODITIES AND ANIMAL HUSBANDRY PRODUCTS AT SELECTED CENTRES IN INDIA

Commodity	Variety	Unit	State	Centre	Nov-19	Oct-19	Nov-18
Wheat	PBW 343	Quintal	Punjab	Amritsar	2200	2200	1900
Wheat	Dara	Quintal	Uttar Pradesh	Chandausi	1990	1975	1860
Wheat	Lokvan	Quintal	Madhya Pradesh	Bhopal	2136	2090	2100
Jowar	-	Quintal	Maharashtra	Mumbai	4000	3800	3100
Gram	No III	Quintal	Madhya Pradesh	Sehore	3800	4200	4060
Maize	Yellow	Quintal	Uttar Pradesh	Kanpur	1850	2020	1415
Gram Split	-	Quintal	Bihar	Patna	6050	6020	5650
Gram Split	-	Quintal	Maharashtra	Mumbai	6000	5700	5700
Arhar Split	-	Quintal	Bihar	Patna	8180	8150	6480
Arhar Split	-	Quintal	Maharashtra	Mumbai	8500	7500	6100
Arhar Split	-	Quintal	NCT of Delhi	Delhi	7900	7650	5600
Arhar Split	Sort II	Quintal	Tamil Nadu	Chennai	8200	8400	6300
Gur	-	Quintal	Maharashtra	Mumbai	5100	4800	3900
Gur	Sort II	Quintal	Tamil Nadu	Coimbatore	4500	4500	4600
Gur	Balti	Quintal	Uttar Pradesh	Hapur	2200	2850	2280
Mustard Seed	Black (S)	Quintal	Uttar Pradesh	Kanpur	3800	3690	4225
Mustard Seed	Black	Quintal	West Bengal	Raniganj	4350	4350	4450
Mustard Seed	-	Quintal	West Bengal	Kolkata	4550	4500	4500
Linseed	Bada Dana	Quintal	Uttar Pradesh	Kanpur	4800	4600	4160
Linseed	Small	Quintal	Uttar Pradesh	Varanasi	4700	4700	4050
Cotton Seed	Mixed	Quintal	Tamil Nadu	Virudhunagar	2400	2500	1650
Cotton Seed	MCU 5	Quintal	Tamil Nadu	Coimbatore	2800	2800	2700
Castor Seed	-	Quintal	Telangana	Hyderabad	4000	4400	5100
Sesamum Seed	White	Quintal	Uttar Pradesh	Varanasi	9280	9800	10100
Copra	FAQ	Quintal	Kerala	Alleppey	10450	10150	9550
Groundnut	Pods	Quintal	Tamil Nadu	Coimbatore	5300	6000	5800
Groundnut	-	Quintal	Maharashtra	Mumbai	8500	9300	5750
Mustard Oil	-	15 Kg.	Uttar Pradesh	Kanpur	1360	1360	1375
Mustard Oil	Ordinary	15 Kg.	West Bengal	Kolkata	1400	1400	1477
Groundnut Oil	-	15 Kg.	Maharashtra	Mumbai	1530	1530	1440
Groundnut Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	2050	2120	1860

TABLE 2. WHOLESALE PRICES OF CERTAIN AGRICULTURAL COMMODITIES AND ANIMAL HUSBANDRY PRODUCTS AT SELECTED CENTRES IN INDIA-*CONTD.*

Commodity	Variety	Unit	State	Centre	Nov-19	Oct-19	Nov-18
Linseed Oil	-	15 Kg.	Uttar Pradesh	Kanpur	1455	1450	1430
Castor Oil	-	15 Kg.	Telangana	Hyderabad	1335	1395	1710
Sesamum Oil	-	15 Kg.	NCT of Delhi	Delhi	1830	1825	1750
Sesamum Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	2900	3500	3400
Coconut Oil	-	15 Kg.	Kerala	Cochin	2313	2175	2070
Mustard Cake	-	Quintal	Uttar Pradesh	Kanpur	2000	1875	1810
Groundnut Cake	-	Quintal	Telangana	Hyderabad	3857	3857	3143
Cotton/Kapas	NH 44	Quintal	Andhra pradesh	Nandyal	5200	5500	5450
Cotton/Kapas	LRA	Quintal	Tamil Nadu	Virudhunagar	3900	4400	NA
Jute Raw	TD 5	Quintal	West Bengal	Kolkata	4850	4650	4350
Jute Raw	W 5	Quintal	West Bengal	Kolkata	4850	4700	4400
Oranges	-	100 No	NCT of Delhi	Delhi	708	708	NA
Oranges	Big	100 No	Tamil Nadu	Chennai	650	900	500
Banana	-	100 No.	NCT of Delhi	Delhi	458	458	417
Banana	Medium	100 No.	Tamil Nadu	Kodaikkanal	700	700	670
Cashewnuts	Raw	Quintal	Maharashtra	Mumbai	95000	86000	110000
Almonds	-	Quintal	Maharashtra	Mumbai	70000	75000	75000
Walnuts	-	Quintal	Maharashtra	Mumbai	65000	63000	70000
Kishmish	-	Quintal	Maharashtra	Mumbai	18000	18000	19000
Peas Green	-	Quintal	Maharashtra	Mumbai	5800	6200	5700
Tomato	Ripe	Quintal	Uttar Pradesh	Kanpur	2300	2750	1000
Ladyfinger	-	Quintal	Tamil Nadu	Chennai	2000	1000	2600
Cauliflower	-	100 No.	Tamil Nadu	Chennai	2000	2500	2000
Potato	Red	Quintal	Bihar	Patna	1580	1470	1120
Potato	Desi	Quintal	West Bengal	Kolkata	1800	1500	1200
Potato	Sort I	Quintal	Tamil Nadu	Mettuppalayam	2720	2973	2493
Onion	Pole	Quintal	Maharashtra	Nashik	5500	3100	800
Turmeric	Nadan	Quintal	Kerala	Cochin	11000	11000	12000
Turmeric	Salam	Quintal	Tamil Nadu	Chennai	11000	11500	11800
Chillies	-	Quintal	Bihar	Patna	11240	10450	9820

TABLE 2. WHOLESALE PRICES OF CERTAIN AGRICULTURAL COMMODITIES AND ANIMAL HUSBANDRY PRODUCTS AT SELECTED CENTRES IN INDIA-*CONCLD.*

Commodity	Variety	Unit	State	Centre	Nov-19	Oct-19	Nov-18
Black Pepper	Nadan	Quintal	Kerala	Kozhikode	31000	28500	34000
Ginger	Dry	Quintal	Kerala	Cochin	26000	26000	20500
Cardamom	Major	Quintal	NCT of Delhi	Delhi	120000	124000	96000
Cardamom	Small	Quintal	West Bengal	Kolkata	270000	270000	130000
Milk	Buffalo	100 Liters	West Bengal	Kolkata	5200	5200	5200
Ghee Deshi	Deshi No 1	Quintal	NCT of Delhi	Delhi	70000	68701	78373
Ghee Deshi	-	Quintal	Maharashtra	Mumbai	40000	40000	44000
Ghee Deshi	Desi	Quintal	Uttar Pradesh	Kanpur	38400	39000	39600
Fish	Rohu	Quintal	NCT of Delhi	Delhi	16700	16700	15500
Fish	Pomphrets	Quintal	Tamil Nadu	Chennai	30000	40000	40000
Eggs	Madras	1000 No.	West Bengal	Kolkata	5000	4120	4595
Tea	-	Quintal	Bihar	Patna	21720	21540	21350
Tea	Atti Kunna	Quintal	Tamil Nadu	Coimbatore	NA	42000	39000
Coffee	Plant-A	Quintal	Tamil Nadu	Coimbatore	38200	38200	25000
Coffee	Rubusta	Quintal	Tamil Nadu	Coimbatore	26500	26500	16000
Tobacco	Kampila	Quintal	Uttar Pradesh	Farukhabad	7400	8100	3480
Tobacco	Raisa	Quintal	Uttar Pradesh	Farukhabad	4300	4100	2440
Tobacco	Bidi Tobacco	Quintal	West Bengal	Kolkata	13200	13200	13300
Rubber	-	Quintal	Kerala	Kottayam	12000	11800	10600
Arecanut	Pheton	Quintal	Tamil Nadu	Chennai	59500	57500	59000

TABLE 3. WHOLESALE PRICES OF SOME IMPORTANT AGRICULTURAL COMMODITIES IN INTERNATIONAL MARKETS DURING YEAR 2019

Commodity	Variety	Country	Centre	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
CARDAMOM	Guatmala Bold Green	U.K.	-	Dollar/MT	22000	24000	24000	24000	28000	28000	28000	28000	28000	28000	28000
				Rs./Qtl	156244	170688	166200	166512	195188	193144	193116	200676	197988	198520	200788
CASHEW KERNELS	Spot U.K. 320s	U.K.	-	Dollar/MT	10231	10156	9982	9878	8956	9198	9003	8809	8905	8656	8596
				Rs./Qtl	72657	72226	69125	68534	62432	63448	62091	63131	62966	61368	61640
CASTOR OIL	Any Origin ex tank Rotterdam	Netherlands	-	Dollar/MT	1777	1823	1816	2001	1976	1897	2002	1911	1911	1628	1566
				Rs./Qtl	12619	12968	12577	13884	13778	13086	13805	13698	13512	11543	11229
CHILLIES	Birds eye 2005 crop	Africa	-	Dollar/MT	4800	4800	4800	4800	4800	5800	5800	5800	5800	5800	5800
				Rs./Qtl	34090	34138	33240	33302	33461	40008	40003	41569	41012	41122	41592
CLOVES	Singapore	Madagascar	-	Dollar/MT	7800	7500	7000	7000	6700	6700	5750	6000	6000	5300	5300
				Rs./Qtl	55396	53340	48475	48566	46706	46217	39658	43002	42426	37577	38006
COCONUT OIL	Crude Phillipine/ Indonesia, cif Rotterdam	Netherlands	-	Dollar/MT	752	724	684	659	637	617	664	741	717	729	757
				Rs./Qtl	5342	5146	4734	4570	4440	4253	4577	5312	5068	5165	5430
COPRA	Phillipines cif Rotterdam	Phillipine	-	Dollar/MT	497	450	414	414	401	417	436	448	453	456	474
				Rs./Qtl	3530	3201	2866	2874	2797	2878	3009	3212	3204	3234	3402
CORRIANDER		India	-	Dollar/MT	1650	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
				Rs./Qtl	11718	12090	11773	11795	11851	11727	11725	12184	12021	12053	12191
CUMMIN SEED		India	-	Dollar/MT	3200	3200	3200	3200	3200	3600	3900	3900	3900	3900	3900
				Rs./Qtl	22726	22758	22160	22202	22307	24833	26898	27951	27577	27651	27967
MAIZE		U.S.A.	Chicago	C/56 lbs	379	376	357	351	348	443	434	363	355	387	363
				Rs./Qtl	1058	1051	972	957	953	1201	1176	1022	987	1078	1023
OATS		CANADA	Winnipeg	Dollar/MT	395	359	355	404	405	359	364	338	362	387	424
				Rs./Qtl	2803	2553	2458	2803	2821	2475	2508	2422	2559	2742	3040
PALM KERNAL OIL	Crude Malaysia/ Indonesia, cif Rotterdam	Netherlands	-	Dollar/MT	761	694	659	649	572	529	529	612	574	566	756
				Rs./Qtl	5406	4933	4565	4501	3985	3649	3648	4383	4058	4012	5422
PALM OIL	Crude Malaysian/ Sumatra, cif Rotterdam	Netherlands	-	Dollar/MT	521	566	514	534	514	509	496	572	582	584	722
				Rs./Qtl	3699	4028	3558	3704	3583	3509	3419	4097	4113	4139	5176
PEPPER (Black)	Sarawak Black lable	Malaysia	-	Dollar/MT	3200	3200	3800	3800	3200	3200	3200	3200	3200	3200	3200
				Rs./Qtl	22726	22758	26315	26364	22307	22074	22070	22934	22627	22688	22947

TABLE 3. WHOLESALE PRICES OF SOME IMPORTANT AGRICULTURAL COMMODITIES IN INTERNATIONAL MARKETS DURING YEAR 2019-*CONTD*.

Commodity	Variety	Country	Centre	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
RAPESEED	Canola	CANADA	Winnipeg	Can Dollar/ MT	482	475	463	440	435	441	448	448	448	455	456
				Rs./Qtl	2577	2558	2393	2279	2238	2322	2346	2413	2387	2471	2460
	UK delivered rapeseed, delivered Erith(buyer)	U.K.	-	Pound/MT	304	304	304	304	304	304	304	304	304	304	304
				Rs./Qtl	2835	2819	2747	2741	2673	2661	2603	2652	2646	2766	2815
RAPESEED OIL	Refined bleached and deodorised ex-tanks,broker price	U.K.	-	Pound/MT	695	695	767	767	775	775	821	821	821	821	821
				Rs./Qtl	6482	6357	6931	6917	6815	6783	7031	7163	7145	7470	7603
SOYABEAN MEAL	UK produced 49% oil &protein ('hi-pro') ex-mill seaforth UK bulk	U.K.	-	Pound/MT	299	286	274	272	314	309	309	309	309	309	309
				Rs./Qtl	2789	2652	2476	2453	2761	2704	2646	2696	2689	2812	2862
SOYABEAN OIL		U.S.A.	-	C/lbs	28	30	30	28	26	28	28	29	29	30	30
				Rs./Qtl	4383	4702	4579	4282	3995	4257	4256	4581	4520	4688	4741
	Refined bleached and deodorised ex-tanks,broker price	U.K.	-	Pound/MT	635	635	647	651	669	-	-	-	-	-	-
				Rs./Qtl	5923	5808	5843	5871	5899	-	-	-	-	-	-
SOYABEANS		U.S.A.	-	C/60 lbs	899	911	898	854	791	903	893	872	883	933	903
				Rs./Qtl	2343	2378	2282	2174	2024	2286	2260	2294	2291	2428	2376
	US NO.2 yellow	Netherlands	Chicago	Dollar/MT	384	380	373	353	340	-	-	364	366	383	367
				Rs./Qtl	2724	2699	2581	2450	2372	-	-	2606	2587	2718	2629
SUNFLOWER SEED OIL	Refined bleached and deodorised ex-tanks,broker price	U.K.	-	Pound/MT	724	724	560	702	713	713	780	780	780	780	780
				Rs./Qtl	6753	6622	5060	6331	6269	6240	6680	6806	6788	7097	7224
Wheat		U.S.A.	Chicago	C/60 lbs	526	487	440	435	431	544	512	472	486	516	529
				Rs./Qtl	1371	1271	1118	1108	1103	1377	1296	1241	1261	1343	1392

Source: - Public Ledger

FOREIGN EXCHANGE RATES

Currency	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
CanDollar	53.44	53.88	51.69	51.86	51.51	52.68	52.35	53.88	53.34	54.26	53.97
UKPound	93.27	92.72	90.36	90.18	87.93	87.52	85.64	87.25	87.03	90.99	92.61
USDollar	71.02	71.12	69.25	69.38	69.71	68.98	68.97	71.67	70.71	70.9	71.71

Crop Production

Sowing and Harvesting Operations Normally in Progress During February, 2020

State	Sowing	Harvesting
(1)	(2)	(3)
Andhra Pradesh	Summer Rice, Ragi (R) Sugarcane	Winter Rice Jowar (K), Maize (R), Ragi (K), Wheat Gram, Tur (K), Urad (K), Mung (K), Other Kharif Pulses, Winter Potato (Plains), Sugarcane, Chillies (Dry), Tobacco, Castorseed, Linseed, Cotton, Turmeric, Onion (2nd Crop) Coriander.
Andhra Pradesh	Assam Autumn Rice, Summer Potato (Hills), Jute.	Gram Urad (R), Winter Potato, Tobacco, Rapeseed & Mustard, Linseed, Cotton.
Bihar	Sugarcane.	Wheat, Barley, Gram, Winter Potato (Plain), Rapeseed & Mustard, Sugarcane, Linseed.
Gujarat	Sugarcane.	Jowar (R), Wheat, Gram Tur (K), Other Rabi Pulses, Winter Potato, Sugarcane, Ginger, Chillies (Dry), Tobacco, Castorseed, Rapeseed & Mustard, Cotton, Turmeric, Onion.
Himachal Pradesh	Winter Potato (Hills).	---
Jammu & Kashmir	Sugarcane, Onion.	Winter Potato.
Karnataka	Summer Rice, Mung (R), Sugrcane.	Winter Rice, Jower (R), Maize (R), Wheat, Barley, Gram, Tur (K), Other Kharif Pulse, Potato, Sugarcane, Black Pepper, Tobacco, Castorseed, Rapeseed & Mustard, Linseed, Cotton, Turmeric Cardiseed.
Kerala	Summer Rice, Tur (K), Other Rabi Pulses (Kulthi), Sugarcane, Sesamum.	Winter Rice, Urad (R), Surgrcane, Cotton, Sweet Potato. Madhya Pradesh Sugarcane, Onion, Jowar (R), Wheat, Barley, Small Millets (R), Gram, Tur, Urad (R), Mung (R), Other Rabi Pulse, Winter Potato (Hills) Sugarcane, Ginger, Chillies (Dry), Tobacco, Castorseed, Rapeseed & Mustard, Linseed, Cotton, Sweet Potato, Turmeric, Sannhemp, Cardiseed, Onion.
Maharashtra	Sugarcane.	Jowar (R), Wheat, Barley, Gram, Tur (K), Urad (R), Mung (R), Other Rabi Pulses, Witner Potato (Plains), Sugarcane, Chillies (Dry), Tobacco, Castorseed, Rapeseed & Mustard, Linseed, Cotton, Cardiseed.
Manipur	Jute.	Wheat, Castorseed, Rapeseed & Mustard, Turmeric, Orissa Sugarcane, Chillies (Dry), Bajra (R), Winter Potato (Plains), Chillies (Dry), Rapeseed & Mustard.

SOWING AND HARVESTING OPERATIONS NORMALLY IN PROGRESS DURING FEBRUARY, 2020-CONTD.

State	Sowing	Harvesting
(1)	(2)	(3)
Punjab and Haryana	Sugarcane, Tobacco, Onion, Potato.	Potato, Sugarcane, Rapeseed & Mustard, Turmeric Rajasthan Sugarcane, Gram, Tur (K), Winter Potato (Plains), Sugarcane, Castorseed, Rapeseed & Mustard, Linseed.
Tamil Nadu	Summer Rice, Jowar (R), Sugarcane, Groundnut, Cotton, Onion, Sesamum (Late).	Winter Rice, Jowar (R), Bajra, Ragi Small Millets (K), Gram, Tur, Urad (K) Mung (K), Other Rabi Pulses (Kulthi), Winter Potato, Sugarcane, Black Papper, Tobacco, Castor seed, Sesamum, Cotton, Turmeric, Onion.
Tripur	Sugarcane.	Gram, Urad (R), Mung (R), Other Rabi Pulses, Winter Potato (Plains), Sugarcane, Chillies (Dry), Rapeseed & Mustard, Sweet Potato.
Uttar Pradesh	Summer Rice, Small Millets (R), Sugarcane, Tobacco Jute, Tapioca (Ist Crop).	Rapeseed & Mustard.
West Bengal	Summer Rice, Sugarcane,	Tur (k), Urd (R), Mung (R), Other Rabi Rulses, Winter Potato Sugarcane, Ginger, Chillies (Dry), Tobacco Sesamum, (Ist Crop, Rapeseed & Mustard.

(K) Kharif (R) Rabi

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N.Q. – Not Quoted.

N.T. – No Transactions.

N.S. – No Supply/No Stock.

R. – Revised.

M.C. – Market Closed.

N.R. – Not Reported.

Neg. – Negligible.

Kg. – Kilogram.

Q. – Quintal.

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ISSN 0002-1679
Regn.No.:840

P. Agri. 21-01-2020
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