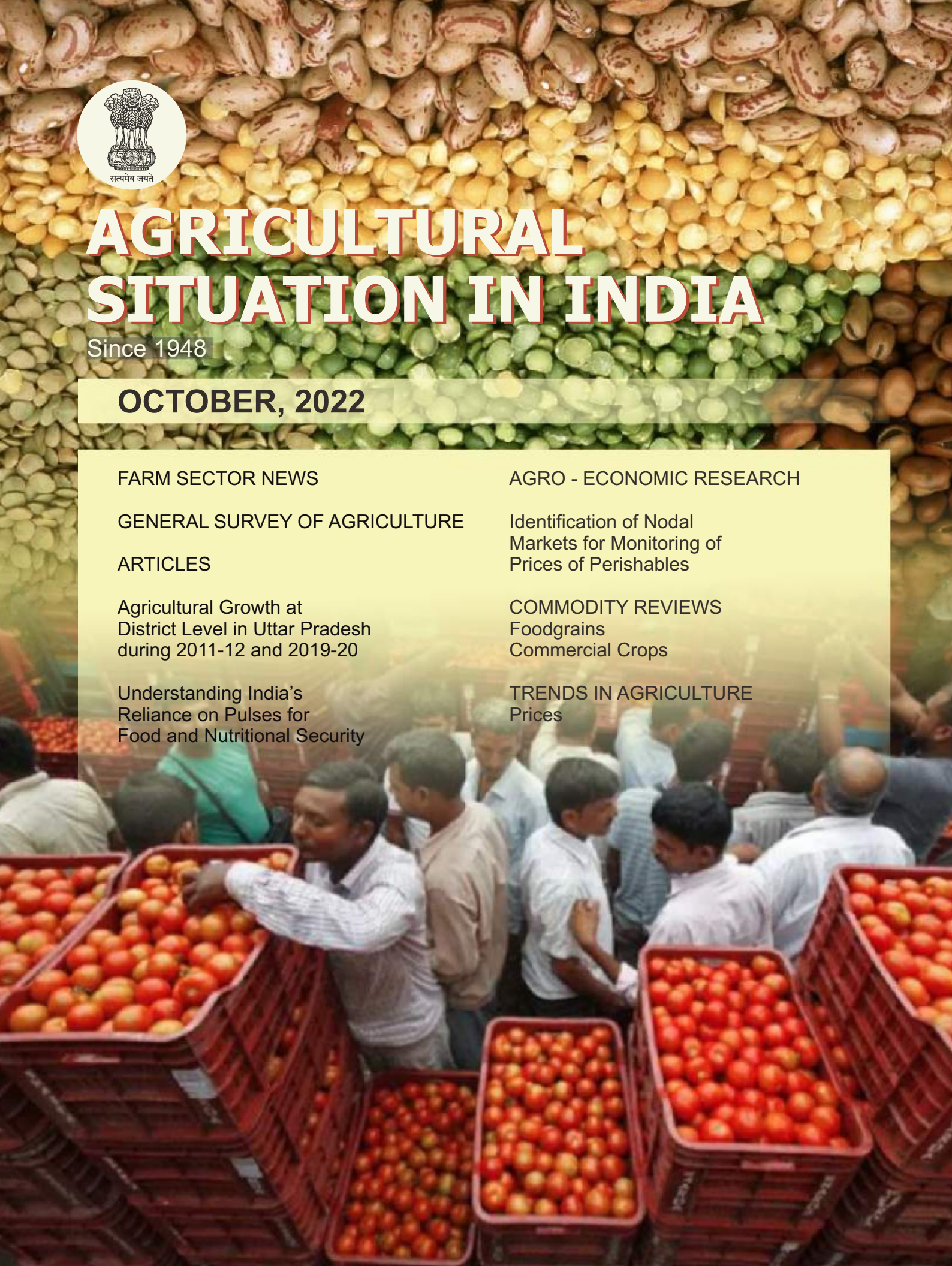

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From Editor's Desk

This issue of "Agricultural Situation in India" encompasses information related to farm sector news, production and procurement of food grains, price indices and associated statistical data along with two research articles, one on "Agricultural Growth at District Level in Uttar Pradesh during 2011-12 and 2019-20" and second on "Understanding India's Reliance on Pulses for Food and Nutritional Security". In addition, an Agro-Economic Research study titled "Identification of Nodal Markets for Monitoring of Prices of Perishables" by the Institute of Economic Growth, University of Delhi under the Agro-Economic Research scheme of Directorate of Economics and Statistics is covered in this edition.

The major farm sector news cover announcement of minimum support prices for Rabi crops for Marketing Season 2023-24, news on meeting held on issues of Crop Residue Management, XXVI meeting of ICAR Regional Committee, Coconut Community Farmers' Conference, 7th ASEAN-India Ministerial Meeting; and events like Mahila Kisan Diwa and PM Kisan Samman Sammelan 2022. Other news inter-alia include creation of a separate Division for Agriculture Startups in the Ministry of Agriculture and release of 3rd Advance Estimates of area and production of horticultural crops for the year 2021-22.

The annual rate of inflation based on all-India WPI has decreased from 13.83 percent in October, 2021 to 8.39 percent (provisional) in the month of October, 2022. The annual food inflation rate increased by 6.48 percent in the month October, 2022 (provisional) over October, 2021, whereas on month-on-month basis, the food inflation rate increased by 1.31 percent in October, 2022 over September, 2022, provisionally. The cumulative post-monsoon season rainfall in the country during the period 1st October, 2022 to 26th October, 2022 has been 60 percent higher than the long period average (LPA). Current live storage in 143 major water reservoirs in the country is 158.45 BCM, as against the average storage of last 10 years, 135.49 BCM.

The article titled "Agricultural Growth at District Level in Uttar Pradesh during 2011-12 and 2019-20" examines the district level growth rates in agriculture, particularly the crop sector in the state of Uttar Pradesh and also tries to identify the major determinants of agricultural growth. The study finds that about one-third of the districts in the state are facing agricultural stagnation over the decade. The state also experienced a declining productivity with only one of the four economic regions showing a positive growth. Area under commercial crops is found to be a major determinant of output and productivity growth. The paper suggests need of newer technological interventions as districts with high productivity have reached a stagnation point. Area and district focused agricultural research needs to be undertaken with emphasis on districts which lag behind. Diversification of agriculture needs to be encouraged as it holds key to growth of agriculture.

The second article on "Understanding India's Reliance on Pulses for Food and Nutritional Security" assess the scenario of pulses in India in terms of area, production and productivity. The study finds that although India is ranked first in terms of area under pulses and production, but the productivity is significantly lower when compared across the world. The share of pulses to the total production of food grains has decreased due to decline in productivity. Also the per capita availability of pulses has declined over the years, which is a matter of concern. There is a need of initiatives like expansion of area under cultivation, use of high yielding varieties, improving soil fertility, innovative interventions in the cropping system and utilizing rice fellow while intercropping pulses with other crops. Such steps may help increase the productivity and meet the demand of pulses without much dependence on imports.

The Agro-Economic Research study on "Identification of Nodal Markets for Monitoring of Prices of Perishables" tries to determine a smaller set of markets for three commodities *viz.*; tomato, potato and onion for the purpose of monitoring these markets. This will help decipher the price trends in other markets. The study identifies nine markets for tomato, eight for onion and six for potato as the leading markets in which the price can be observed so as to interpret the price trends across the other markets in India. This exercise of focusing on fewer markets will help reduce the operational costs and increase the efficiency which will help the policymakers in taking timely decisions on production planning, exports and imports.

Promodita Sathish

Farm Sector News

Cabinet Decisions and Announcements

Minimum Support Prices for Rabi crops for Marketing Season 2023-24

The Cabinet Committee on Economic Affairs chaired by the Hon'ble Prime Minister, Shri Narendra Modi has approved the increase in the Minimum Support Prices (MSP) for all mandated Rabi crops for Marketing Season 2023-24.

The Government has increased the MSP of Rabi crops for Marketing Season 2023-24 to ensure remunerative prices to the growers for their produce. The absolute highest increase in MSP was approved for lentil (masur) at Rs. 500 per quintal, followed by rapeseed and mustard at Rs. 400 per quintal. For safflower, an increase of Rs. 209 per quintal was approved. For wheat, gram and barley, an increase of Rs. 110 per quintal, Rs.105 per quintal and Rs.100 per quintal, respectively, was approved.

MSP FOR ALL RABI CROPS FOR MARKETING SEASON 2023-24

(Rs. per quintal)

Sl. No.	Crops	MSP RMS 2022-23	MSP RMS 2023-24	Cost* of production RMS 2023-24	Increase in MSP (Absolute)	Return over cost (in percent)
1	Wheat	2015	2125	1065	110	100
2	Barley	1635	1735	1082	100	60
3	Gram	5230	5335	3206	105	66
4	Lentil (Masur)	5500	6000	3239	500	85
5	Rapeseed & Mustard	5050	5450	2670	400	104
6	Safflower	5441	5650	3765	209	50

Source: DES, DA&FW, Government of India

Note:*Refers to cost which includes all paid out costs such as those incurred on account of hired human labour, bullock labour/machine labour, rent paid for leased in land, expenses incurred on use of material inputs like seeds, fertilizers, manures, irrigations charges, depreciation on implements and farm buildings, interest on working capital, diesel/electricity for operation of pump sets etc., misc. expenses and imputed value of family labour.

The increase in MSP for Rabi crops for Marketing Season 2023-24 is in line with the Union Budget 2018-19 announcement of fixing the MSP at a level of atleast 1.5 times of the All-India weighted average cost of production, aiming at reasonably fair remuneration for the farmers. The maximum rate of return is 104 percent for rapeseed & mustard, followed by 100 percent for wheat, 85 percent for lentil, 66 percent for gram, 60 percent for barley and 50 percent for safflower.

Meetings and Events

XXVI Meeting of ICAR Regional Committee - II held

Indian Council of Agricultural Research (ICAR) under Ministry of Agriculture and Farmers Welfare, Government of India conducted the XXVI meeting of ICAR Regional Committee-II comprising the states of West Bengal, Odisha, Telangana, Andhra Pradesh and the Union Territory of Andaman & Nicobar Islands on 14th October, 2022 at ICAR-National Rice Research Institute, Cuttack.

Addressing the inaugural session in virtual mode, the Hon'ble Union Minister of State for Agriculture and Farmers Welfare, Shri Kailash Choudhary said that there is a need to intensify research and development activities and ensure that it reaches to our farmers at the ground level. "In order to increase the farmers' income, we need to decrease their loan burden, provide developed seeds, create market linkage and storage facilities. States need to work proactively at the field level, the Centre is always there to provide assistance," he said.

Stressing on the importance of natural farming, the Minister said that there is a need to shift from chemicals, fertilizers based farming. "Technology needs to be extended to our farmers. Only research can't do it alone, the end product of the research needs to reach the farmer," he added.

He also emphasized that such type of review is essential not only to examine the progress, but to pin-point the problems and chalk out the possible solutions. States like Odisha, West Bengal, Andhra Pradesh and Telangana are becoming highly affected by the adverse climatic conditions. Therefore, new climate-smart technologies for the farmers should be developed. He claimed that until the agricultural activities are taken as a commercial venture, one can't reap full potential benefits and get remunerative returns.

Secretary, Department of Agricultural Research & Education (DARE) & Director General (DG), ICAR, Dr. Himanshu Pathak stated that in spite of Covid-19 pandemic, India's exports of agricultural and processed food products increased by 13% as compared to the previous year. However, the share in world export of food product is only about 3% due to low level of processing and lower value addition. Also low level of processing is reflected in the composition of India's food export basket which essentially consists of primary produce like rice, flour, sugar, meat, fish, etc. He also expressed his concern about the low productivity of this region due to various reasons like poor soil quality, low use of fertilizer, insect-pest infestation and high dependence on monsoon rainfall.

State-wise problems and research needs/ development issues were discussed during the technical session. Action Taken Report (ATR) with respect to the issues finalized during earlier meeting were deliberated and discussion was done to prepare a roadmap for the development of agriculture including animal husbandry, dairy, fisheries, natural resource management and human resource development in the region. This meeting will help to establish the link between ICAR and State Governments for identifying state specific problems related to agricultural and allied aspects and offering suitable solutions through achievements and accomplishments of the National Agricultural Research System (NARS) of the concerned states within specific timeline.

The ICAR has set up eight Regional Committees on the basis of agro-climatic regions. The purpose of the Regional Committee is to provide a forum to the researchers and the State Government functionaries to examine the major gaps in the current research and training efforts in agriculture, animal husbandry and fisheries; to identify priorities; and to decide agenda of research and extension education in different agro-ecological regions of the country for the coming two years. A research agenda of national relevance in the areas of agricultural technology assessment, refinement and transfer is set up for discussion in the regular meetings of the Regional Committee, which is held once in two years.

Coconut Community Farmers' Conference

Hon'ble Union Minister for Agriculture and Farmers Welfare, Shri Narendra Singh Tomar addressed the Coconut Community Farmers' Conference in Coimbatore, Tamil Nadu on 14th October, 2022. On the occasion, the Minister said that the Centre will continue to provide all possible assistance to the farmers in the coastal states to promote coconut cultivation in the country. The efforts made in the field of research and development in the last few years have resulted in the development of new technologies in the field of farming and processing, and further improved the available technologies. With the increase in the number of coconut based industries in the country, new products and many employment opportunities are also increasing in the market.

Shri Tomar congratulated the Coconut Development Board and Sugarcane Breeding Institute for their initiatives towards the prosperity of the coconut growers' community. He said that agriculture sector is the backbone of the country's economy, so it is the responsibility of the Central and State Governments to strengthen it, promote it and ensure profitable farming for the farmers. Contribution of coconut cultivation in the agricultural economy is very important. India is a leader in coconut cultivation and is amongst the world's three largest producers. Tamil Nadu contributes 21 percent of the area under coconut

in the country and 26 percent of the production. Tamil Nadu ranks first in coconut processing activities and Coimbatore is first in terms of area under coconut cultivation, with an area of 88,467 hectares under coconut cultivation. Shri Tomar said that the farmers are making significant contribution in the development of coconut sector and increasing the agricultural economy. Coconut Development Board is forming a three-tier farmer group by integrating small and marginal farmers. Presently there are 697 Coconut Growers Societies, 73 Coconut Growers Federations and 19 Coconut Producing Companies in the state. Support has been given to set up 537 new processing units in India with a processing capacity of 3,638 million coconuts per year. This success has been achieved through the Mission Programme implemented by the Coconut Development Board in the country. Out of these, 136 units are from Tamil Nadu which are creating employment opportunities and also helping improve the financial condition of the farmers.

Shri Tomar said that even after everything is favourable in the field of agriculture, farmers have to face natural disasters, which causes them losses. It is compensated through the Pradhan Mantri Fasal Bima Yojana and the Tamil Nadu State Scheme. Agriculture contributes significantly to strengthen the economy, he said. Agriculture is so fundamental that it has helped tide over adverse conditions like Covid-19.

Mahila Kisan Diwas

The National Gender Resource Centre in Agriculture (NGRCA), Department of Agriculture & Farmers Welfare, Ministry with Agriculture & Farmer's Welfare in collaboration with National Institute of Agricultural Extension Management (MANAGE), an autonomous organization under Ministry of Agriculture and Farmers Welfare (MoA&FW), celebrated 'Mahila Kisan Diwas' or 'International Rural Women Day' on 15th October, 2022. As the year 2023 has been declared as the 'International Year of Millets' by the United Nations (UN), the theme of this year Mahila Kisan Diwas was **'Millets: Empowering Women and Providing Nutritional Security'.** This inaugural event was organized through video conferencing under the guidance of Hon'ble Union Agriculture Minister, Shri Narendra Singh Tomar. The technical session of the programme was organized at MANAGE, Hyderabad with the technical support provided by Indian Institute of Millet Research (IIMR), Hyderabad.

Speaking on the occasion, Shri Tomar said, the resolution initiated by Government of India and supported by 72 countries to mark year 2023 as the 'International Year of Millets' was unanimously adopted by the United Nations General Assembly. The Government of India has declared to celebrate IYOM, 2023 to make it peoples' movement so that the Indian millets, recipes, value added products are accepted globally. The 'International Year of Millets' stands to provide a unique opportunity to increase global production, ensure efficient processing and consumption, promote a better utilization of crop rotations and encourage better connectivity throughout food systems to promote millets as a key component of the food basket. Shri Tomar stated the Government of India is committed to give priority to women for bringing them in the mainstream of agriculture development. He expressed that women are the primary producers of food grains, custodians of biodiversity and millets are an important food grain from our indigenous food systems. Millet-based farming is the answer to cope with the changing time as millet farming preserves biodiversity and empowers women farmers as cultivators to agripreneurs and self-employed women; more confident in their abilities and are able to address their problems better. The Government of India has also taken several initiatives focusing on empowerment of women, keeping them in the center stage of development process. These initiatives include constitution of Self Help Groups, Farmer Producer Organizations, Producer Companies and capacity building of women through training in various institutions like Krishi Vigyan Kendras.

Shri Tomar released a book on depicting "Evidences based Gender Inequality in Agriculture and Food Systems in India" which will be helpful for the policy makers, academicians and researchers to focus on areas where the gender analysis is needed. Senior and middle level extension functionaries, women farmers and agri-

entrepreneurs and resource persons from various states/institutes/start-ups/training institutes participated in the event and an exhibition was also showcased at MANAGE, Hyderabad by women start-ups. Successful women entrepreneurs from various states shared their views and experiences on the occasion during the event.

PM Kisan Samman Sammelan 2022

Hon'ble Prime Minister, Shri Narendra Modi inaugurated the PM Kisan Samman Sammelan 2022 at Indian Agricultural Research Institute in New Delhi on 17th October, 2022. The Prime Minister also inaugurated 600 Pradhan Mantri Kisan Samruddhi Kendras (PMKSK) under the Ministry of Chemicals & Fertilisers. Furthermore, the Prime Minister also launched Pradhan Mantri Bhartiya Jan Urvarak Pariyojana - One Nation One Fertiliser. During the event, the Prime Minister also released the 12th installment amount of Rs. 16,000 crore under the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) through Direct Benefit Transfer. The Prime Minister also inaugurated the Agri Startup Conclave and Exhibition. During the event, the PM also launched 'Indian Edge', an e-magazine on fertiliser. Shri Modi took a walkthrough of Theme Pavilion of Startup Exhibition and inspected the products on display.

Addressing the gathering, the Prime Minister acknowledged the presence of Jai Jawan, Jai Kisan, Jai Vigyan and Jai Anusandhan in one premise, and said that we can see the live form of this mantra here today. He further elaborated that Kisan Sammelan is a means to make the lives of farmers easier, boost their capability and promote advanced agricultural techniques.

In his address at the PM Kisan Samman Sammelan 2022, the Union Agriculture and Farmers Welfare Minister, Shri Narendra Singh Tomar expressed happiness that the event brought farmers and Agri Start-ups on the same platform. He said that apart from one crore farmers, who joined the event virtually, 732 Krishi Vigyan Kendras (KVKs), 75 ICAR Institutes, 75 State Agricultural Universities, 600 PM Kisan Centres, 50,000 Primary Agricultural Cooperative Societies, and 2 lakh Community Service Centers (CSCs) attended the event in virtual mode.

Referring to the inauguration of the Agri Startup Conclave and exhibition by Shri Modi, the Agriculture Minister said that our farmers are skilled and innovative, but they don't have any platform to showcase their talents. He said, innovative and educated youth of our country are working on various initiates like innovation of Precision Farming, Post-Harvest & Value Add Solutions, Allied Agriculture, Waste to Wealth, Mechanization for Small Farmers, Supply Chain Management & Agri-Logistic and working on both farming or non-farming sector.

Shri Tomar also informed that around 1500 start-ups are participating in the two-day Kisan Sammelan and 300 start-ups are showcasing their farm related innovations to increase production and productivity, reduce post-harvest losses and augment income, besides creating new job opportunities.

Shri Tomar said that with inauguration of 600 Prime Minister Kisan Smurudhi Kendra (PMKSK), the fertilizer retail shops will now be converted into one stop shop. He said that these centres will not only provide inputs to the farmers but also resolve their other types of problems. He said PMKSK will cater to the needs of the farmers in the country and provide agri-inputs (fertilizers, seeds, implements, etc); testing that will provide facilities for soil, seeds and fertilizers; create awareness among farmers, provide information regarding various Government schemes and ensure regular capacity building of retailers at block/district level outlets.

Speaking about One Nation One Fertilizer (ONOF) scheme, Shri Tomar said that now all type of fertilizers, whether it is DAP, NPK or urea, will be sold under one brand name "Bharat" to standardize fertiliser brands across the nation, irrespective of the company that manufactures it.

Inter-ministerial review meeting with states on issues of crop residue management

Union inter-ministerial meeting with the States on the issues of crop residue management was chaired by the Union Minister for Agriculture and Farmers Welfare, Shri Narendra Singh Tomar on 19th October, 2022 with the Union Minister

for Environment, Forest and Climate Change, Shri Bhupendra Yadav and the Union Minister for Fisheries, Animal Husbandry and Dairying, Shri Parshottam Rupala in co-chair. The three ministers held discussions with the states to check the burning of stubble. Shri Tomar said that there is a need to fix the accountability of the collectors in the affected districts by the respective State Governments, while Shri Yadav said that the states should implement effective measures immediately. Shri Rupala stressed on proactive steps, especially for the problem of stubble burning in Punjab.

In the high-level review meeting, senior officials of Punjab, Haryana, Uttar Pradesh and Delhi State Government and top officials of all the three central ministries as well as the Indian Council of Agricultural Research, Central Pollution Control Board, Commission for Air Quality Management in National Capital Region and Adjoining Areas, Ministry of Power and senior officials of other central ministries and departments participated. It was informed in the meeting that the states need to ensure effective utilization of 2.07 lakh machines already supplied by the Centre during the last 4 years and 47,000 machines being provided during the current year. Under the central scheme on crop residue management, the Government is already providing financial assistance to Punjab, Haryana, Uttar Pradesh and NCT Delhi to combat air pollution in Delhi NCR due to stubble burning. Rs. 601.53 crore has already been released by the Centre during the current year so far. Also, out of the amount given in the last four years, about Rs 900 crore is available with the states. The need for effective utilization of funds provided by the Government of India to the states for stubble management was emphasized in the meeting.

Shri Tomar said that the states should promote widespread use of bio-decomposer developed by the Pusa Institute for effective in-situ decomposition of stubble. He said that the Central Government has tried its best to fulfill the expectations of states. If the State Governments also work diligently in the same way, it will bring good results. Especially, if effective checking is done on stubble burning in Amritsar and Tarn Taran districts of Punjab, then half the job will be done, because these two districts are facing the maximum problem. Effective control in these four states will also help contain the problem from spreading to other states. If we work with holistic efforts in a planned manner, the availability of fodder for cattle will also be easy. Shri Tomar said that a workshop is being organized in Pusa, Delhi on 4th November, in which farmers from Punjab and adjoining areas have been called for this purpose, senior officers of Punjab should also participate in this workshop so that their doubts regarding the Pusa decomposer are cleared. Shri Tomar said that Pusa decomposer is the cheapest and most effective solution for crop residue management, which needs to be promoted.

Environment Minister Shri Yadav said that more than two lakh machines given by the Centre are sufficient and it is necessary that they should be fully utilized for addressing the problem. Other contributing factors of pollution have also been considered by the Centre. Emphasizing on effective control to prevent stubble burning, especially in Punjab, Shri Yadav called upon the state's Chief Secretary to take immediate and appropriate action as well as to promote the use of Pusa decomposer.

During the meeting, explaining the need to implement appropriate IEC (Information, Education & Communication) activities for the targeted farmers, the states were advised to make a strategic plan by deploying all the necessary resources and deal with the situation. Considering the benefits of bio decomposer, states were advised to demonstrate this technology in farmers' fields on a large scale. During the current year, a target has been set to bring more than 8.15 lakh hectares of land in the states under the ambit of this technology. To promote and disseminate the ex-situ use of stubble by mapping the demand of stubble from biomass based power plants, bioethanol plants and nearby industries as well as to reach out to all the stakeholders through Kisan melas, publications, seminars, consultations, it has been urged to undertake IEC activities for awareness among farmers through intensive campaigns with their participation. This will effectively control stubble burning.

7th ASEAN-India Ministerial Meeting

The 7th ASEAN-India Ministerial Meeting on Agriculture and Forestry (AIMMAF) was held virtually on 26th October, 2022. The meeting was co-chaired by the Hon'ble Union Minister for Agriculture and Farmers Welfare, Shri Narendra Singh Tomar. Agriculture Ministers of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam also participated in the meeting.

Shri Tomar, in his opening remarks during the meeting, reiterated Prime Minister Shri Narendra Modi's vision of keeping ASEAN at the center of India's Act East Policy. He also emphasised on mutually close regional cooperation with ASEAN to ensure sustainable and inclusive growth for agricultural development in the region. Referring to the importance of millet (nutritional-cereals) as a nutritious food and the international nutritional-cereal year 2023, Shri Tomar urged the ASEAN member countries to support the efforts of India in increasing the production, processing, value addition and consumption of millets. Shri Tomar said that India will promote nutritious cereal products for the health and nutrition of the people. Nutritious cereals help in the creation of nutritious, with low resource requirement and more efficient agri-food systems.

In the meeting, the progress in implementation of various programs and activities under the Medium Term Action Plan of ASEAN-India Cooperation (Year 2021-2025) was reviewed. The meeting also welcomed the 30th anniversary of ASEAN-India relations. In the meeting, the commitment to ASEAN-India cooperation in agriculture and forestry was reaffirmed. It was said in the meeting that in order to mitigate the unprecedented impact of the Covid-19 pandemic by ensuring a seamless flow of safe and nutritious agricultural products to ASEAN and India, it is necessary to take continuous measures under ASEAN-India cooperation for the implementation of post-pandemic recovery. Union Minister Shri Tomar committed to enhance India's cooperation with ASEAN in food security, nutrition, climate change adaptation, digital farming, nature-friendly agriculture, food processing, value chain, agricultural marketing and capacity building.

General Agricultural Sector News

Farm demonstration on crop residue management

Dr. Abhilaksh Likhi, Additional Secretary, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare attended a farm demonstration on crop residue management on 03rd October, 2022 at village Rangian in Kharar tehsil, Dist. SAS Nagar, Punjab and interacted with farmers.

The objectives of the Crop Residue Management (CRM) scheme includes protecting environment from air pollution and preventing loss of nutrients and soil microorganisms caused by burning of crop residue; promoting management of crop residue by retention/incorporation into the soil or collection for further utilization through the use of appropriate mechanization inputs; promoting farm machinery banks for custom hiring of crop residue management machinery to offset the adverse economies of scale arising due to small landholding and high cost of individual ownership; creating awareness among stakeholders through demonstration, capacity building activities and differentiated Information, Education and Communication (IEC) strategies for effective utilization and management of crop residue.

To support the efforts of the Governments of Punjab, Haryana, Uttar Pradesh and NCT of Delhi to address air pollution caused due to stubble burning and to subsidize machinery required for management of crop residue, a Central Sector Scheme on Crop Residue Management (CRM) was introduced *w.e.f.* 2018-19. Under this scheme, financial assistance @ 50% is provided to the farmers for purchase of crop residue management machinery and @ 80% is provided to Cooperative Societies, FPOs and panchayats for establishment of Custom Hiring Centres (CHCs). The scheme promotes the usage of machines such as super straw management systems, happy seeder, super seeder, smart seeder, zero till seed cum fertilizer drill, mulcher, paddy straw chopper, hydraulically

reversible mould board plough, crop reapers and reaper binders for in-situ management of crop residue and balers & rakes which are used for straw collection in the form of bales for other ex-situ uses of straw.

During the last 4 years, the states have distributed more than 2.07 lakh machines to the individual farmers and to more than 38,000 CHCs in these 4 states, which also include more than 3,243 balers & rakes which are used for ex-situ collection of straw. Pusa decomposer, a microbial consortium of fungal species (both in liquid and capsule forms) developed by Indian Council of Agricultural Research (ICAR) has been found effective for rapid in-situ decomposition of paddy straw. During the year 2021, decomposer has been used in the states of Punjab, Haryana, Uttar Pradesh and NCT of Delhi in around 5.7 lakh hectare area which is equivalent to about 3.5 million tonnes of straw managed. Through satellite imaging and monitoring, it was observed that 92% area of the decomposer sprayed plots has been managed through decomposition and only 8% area in these plots was burned.

Dr. Likhi emphasized that for effective control of paddy stubble burning during the ensuing season, the states should chalk out a comprehensive action plan at micro level, establish a mechanism to ensure effective utilization of machines, promote use of bio-decomposer in a complimentary mode with the CRM machines, promote ex-situ utilization of straw by way of mapping demand from adjoining industries like biomass based power plants, bioethanol plants, etc. and take up IEC activities for mass awareness among farmers through intensive campaigns in the electronic/ print media, social media as well as through Kisan Melas, publications, seminars and advisories with the involvement of all stakeholders in this sector. He further added that if all the actions are taken at the state level in a holistic manner, stubble burning can be effectively controlled during the coming season.

MoU signed between DA&FW and NAFED for International Year of Millets - 2023

A Memorandum of Understanding was signed between the Department of Agriculture and Farmers Welfare and the National Agricultural Cooperative Marketing Federation of India Limited in New Delhi on 04th October, 2022 to boost the initiative visioned by the Hon'ble Prime Minister, Shri Narendra Modi to promote millets towards celebration of the International Year of Millets 2023.

Both organizations will work together for the promotion and marketing of millet-based products, keeping in view the initiative of "International Year of Millets (IYOM)-2023" proposed by the Government of India to the United Nations, which is to be celebrated across the world. As India is gearing up to bring millets back on the global map, they will build support and organize, promote, market, and forge effective market linkages for millet-based products to maximize the value capture and millet-based commodities across the country.

DA&FW and NAFED will collaborate in key areas like facilitating advisory support to manufacturers/processors of millet-based products to develop value-added millet-based commodities; on-boarding of startups, inclusive of startups empanelled with Indian Institute of Millets Research (IIMR); formation of FPOs specifically for developing a range of millet-based products; promote and market millet-based products through the network of NAFED Bazaar Stores and other institutions linked with NAFED as well as installation of millet based vending machines at various locations across Delhi-NCR; and dispensing millet-based products that shall assist in establishing the focus on millet-based commodities.

Separate Division for Agriculture Startups in the Ministry of Agriculture

Taking major policy initiatives for Agriculture Startups, Hon'ble Union Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar made several key announcements on 18th October, 2022 in the Agri Startup Conference organized on the second day of PM Kisan Samman Sammelan at Pusa Mela Ground, Delhi. Shri Tomar informed that a high-level steering committee will be constituted under the chairmanship of Agriculture Minister for overall guidance of the Agriculture

Startup ecosystem. A Rs. 500 crore accelerator programme for taking forward and popularizing the successful initiatives of Agri Startups will be started.

Amidst a large gathering of Agri Startup delegates, Shri Tomar announced that an Executive Committee would be constituted under the chairmanship of Secretary, Agriculture, comprising of concerned agencies like DARE, DPIIT, agricultural incubators and knowledge partners, agricultural universities, research institutes, top investors and other stakeholders. Also, a separate Division will be created under the chairmanship of Joint Secretary for Agriculture Startups in the Ministry of Agriculture. A cell will also be created to work as a single window agency for Agri Startups to facilitate all linkages required with certification agencies, financial institutions, agricultural universities, etc. Shri Tomar informed that a marketing linkage will be created with organizations like e-NAM and NAFED to meet the market needs of the products developed by the Agri Startups. A portal will also be developed to create a database for all Agriculture Startups and monitor their development. Shri Tomar said that efforts will be made to organize Agri Startup Conclave at national and regional level to promote startups in agriculture sector.

Union Agriculture Minister and Minister of Botswana hold talks

The visiting Minister of International Affairs and Cooperation of Botswana, Dr. Lemogang Kwape held a meeting with the Union Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar in New Delhi on 21st October, 2022 to discuss the issues of cooperation between the two countries in agriculture and allied sectors.

In the meeting, both the Ministers expressed satisfaction at the friendly and close bilateral relations between the two countries. Shri Tomar said that overseas Indians are making a significant contribution to the economy of Botswana. He spoke about the possibility of further enhancing bilateral trade to increase the benefits of farmers-producers of both the countries. Both the ministers emphasized on promoting the cultivation of nutri-cereals on a large scale in view of their nutritious value and significance. Shri Tomar informed that India is gearing up to celebrate the International Year of Millets on a global scale.

Both sides also discussed the issues of market access for their agricultural products and assured each other of resolving the issues at the earliest. Since the Memorandum of Understanding signed between the two Governments in January, 2010 on cooperation in agriculture and allied sectors has expired, the two Ministers agreed upon the early revival of the MoU.

3rd Advance Estimates of area and production of horticultural crops for the year 2021-22

Ministry of Agriculture and Farmers Welfare, Government of India has released the 3rd advance estimates of the area and production of various horticultural crops for the year 2021-22. According to this estimate, a record 342.33 million tonnes are estimated to be produced in an area of 28.08 million hectares.

The third advance estimates of the area and production of various horticultural crops for the year 2021-22, compiled on the basis of information received from States/UTs and other government source agencies, are as follows-

Total Horticulture	2020-21 (Final)	2021-22 (2nd Advance Estimate)	2021-22 (3rd Advance Estimate)
Area (in million hectares)	27.48	27.74	28.08
Production (in million tonnes)	334.60	341.63	342.33

Source: DA&FW, Government of India

Crop	2020-21 (Final)	2021-22 (3rd Advance Estimate)
Fruits	102.48	107.24
Vegetables	200.45	204.84
Onion	26.64	31.27
Potatoes	56.17	53.39
Tomato	21.18	20.33

Source: DA&FW, Government of India

General Survey of Agriculture

Trend in Food Prices

The rate of inflation, based on all-India WPI, stood at 8.39% (Provisional) for the month of October, 2022 as compared to 13.83% during the corresponding period of last year.

WPI Food Index (Weight 24.38%): The Food Index consisting of 'Food Articles' from Primary Articles group and 'Food Product' from Manufactured Products group has increased from 175.2 in September, 2022 to 177.5 in October, 2022. The rate of inflation based on WPI Food Index decreased from 8.08% in September, 2022 to 6.48% in October, 2022.

Based on Wholesale Price Index (WPI) (2011-12=100), the WPI of vegetables, fruits, pulses and cereals increased by 17.61 percent, 0.23 percent, 0.45 percent and 12.03 percent, respectively, in October, 2022 over corresponding period of last year. Whereas on month-on-month basis, the WPI for cereals, pulses and vegetables increased by 0.67 percent, 0.51 percent and 12.27 percent, respectively, and for fruits, it decreased by 1.42 percent in October, 2022 over September, 2022.

Among cereals, the WPI based rate of inflation for wheat and paddy increased by 16.25 percent and 6.63 percent, respectively, in October, 2022 over October, 2021 while on month-on-month basis, the WPI for paddy and wheat increased by 1.10 percent and 1.93 percent, respectively, in October, 2022 over September, 2022.

Rainfall and Reservoir Situation, Water Storage in Major Reservoirs

Cumulative Post-Monsoon Season (October-December), 2022 rainfall for the country as a whole during the period 1st October, 2022 to 26th October, 2022 has been 60% 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 212% in North-West India, by 74% in Central India, by 38% in East & North East India and by 28% in South Peninsula.

Out of 36 meteorological sub-divisions, 25 meteorological sub-divisions received large excess/excess rainfall, 8 meteorological sub-divisions received normal rainfall and 03 meteorological sub-divisions received deficient/large deficient rainfall.

Current live storage in 143 reservoirs (as on 27th October, 2022) monitored by Central Water Commission having Total Live Capacity of 177.46 BCM was 158.45 BCM as against 146.30 BCM on 27.10.2021 (last year) and 135.49 BCM of normal storage (average storage of last 10 years). Current year's storage is 108% of last year's storage and 117% of the normal storage.

Articles

Agricultural Growth at District Level in Uttar Pradesh during 2011-12 and 2019-20

Ajit Kumar Singh[1]

Abstract

This paper analyses the growth of agriculture (crop sector) at district level in the state of Uttar Pradesh for the period 2011-12 to 2019-20. The analysis is based on secondary data obtained from the Division of Economics and Statistics, State Planning Institute, Uttar Pradesh Government. Compound annual rates of growth of gross value of output at the district level at constant prices of 2011-12 have been calculated. The paper also examines the growth rates of gross and net agricultural productivity at the district level during this period. Attempt has also been made to identify the main determinants of agricultural growth. The analysis of agricultural growth in Uttar Pradesh during the study period reveals a rather mixed picture. Many districts show negative growth in agricultural output and productivity. Only districts in the Central region show satisfactory growth. Significant disparities in rate of growth of agriculture were observed at the regional and district level. High and low growth districts are spread all over the state. It is found that there is a strong negative relation between size of holding and growth rate of agriculture. Thus, the more developed districts have reached plateau, while less developed districts are making better efforts to raise productivity. Area under commercial crops was found to be the main determinant of output and productivity growth. Greater diversification of agriculture thus holds the key for future agricultural growth.

Keywords: *Agricultural growth, Uttar Pradesh, inter-district disparities, determinants of agricultural growth.*

1. Introduction

The Central and the State Governments have committed themselves to doubling farmers' income by 2022. In this context, analysis of agricultural growth in the recent years at the state and district levels becomes pertinent. Several studies have focused on the growth experience at the state level. However, given the large inter and intra-regional variations in the agricultural conditions, studies at a more disaggregated level are required so that location specific strategies for agricultural development can be formulated.

A number of studies have analysed agricultural growth at the district level. Singh (2007) examined the level and growth of aggregate crop output and yield at the district level for all the districts in India during 1990-93 to 1999-2002. Kumar and Jain (2013) examined the trends in growth and instability in Indian agriculture at the district level during the period 1990-91 to 2007-08. They also identified distinctive features and drivers of productivity growth across districts.

Some scholars have focussed on agricultural growth at district level in selected states. Manjunath and Kannan (2017) studied the effects of rural infrastructure on agricultural development at district level in Karnataka. Reddy (2012) probed sources of agricultural productivity growth in Orissa. Sihmar (2014) studied growth and instability in agricultural production in Haryana at district level. Haque and Joshi (2019) compared the agricultural performance of aspirational districts in Bihar with other districts of the state. Raman and Kumari (2012) analysed district and regional level disparity in agriculture development in Uttar Pradesh on a number of agricultural parameters. They prepared a composite index of agricultural development for

[1]Former Director, Giri Institute of Development Studies, Lucknow; email id: aksingh101@rediffmail.com
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two cross-section years 1990-91 and 2008-09. The study showed that the development of agriculture in Uttar Pradesh over the years has remained polarised in Western region followed by Central region while Bundelkhand region has been the least developed. Kumar (2015) also examined inter-district variations in agricultural development in Uttar Pradesh with the help of composite index of development.

The present author had examined agricultural growth at the district level in Uttar Pradesh covering the period since 1951 to 1980 (Singh, 1984). However, there has been no study of district level agricultural growth in Uttar Pradesh for a long time.

In this paper, analysis of growth of agriculture (crop sector) at the district level in the state of Uttar Pradesh for the period 2011-12 to 2019-20 has been done with an attempt to identify the main determinants of agricultural growth.

1.1 Objectives of the study

1. Analysis of growth of agriculture (crop sector) at the district level in the state of Uttar Pradesh for the period 2011-12 to 2019-20.

2. Examine the growth rates of gross and net agricultural productivity at the district level during the study period.

3. Identify the main determinants of agricultural growth.

2. Data sources and methodology

The analysis is based on secondary data obtained from the publications of the Division of Economics and Statistics, State Planning Institute, Uttar Pradesh Government like the Statistical Diary, Statistical Abstract and District Development Indicators.

The compound annual growth rate (CAGR) for gross value of district domestic product agriculture and gross and net productivity per hectare have been calculated using the following formula:

$$CAGR = [(Final\ value/Initial\ value)^{(1/8)}-1]*100$$

Linear regression estimates have been calculated using selected variables as determinants of agricultural growth. Linear regression model has been applied to explain the growth of district domestic product of agriculture, gross productivity per hectare and net productivity per hectare. The following specification of the model was used:

$$Y = B_o + B_1X_1 + B_2 X_2 + ...+ B_n X_n$$

where,

Y = Dependent variables

X_1, X_2, X_n = Independent variables

B_o = Intercept

B_1, B_2, B_n = Coefficients

3. Results and discussion

3.1 Regional disparities in Uttar Pradesh

The economy of Uttar Pradesh is predominantly agrarian. As per the 2011 Census, around 60 percent of the total workers in the state are still employed in agriculture, while it contributes about one-fourth of the state's income. Uttar Pradesh is a major producer of diverse agricultural crops in the country. It is the largest producer of wheat, pulses, sugarcane, tobacco, potato and milk; the second largest producer of rice, fruits and vegetables; and the third largest producer of coarse grains among states in India.

The state is well endowed with favorable factors for agricultural development in terms of vast tracts of fertile soils, good rainfall, plentiful surface and ground water, temperate climate and sunshine, etc. It is characterized by rich diversity in natural resources and climate. The state is divided into four economic regions, namely Western, Central, Eastern and Bundelkhand. The first three regions fall in the fertile Gangetic plains, while Bundelkhand falls in the Vindhyan plateau.

There are marked inter-regional variations in agricultural development in terms of irrigation facilities, mechanization, use of modern inputs, etc. which are reflected in inter-regional differentials in productivity levels of various crops (Table 1). The yield levels of major foodgrain and non-foodgrain crops in western region are distinctly higher as compared to the other regions. On the other hand, Bundelkhand, where irrigated area is relatively low and conditions are not favorable to agriculture, has the lowest level of yields. Moreover, sharp differentials in levels of agricultural development and productivity levels prevail at the district level in all the regions of the state.

TABLE 1: INDICATORS OF AGRICULTURAL DEVELOPMENT BY REGIONS, 2017-18

Indicator	Western region	Central region	Bundelkhand	Eastern region	Uttar Pradesh
Net irrigated area as % of NSA	96.95	87.38	65.5	82.49	86.64
Gross irrigated area as % of GSA	89.57	84.68	49.51	77.53	80.39
% of net irrigated area by tube wells	75.58	83.64	41.65	77.24	74.59
% of holdings below 1 ha (2015-16)	74.87	81.95	56.35	86.53	80.18
% of area in holdings below 1 ha (2015-16)	35.5	47.07	18.56	53.65	41.82
Average size of holding (ha, 2015-16)	0.84	0.68	1.43	0.58	0.73
Cropping Intensity	167.28	157.28	143.14	166.6	162.4
Fertiliser distribution per ha	200.88	178.67	100.19	167.54	173.28
Tractor per 100 ha of GSA	5.51	5.27	4.03	4.56	4.99
Area under commercial crops (%)	35.06	27.56	22.72	16.03	25.88
Average yield of major crops (qtl./ha)					
Wheat	42.06	38.72	32.52	36.54	38.6
Rice	27.17	27.14	20.1	27.11	27.04
Food grains	34.24	30.76	20.14	29.55	30.23
Sugarcane	837.11	811.87	386.31	716.86	808.07

Source: District Level Development Indicators 2020, Division of Economics and Statistics, State Planning Institute, Uttar Pradesh

3.2 Gross value productivity per hectare at district level

A major indicator of agricultural development is the gross value productivity per hectare. Highest productivity levels are found in Western region (Rs. 2,02,440), followed by Central region (Rs. 164682). Productivity levels are relatively low in Eastern region and Bundelkhand. Table 2 shows the distribution of districts according to level of agricultural productivity. Ten districts have productivity level of above Rs. 2,50,000, out of which 9 are in Western region and 1 is in Central region. Another eight districts have productivity levels between Rs. 2,00,000 and Rs. 2,50,000, out of which 5 are in Western region, 2 in Central region and 1 in Eastern region. On the other hand, 10 districts have productivity levels below Rs. 1,00,000 per hectare, out of which 5 are in Bundelkhand, 3 are in Eastern region and 1 each in Western and Central region. It is also observed from the table that there are large intra-regional differentials in productivity in all the regions.

TABLE 2: DISTRICTS ARRANGED IN TERMS OF GROSS VALUE PRODUCTIVITY PER HECTARE OF NSA IN 2017-18

(in Rs.)

Region	50000-100000	100000-150000	150000-200000	200000-250000	Above 250000	All districts	Productivity per ha
Western	1	5	10	5	9	30	202440
Central	1	4	2	2	1	10	164682
Bundelkhand	5	2	-	-	-	7	81944
Eastern	3	16	8	1	-	28	132158
Uttar Pradesh	**10**	**27**	**20**	**8**	**10**	**75**	**157724**

Source: Computed from data given in Statistical Abstract 2020, Uttar Pradesh

Table 3 arranges the districts into quintiles according to gross productivity per hectare. Out of the fifteen districts with highest productivity, as many as 13 districts belong to Western region. The top 5 districts in terms of productivity are Kasganj, Meerut, Bareilly, Muzaffarnagar and Lucknow. On the other hand, the 5 districts with lowest productivity are Hamirpur, Chitrokoot, Banda, Sonbhadra and Mahoba, all of which except Sonbhadra are in Bundelkhand.

TABLE 3: DISTRICTS ARRANGED INTO QUINTILES ACCORDING TO GROSS PRODUCTIVITY PER HECTARE IN 2017-18

(in Rs.)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	**Productivity**	**District**	**Productivity**	**District**	**Productivity**	**District**	**Productivity**	**District**	**Productivity**
Kasganj	315036	Bijnor	221383	Amethi	155884	Sant Kabir Nagar	130445	Shravasti	108454
Meerut	311653	Kheri	215367	Gonda	153828	Fatehpur	129824	Deoria	107993
Bareilly	301906	Hathras	207748	Ambedkar Nagar	153686	Bahraich	129664	Jalaun	105739
Muzaffar-nagar	300590	Bulandshahr	194822	Sultanpur	152976	G.B. Nagar	128049	Prayagraj	103791
Lucknow	293552	Gorakhpur	191504	Aligarh	152555	Varanasi	127786	Kanpur Dehat	103666
Baghpat	291712	Kannauj	182094	Mainpuri	152428	Azamgarh	125855	Mathura	99650
Ghaziabad	280235	Farrukhabad	180712	Badaun	151238	Ballia	125444	Pratap-garh	97274
Shamli	278365	Moradabad	177691	Unnao	150617	Jaunpur	124154	Lalitpur	93622
Rampur	263164	Etah	176785	Agra	147977	Balrampur	122922	Rae Bareli	87621
Saharanpur	258460	Sitapur	167218	Basti	147894	Auraiya	122781	Mirzapur	87332
Barabanki	248359	Shahjahan-pur	166686	Etawah	137561	Sant Ravi-das Nagar	122644	Hamirpur	70381
Hapur	237013	Sambhal	162584	Chandauli	137213	Mau	121820	Chitra-koot	57962
Amroha	234554	Faizabad	161394	Firozabad	137211	Jhansi	117086	Banda	54309
Kushinagar	233040	Maharajganj	161309	Hardoi	132616	Ghazipur	113252	Son-bhadra	54108
Pilibhit	225152	Kaushambi	157504	Kanpur Nagar	132555	Siddharth Nagar	109702	Mahoba	52821

Source: Computed by author.

3.3 Growth rate of agricultural DDP

Agricultural growth is measured in terms of value of district domestic product (DDP) at constant prices of 2011-12. The growth rate of agriculture during the period 2011-12 and 2019-20 in Uttar Pradesh was 2.55 percent per annum. However, significant variations in growth rate were observed at the regional and district levels (Table 4). In the Western region and Bundelkhand, growth of agriculture was around 1.7 percent per annum, while Eastern region registered a growth of 2.31 percent per annum. Only Central region showed a satisfactory agricultural growth of 5.44 percent per annum.

District level analysis reveals that as many as 13 districts out of 75 districts in the state experienced negative growth of agriculture over this period. Of these districts, 7 were in Western region, 4 in Eastern region and 2 in Bundelkhand. In another 11 districts, the growth rate was below 1 percent per annum. Thus, one-third of the districts in the state are facing agricultural stagnation during the last decade. In 27 districts, the growth rate was between 1 and 3 percent. Growth rate of agriculture was above 3 percent per annum in 24 districts.

TABLE 4: DISTRICTS ARRANGED ACCORDING TO RATE OF GROWTH OF GROSS AGRICULTURAL DDP (2012-20)

Region	Negative	Below 1%	1-3%	More than 3%	Total districts	CAGR (%)
Western	7	3	9	11	30	1.66
Central		1	4	5	10	5.44
Bundelkhand	2	1	2	2	7	1.68
Eastern	4	6	12	6	28	2.31
Uttar Pradesh	**13**	**11**	**27**	**24**	**75**	**2.55**

Source: Computed by author.

Table 5 arranges the districts into quintiles according to the growth rate of agricultural DDP. The districts of Barabanki, Hapur, Gorakhpur, Kushinagar, Meerut and Shamli show a growth of above 5 percent per annum. On the other hand, districts of Lalitpur, Sonbhadra, Gautam Buddh Nagar, Varanasi, Bareilly and Ghaziabad show a negative growth of over 1 percent per annum. Thus, we find that the high and low growth districts are spread over all the regions of the state and there are no clusters of high or low growth district.

TABLE 5: DISTRICTS ARRANGED IN QUINTILES ACCORDING TO CAGR OF GROSS AGRICULTURAL DDP (2012-20)

(in percentage)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**
Barabanki	19.27	Mahoba	4.00	Banda	2.52	Raebareli	1.49	Ballia	0.02
Hapur	10.75	Badaun	3.99	Mainpuri	2.52	Kasganj	1.47	Deoria	0.01
Gorakhpur	7.19	Lucknow	3.93	Ambedkar Nagar	2.46	Basti	1.43	Jhansi	-0.11
Kushinagar	7.11	Rampur	3.80	Kanpur Nagar	2.43	Jaunpur	1.31	Agra	-0.18
Meerut	5.24	Pratapgarh	3.71	Prayagraj	2.42	Shahjahanpur	1.20	Bhadohi	-0.21

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	CAGR	District	CAGR	District	CAGR	District	CAGR	District	CAGR
Shamli	5.03	Farrukhabad	3.55	Maharajganj	2.36	Etawah	1.03	Auraiya	-0.25
Kannauj	4.88	Amroha	3.41	Baghpat	2.28	Etah	0.95	Mau	-0.40
Jalaun	4.55	Bijnor	3.17	Unnao	2.28	Aligarh	0.95	Mathura	-0.64
Sambhal	4.42	Sant Kabeer Nagar	3.02	Pilibhit	2.25	Firozabad	0.91	Moradabad	-0.99
Sitapur	4.24	Gonda	2.86	Hardoi	2.24	Ghazipur	0.84	Lalitpur	-1.27
Kheri	4.22	Saharanpur	2.83	Chitrakoot	2.09	Siddharth Nagar	0.81	Sonbhadra	-1.56
Muzaffarnagar	4.21	Bulandshahr	2.81	Sultanpur	1.86	Mirzapur	0.71	Gautam Buddh Nagar	-2.28
Fatehpur	4.11	Balrampur	2.58	Chandauli	1.63	Amethi	0.65	Varanasi	-2.50
Kaushambi	4.05	Shravasti	2.57	Hathras	1.55	Hamirpur	0.52	Bareilly	-7.30
Faizabad	4.02	Bahraich	2.53	Azamgarh	1.50	Kanpur Dehat	0.08	Ghaziabad	-11.05

Source: Computed by author

It looks that the situation in each district is different and local factors are influencing the growth rate of agriculture in the state. Even neighboring districts show wide variations in growth of agriculture. For instance, the growth rate was 10.75 percent per annum in Hapur, 5.24 percent in Meerut, 5.03 in Shamli, but -11.05 percent in Ghaziabad. In Bundelkhand, Jalaun showed a growth rate of 4.55 percent but neighbouring Hamirpur showed a growth rate of only 0.52 percent. In Eastern region, Kaushambi had a growth rate of 4.05 percent, Pratapgarh 3.71 percent and Sultanpur 1.86 percent, while Amethi had a growth rate of 0.65 percent. Similarly, Kushinagar had a growth rate of 7.11 percent but Siddharth Nagar had a growth rate of 0.81 percent, while neighbouring Deoria showed negative growth rate.

3.4 Growth rate of gross agricultural productivity

The trends in gross agricultural productivity measured by per hectare value of gross agricultural produce at constant prices reveals a dismal picture. Agricultural productivity declined at an annual rate of 0.47 percent in Uttar Pradesh during the period 2011-12 to 2019-20. Agricultural productivity showed negative trends in the Western, Eastern and Bundelkhand regions (Table 6). Only the Central region showed a positive growth of 2.34 percent per annum during this period. It is found that as many as 46 out of the 75 districts witnessed a negative trend in agricultural productivity during 2012-20 and in another 10 districts, the growth was less than 1 percent per annum. Only 7 districts showed growth rate of above 3 percent in agricultural productivity.

TABLE 6: DISTRICTS ACCORDING TO RATE OF GROWTH OF GROSS AGRICULTURAL DDP PER HECTARE (2012-20)

Region	Negative	Up to 1%	1-3%	Above 3%	All districts	CAGR (%)
Western	20	4	4	2	30	-1.51
Central	4	1	4	1	10	2.34
Bundelkhand	3	1	3	-	7	-1.46
Eastern	19	4	1	4	28	-1.28
Uttar Pradesh	**46**	**10**	**12**	**7**	**75**	**-0.47**

Source: Computed by author.

In Table 7, the districts have been arranged in quintiles according to CAGR of gross agricultural productivity per hectare. Barabanki, Hapur, Gorakhpur and Kushinagar show best performance in growth of agricultural productivity, all registering growth rate of above 4 percent per annum. Highest negative growth exceeding 4 percent per annum took place in the districts of Auraiya, Bareilly, Maharajganj, Ghaziabad and Chitrakoot.

TABLE 7: DISTRICTS ARRANGED IN QUINTILES ACCORDING TO CAGR OF GROSS AGRICULTURAL DDP PER HECTARE (2012-20)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**
Barabanki	15.08	Mahoba	1.40	Pilibhit	-0.16	Jaunpur	-1.32	Ballia	-0.29
Hapur	7.62	Badaun	1.07	Kannauj	-0.17	Etawah	-1.36	Sant Kabeer Nagar	-0.33
Gorakhpur	4.69	Sitapur	1.02	Jhansi	-0.30	Sharvasti	-1.40	Mathura	-0.49
Kushinagar	4.10	Azamgarh	0.81	Unnao	-0.46	Balrampur	-1.45	Bhadohi	-0.54
Banda	2.50	Rampur	0.74	Bulandshahr	-0.52	Lalitpur	-1.59	Gautam Buddh Nagar	-0.55
Jalaun	2.41	Sidharth Nagar	0.58	Mainpuri	-0.54	Farrukhabad	-1.63	Deoria	-0.61
Pratapgarh	2.38	Saharanpur	0.51	Kasganj	-0.54	Hathras	-1.75	Mau	-0.95
Meerut	2.17	Kanpur Dehat	0.39	Basti	-0.67	Aligarh	-2.16	Varanasi	-1.41
Amethi	2.08	Bahraich	0.32	Ghazipur	-0.79	Shahjahan-pur	-2.32	Raebareli	-1.42
Lucknow	1.67	Bijnor	0.30	Faizabad	-0.80	Agra	-2.34	Sonbhadra	-3.50
Kheri	1.62	Chandauli	0.25	Mirzapur	-0.82	Kanpur Nagar	-2.92	Auraiya	-4.16
Sambhal	1.57	Amroha	0.23	Baghpat	-0.91	Moradabad	-3.08	Bareilly	-6.42
Shamli	1.57	Hamirpur	0.01	Ambedkar Nagar	-0.92	Sultanpur	-3.38	Maharajganj	-7.24
Muzaffarnagar	1.56	Hardoi	-0.07	Kausambhi	-1.22	Firozabad	-3.67	Ghaziabad	-7.60
Fatehpur	1.47	Gonda	-0.09	Prayagraj	-1.24	Etah	-3.72	Chitrakoot	-10.98

Source: Computed by author

3.5 Growth of net agricultural productivity

Growth of net agricultural productivity has been measured in terms of net agricultural DDP per hectare of net sown area. Net agricultural productivity increased at a rate of 2.21 percent per annum in Uttar Pradesh during the period 2011-12 and 2019-20. Slowest growth of 1.08 percent per annum took place in the Western region, whereas the Central Uttar Pradesh with an annual growth rate of 4.83 percent was the fastest growing region (Table 8). As many as 18 districts showed a decline in net agricultural productivity. In 11 districts, the growth rate of net productivity was below 1 percent. In 26 districts, the growth rate was between 1 and 3 percent per year, while 20 districts registered a growth rate of above 3 percent per year.

TABLE 8: DISTRICTS ACCORDING TO RATE OF GROWTH OF NET AGRICULTURAL DDP PER HECTARE (2012-20)

Region	Negative	Up to 1%	1-3%	3-5%	Above 5%	Total districts	CAGR (%)
Western	6	7	9	7	1	30	1.08
Central	2		3	4	1	10	4.83
Bundelkhand	2	1	2	1	1	7	1.75
Eastern	8	3	12	3	2	28	1.5
Uttar Pradesh	**18**	**11**	**26**	**15**	**5**	**75**	**2.21**

Source: Computed by author.

Table 9 arranges districts in quintiles according to CAGR of net agricultural productivity. Highest growth of above 5 percent per annum took place in the districts of Barabanki, Hapur, Kushinagar, Gorakhpur and Mahoba. The worst performing districts in terms of growth of net agricultural productivity were Varanasi, Sonbhadra, Maharajganj, Auraiyya, Bareilly and Ghaziabad, where agricultural productivity declined at a rate exceeding 3 percent per annum.

TABLE 9: DISTRICTS ARRANGED IN QUINTILES ACCORDING TO CAGR OF NET AGRICULTURAL DDP PER HECTARE (2012-20)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**	**District**	**CAGR**
Barabanki	18.40	Badaun	3.72	Pilibhit	2.06	Jaunpur	1.05	Mau	-0.29
Hapur	10.31	Lucknow	3.70	Bahraich	2.04	Firozabad	0.86	Deoria	-0.33
Kushinagar	7.69	Kannauj	3.68	Sidharth Nagar	2.01	Kasganj	0.80	Moradabad	-0.49
Gorakhpur	7.15	Sitapur	3.64	Baghpat	2.00	Hamirpur	0.59	Gautam Buddh Nagar	-0.54
Mahoba	5.23	Faizabad	3.10	Balrampur	1.99	Agra	0.57	Mirzapur	-0.55
Meerut	4.82	Shravasti	2.97	Kanpur Nagar	1.89	Etawah	0.54	Bhadohi	-0.61
Kausambhi	4.75	Gonda	2.95	Mainpuri	1.72	Aligarh	0.51	Mathura	-0.95
Sambhal	4.53	Bijnor	2.87	Azamgarh	1.69	Sant Kabeer Nagar	0.40	Lalitpur	-1.41
Jalaun	4.17	Pratapgarh	2.83	Basti	1.64	Prayagraj	0.29	Raebareli	-1.42
Shamli	4.11	Amroha	2.77	Unnao	1.63	Shahjanpur	0.27	Varanasi	-3.50
Muzaffarnagar	4.09	Saharanpur	2.70	Chandauli	1.61	Etah	0.23	Sonbhadra	-4.16
Amethi	3.97	Chitrakoot	2.67	Ambedkar Nagar	1.53	Ghazipur	0.15	Maharajganj	-6.42
Kheri	3.83	Bulandshahr	2.45	Sultanpur	1.31	Kanpur Dehat	-0.10	Auraiya	-7.24
Fatehpur	3.79	Banda	2.30	Farrukhabad	1.23	Jhansi	-0.11	Bareilly	-7.60
Rampur	3.73	Hardoi	2.16	Hathras	1.15	Ballia	-0.21	Ghaziabad	-10.98

Source: Computed by author

3.6 Analysis of growth rate

Growth of gross sown area, irrigated area, fertilizer consumption and area under commercial crops are regarded as the key drivers of agricultural growth. The trends in these variables have been shown in Table 10. Over the period of study, the growth of these variables has been rather slow. Gross sown area has increased by merely 4.4 percent in the period 2011-12 and 2018-19, while gross irrigated area increased by 8.9 percent and fertilizer distribution by 10.9 percent. Growth rate comes to 0.62 percent per annum in case of gross sown area, 1.23 percent in case of gross irrigated area and 1.49 percent in case of fertilizer distribution. Growth rate of these variables were much faster during the eighties and nineties when agricultural growth was high (Singh, 2018).

TABLE 10: TRENDS IN MAIN DETERMINANTS OF AGRICULTURAL GROWTH

Indicator	2011-12	2018-19	% increase	CAGR (%)
Gross Sown Area (000 ha)	25728	26859	4.40	0.62
Gross irrigated area (000 ha)	19901	21681	8.94	1.23
Gross irrigated area as % of GSA	77.35	81.00	4.72	0.66
Fertiliser distribution ('000 MT)	4258	4722	10.89	1.49
Fertiliser distribution per ha of GSA in kg	165.50	175.80	6.22	0.87

Source: Computed by author.

Analysis at the district level showed an interesting picture. As shown in Table 11, 16 districts showed an increase in gross sown area exceeding 10 percent. Another 16 districts showed an increase in gross sown area between 5 and 10 percent. In 20 districts, growth in gross sown area was less than 5 percent. On the other hand, as many as 24 districts showed a decline in gross sown area, out of which 11 districts were in Western region. In 8 districts, the decline was more than 10 percent.

TABLE 11: DISTRICTS ARRANGED ACCORDING TO THE PERCENTAGE CHANGE IN GROSS AREA SOWN BETWEEN 2011-12 AND 2018-19

(in percentage)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	Change	District	Change	District	Change	District	Change	District	Change
Hapur	69.05	Kasganj	10.61	Saharanpur	5.80	Ballia	1.43	Kushinagar	-2.86
Sonbhadra	52.36	Kanpur Dehat	9.90	Shravasti	5.49	Firozabad	1.32	Mau	-2.96
Raebareli	30.42	Ghazipur	9.78	Shamli	4.29	Sitapur	1.06	Muzaffarnagar	-3.90
Mirzapur	26.72	Hamirpur	9.57	Sant Ravidas Nagar	4.08	Hardoi	0.75	Gonda	-4.53
Pratapgarh	21.71	Etah	8.61	Aligarh	4.04	Agra	0.47	Jhansi	-4.69
Prayagraj	19.79	Farrukhabad	8.53	Bulandshahr	3.65	Azamgarh	0.20	Lucknow	-5.71
Kannauj	19.37	Hathras	8.51	Ambedkar Nagar	3.55	Bijnor	-0.24	Chitrakoot	-7.07
Sambhal	18.79	Banda	7.94	Sant Kabeer Nagar	2.93	Bareilly	-0.37	Mahoba	-10.31
Basti	18.12	Auraiya	7.73	Fatehpur	2.91	Chandauli	-0.85	Sultanpur	-12.09
Jalaun	18.05	Badaun	6.28	Unnao	2.83	Mainpuri	-0.91	Amethi	-16.44
Meerut	16.99	Etawah	6.20	Mathura	2.51	Kanpur Nagar	-1.13	Amroha	-24.05

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	Change	District	Change	District	Change	District	Change	District	Change
Balrampur	15.56	Barabanki	6.09	Gorakhpur	2.37	Kheri	-1.40	Moradabad	-24.88
Sidharth Nagar	12.65	Jaunpur	5.94	Deoria	2.17	Shahjahanpur	-2.41	Gautam Buddh Nagar	-29.17
Bahraich	12.20	Faizabad	5.82	Maharajganj	1.65	Rampur	-2.45	Baghpat	-42.00
Kaushambhi	11.80	Varanasi	5.81	Pilibhit	1.53	Lalitpur	-2.54	Ghaziabad	-56.32

Source: Computed by author

Table 12 arranges districts according to change in percent area under irrigation. In 12 districts, growth of area under irrigation exceeded 10 percent points. Most of these districts were in Bundelkhand and Eastern tarai. In 18 districts, increase was between 3 and 5 percent points and in 12 districts, the increase was between 1 and 3 percent points. In 10 districts, increase in irrigated area was less than 1 percent point, while 11 districts registered a decline in percent irrigated area

TABLE 12: GROWTH OF IRRIGATED AREA AS % OF GSA

(in percentage)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	Change	District	Change	District	Change	District	Change	District	Change
Chitrakoot	25.31	Farrukhabad	8.56	Sitapur	3.31	Firozabad	1.57	Ghaziabad	0
Basti	23.43	Deoria	7.99	Etah	3.14	Kanpur Nagar	1.37	Hapur	0
Jhansi	23.00	Mahoba	5.23	Ayodhya	3.12	Azamgarh	1.2	Jaunpur	0
Sonbhadra	17.48	Ballia	4.75	Fatehpur	3.12	Sambhal	0.94	Meerut	0
Hamirpur	16.80	Sant Ravidas Nagar	4.68	Chandauli	3.06	Moradabad	0.51	Bareilly	-0.13
Banda	13.94	Bijnor	4.66	Saharanpur	3.00	Varanasi	0.28	Amethi	-0.23
Gonda	12.69	Mau	4.52	Shravasti	2.89	Kasganj	0.27	Hardoi	-0.5
Bahraich	12.00	Kanpur Dehat	4.49	Mainpuri	2.75	Mathura	0.24	Rampur	-0.52
Kushi-nagar	11.10	Shahjahanpur	4.16	Pratapgarh	2.48	Ambedkar Nagar	0.17	Agra	-0.9
Kaush-ambi	11.01	Hathras	4.14	Barabanki	2.44	Pilibhit	0.08	Badaun	-1.08
Mirzapur	10.92	Auraiya	4.12	Aligarh	2.36	Shamli	0.07	Sant Kabir Nagar	-1.19
Kheri	10.36	Raebareli	3.99	Unnao	2.28	G.B. Nagar	0.04	Amroha	-1.69
Prayagraj	9.84	Siddharth Nagar	3.71	Muzaffar-nagar	2.1	Maharajganj	0.01	Gorakhpur	-2.16
Kannauj	9.20	Lucknow	3.63	Etawah	2.09	Baghpat	0	Jalaun	-2.18
Balrampur	9.17	Ghazipur	3.38	Sultanpur	2.05	Bulandshahr	0	Lalitpur	-8.97

Source: Computed by author.

The analysis of fertilizer consumption per hectare reveals a rather depressing picture with half of the districts showing a decline in fertilizer consumption per hectare over the period under study (Table 13). In 14 districts, consumption of fertilizer increased by more than 50 kg per hectare while in 12 districts, fertilizer consumption increased between 20 and 50 kg per hectare. In 8 districts, fertilizer consumption increased by less than 15 kg per hectare. However, in as many as 37 districts, fertilizer consumption per hectare declined. In as many as 13 districts the decline was more than 50 kg per hectare. The decline of fertilizer consumption was mainly due to the rising cost of fertilizers and non-availability of fertilizers on time.

TABLE 13: CHANGE IN FERTILIZER CONSUMPTION PER HECTARE BETWEEN 2011-12 AND 2019-20

(in Kg)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	Change	District	Change	District	Change	District	Change	District	Change
Agra	220.00	Fatehpur	42.83	Jalaun	13.69	Shravasti	-15.77	Shamli	-47.49
Firozabad	111.21	Etawah	36.19	Mahoba	13.05	Rampur	-16.13	Kheri	-48.49
Aligarh	104.59	Kannauj	36.17	Chitrakoot	12.63	Farrukhabad	-24.79	G.B. Nagar	-51.43
Mathura	102.12	Ghaziabad	36.05	Sitapur	9.95	Ambedkar Nagar	-25.44	Kushinagar	-51.91
Mau	99.27	Chandauli	34.92	Jaunpur	9.77	Bareilly	-27.23	Sant Ravidas Nagar	-53.81
Bahraich	83.84	Lalitpur	34.79	Mainpuri	8.81	Pratapgarh	-28.01	Amroha	-57.65
Hathras	76.10	Etah	34.25	Ballia	7.78	Barabanki	-28.34	Ayodhya	-68.35
Hardoi	73.05	Amethi	33.85	Unnao	0.80	Kanpur Nagar	-31.28	Pilibhit	-71.64
Mirzapur	61.82	Jhansi	32.00	Sultanpur	-5.49	Badaun	-32.58	Gorakhpur	-75.05
Raebareli	60.37	Sonbhadra	26.92	Saharanpur	-5.51	Prayagraj	-40.16	Muzaffarnagar	-75.11
Hamirpur	53.84	Banda	21.34	Kanpur Dehat	-7.38	Balrampur	-40.82	Lucknow	-78.09
Varanasi	53.30	Bulandshahr	19.84	Baghpat	-7.90	Sant Kabir Nagar	-44.14	Basti	-89.87
Maharajganj	52.62	Azamgarh	18.92	Kaushambi	-9.55	Meerut	-45.32	Deoria	-116.87
Shahjahanpur	50.45	Auraiya	18.76	Siddharth Nagar	-10.58	Kasganj	-46.47	Sambhal	-209.28
Hapur	46.56	Ghazipur	16.67	Gonda	-12.19	Bijnor	-46.86	Moradabad	-214.82

Source: Computed by author

Shift towards commercial crops is an important factor in raising value productivity in agriculture. Table 14 shows the change in area under commercial crops between 2011-12 and 2019-20 in percentage points. In 11 districts, there was a positive shift in favour of commercial crops exceeding 10 percentage points. In 14 districts, the shift was between 5 and 10 percentage while in 23 districts, the gain was below 5 percentage points. But there was a negative shift in as many as 16 districts, nine of which were in Western region.

TABLE 14: CHANGE IN AREA UNDER COMMERCIAL CROPS BETWEEN 2011-12 AND 2019-20

(in percentage)

First Quintile		Second Quintile		Third Quintile		Fourth Quintile		Fifth Quintile	
District	Change	District	Change	District	Change	District	Change	District	Change
Sonbhadra	31.51	Kasganj	7.64	Barabanki	3.58	Gorakhpur	2.09	Kanpur Nagar	-0.32
Mirzapur	22.11	Bahraich	7.62	Lalitpur	3.54	Ambedkar Nagar	2.04	Baghpat	-0.33
Raebareli	19.73	Ghazipur	7.39	Fatehpur	3.46	Sultanpur	1.76	Mainpuri	-0.40
Pratapgarh	18.39	Kannauj	7.39	Ayodhya	3.34	Hathras	1.66	Agra	-0.70
Prayagraj	15.76	Siddharth Nagar	7.05	Hardoi	3.17	Etawah	1.59	Muzaffarnagar	-0.74
Jalaun	13.28	Bareilly	6.92	Maharajganj	3.09	Sant Kabir Nagar	1.56	Firozabad	-0.81
Kaushambi	13.10	Jhansi	6.40	Hapur	3.03	Sant Ravidas Nagar	1.53	Moradabad	-1.62
Balrampur	11.92	Amroha	6.34	Saharanpur	2.90	Deoria	1.49	Gonda	-1.83
Basti	11.76	Kanpur Dehat	6.32	Farrukhabad	2.89	Ballia	1.29	Chitrakoot	-1.87
Banda	11.24	Amethi	5.78	Shamli	2.73	Shravasti	1.28	Kushinagar	-2.00
Mahoba	11.18	Hamirpur	5.63	Unnao	2.64	Shahjahanpur	1.17	Lucknow	-2.28
G.B. Nagar	9.99	Jaunpur	4.79	Sambhal	2.45	Kheri	0.73	Rampur	-3.21
Badaun	9.61	Aligarh	4.64	Meerut	2.37	Varanasi	0.22	Mau	-4.75
Pilibhit	9.26	Auraiya	4.31	Sitapur	2.27	Ghaziabad	0.20	Chandauli	-9.09
Etah	7.95	Bulandshahr	3.58	Mathura	2.11	Azamgarh	-0.16	Bijnor	-10.58

Source: Computed by author.

The above analysis shows that the sources of agricultural growth are drying up in the state. Correlation analysis revealed that the average size of holdings is negatively related to agricultural growth, implying that the smaller holdings are trying more to increase their productivity as compared to the large holdings. Proportion of area under commercial crops shows a strong positive association with agricultural growth. Agricultural growth is negatively associated with initial value of output per hectare. This means that districts with lower productivity are making better efforts for their improvement, while saturation level has been reached in the more developed districts.

3.7 Regression results

Linear regression has been run on growth of agriculture output and productivity and selected variables. The results are shown in Table 15. Average size of holding, area under commercial crops and gross value of output per hectare

explain 33 percent of variation in agricultural growth. While area under commercial crops is positively associated with agricultural growth, the association with average size of holding and gross productivity is negative.

TABLE 14: LINEAR REGRESSION COEFFICIENTS OF GROWTH RATE OF AGRICULTURE DDP AND PRODUCTIVITY AT DISTRICT LEVEL AND ITS DETERMINANTS

Variables	Growth rate of agriculture DDP	Growth rate of gross agricultural productivity	Growth rate of net agricultural productivity
Intercept	10.5156517 (4.197689)	-0.14452 (-0.0524622)	5.3529095 (2.112363)
Average size of holding (ha)	5.230005 (-3.45299)	-1.74811 (-1.0252257)	-3.082587 (-1.95212)
Area under commercial crops (%)	0.162961 (4.98581)	0.16605 (4.452079)	0.155111 (-1.79314)
Gross value of output per ha (Rs.)	-5.7838E-05 (-5.89239)	-7.3E-05 (-5.26484)	-7.56962E-05 (-4.06056)
Irrigated area as percent of GSA	0.003292 (-0.14675)	0.062327 (2.378104)	0.0273793 (1.097601)
Fertiliser consumption per ha (kg)	0.01027473 (-1.84029)	-0.00563 (-1.00171)	-0.009260 (-1.79314)
Adjusted R Square	0.348381	0.413945	0.338523
F Statistic	8.484951	10.888556	8.164765

Source: Computed by author.
Note: Figures in brackets show T values

Growth of productivity was found to be negatively related with value of gross output per hectare in the initial year, showing that districts with lower productivity have registered faster growth in productivity, while districts with higher productivity are facing relative stagnation in productivity. Proportion of irrigated area and proportion of area under commercial crops was found to be positively and strongly connected with growth of gross productivity. The regression model explains 41.7 percent of variation in growth rates of gross productivity.

Growth of net agricultural productivity was found to be negatively connected with initial level of productivity as in the case of gross productivity. Coefficient for area under commercial crops was strongly and positively related to growth of net productivity, but the coefficient of irrigation though positive was not found to be significant. Size of holding shows a negative relation with growth of net productivity. The regression model explains 33.9 percent of variation in growth rates of net productivity.

4. Conclusion

The analysis of agricultural growth in Uttar Pradesh during the period 2011-12 and 2019-20 reveals a rather dismal picture. Many districts show negative growth in agricultural output and productivity. Only districts in the Central region show satisfactory growth. Significant disparities in rate of growth of agriculture were observed at the regional and district level. High and low growth districts are spread all over the state. The

widespread unrest among the farmers of the state is due to the stagnation they face in their household income.

It is found that there is a strong negative relation between size of holding and growth rate of agriculture. Thus, the more developed districts have reached plateau, while less developed districts are making better efforts to raise productivity. Area under commercial crops was found to be the main determinant of output and productivity growth. Greater diversification of agriculture thus holds the key for future agricultural growth.

5. Policy suggestions

The existing technology has reached saturation point in most of the districts. Agriculture in Uttar Pradesh is waiting for a new technological breakthrough to raise productivity levels. Agricultural research needs a big push with focus on region/district level requirements.

Factors responsible of slowing down of critical growth drivers like fertiliser consumption need to be examined and remedial measures suggested. The strategy of agricultural development should focus particularly on the lagging districts in terms of productivity and growth.

It is high time that the State Government appoints a Commission consisting of eminent experts to study factors constraining agricultural development at the district level and suggest district level interventions for boosting agricultural productivity and growth.

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Understanding India's Reliance on Pulses for Food and Nutritional Security

RAVIRAJ PAWAR[1] AND PRADIPKUMAR ADHALE[2]

Abstract

Pulses are a low-cost source of protein, vitamins and minerals in the Indian diet. India leads the world in area and production of pulses, accounting for 35% and 25% of global area and production, respectively. Two major pulses, beans and chickpea account for more than half of the worldwide pulse area and production, while pea has the highest productivity in total pulses. Despite a slight increase in pulse cultivation area compared to total food grains over the year, the share of pulse production compared to total food grains has decreased over time due to decline in pulse productivity. However, the availability of pulses has increased due to increased imports rather than a increase in production. Furthermore, there is potential for pulse production to meet the demand for a balanced diet of the ever-growing population of India.

Keywords: *Pulses, food security, India*

1. Introduction

Pulses are an essential part of many people's diets worldwide. They have enormous potential to improve human health, conserve our soils, protect the environment, and contribute to global food security (FAO, 2016; Mohanty and Satyasai, 2015; Calles, 2016). The United Nations declared 2016 as the "International Year of Pulses" (IYP) to raise public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition, with the United Nations Food and Agriculture Organization coordinating its implementation in collaboration with UN organizations, Governments, civil society organizations, and other relevant stakeholders (UN, 2013). Pulses are grown in 171 countries worldwide, with India being the world's largest producer, consumer, and importer (Singh, 2013). The International Year of Pulses was conceived as a way to bring global attention to the role of pulses in sustainable agriculture and healthy diets. The celebration of pulses provided a unique opportunity for all the members of the worldwide pulse trade to work together to highlight the role of pulses in healthy people and a healthy planet. As the world's largest producer, importer and consumer of pulses, India is central to the global pulse markets. Pulses can be produced in India with minimal resource use, making them less expensive than animal protein. Compared to other vegetables, pulses are high in protein, less expensive, and can be grown as an intercrop and mixed crop. Pulses are mostly grown under rainfed conditions and do not require extensive irrigation, which is why they are grown in areas that have been left over after cereals, and cash crops have been harvested (Anonymous, 2018). Pulses improve soil fertility and physical structure, perform well in mixed or intercropping systems, crop rotation, and dry farming, and provide green pods for vegetables and healthy cattle fodder (GOI, 2017; Sasdhar and Nagaraja, 2018). Pulses account for 9-10 percent of the total food grain basket and are an essential and low-cost source of plant-based proteins, vitamins and minerals. They are also considered smart foods due to their high protein content (20-25%), which is twice that of wheat and three times that of rice and can help with obesity, diabetes, malnutrition and other issues (Singh and Yadav, 2020). Recent changes in consumer taste and preferences, rising affluence, urbanization, changes in consumer eating habits, increased awareness of safe and healthful food, and other variables have substantially impacted food consumption patterns. As a result, diet composition and nutrition intake have shifted intensely (Shalendra *et al.*, 2013). The

[1]Crop Analyst, State of Maharashtra's Agri-business and Rural Transformation Program (SMART), Pune; email: ravipawar5769@gmail.com
[2]Agricultural Economist, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, India.
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links between food security and nutrition have been recognized and acknowledged under SDG 2, which aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture (Bhavani and Rampal, 2018; Johnston *et al*., 2015).

Agriculture is crucial to achieve adequate nutrition as it produces food essential for nutrition security (Pinstrup-Anderson, 2006). Many studies have empirically estimated that agricultural growth has a significant effect on reducing malnutrition (Gulati *et al*., 2012; Headey, Chiu, and Kadaliya, 2012; Bhagowalia *et al*., 2012; Hoddinott *et al*., 2013), with increased food production appearing to be the most crucial link between agricultural growth and nutrition (Headey, 2011). Food and nutritional security are said to be achieved when adequate food (quality, quantity, safety, and socio-economic acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life (Weingärtner, 2000; UNICEF, 2008). Pulses production must be paralleled with the country's unabated population growth because they are the primary source of a balanced diet, particularly for the rural masses (GOI, 2017). Therefore, it is important to investigate the global and national scenario of production and productivity of pulses as well as export and import.

1.1 Objectives of the study

- To assess the area, production and productivity scenario of pulses at global and national level.
- To examine the dependency on pulses for the food and nutritional security in India.

2. Data sources and methodology

The current study is based on the secondary data collected from different sources like Indian Council of Medical Research (ICMR); Annual Report, Directorate of Pulses Development of the year 2017-18. The statistical tools like averages, percentages, compound annual growth rates (CAGR) were estimated by using exponential function. The CAGR were computed based on time series data on production, import, export and availability of pulses for India for the study period *viz*., 2009 to 2018. The following exponential growth function was used.

$$Y = ab^t$$

where,

Y = Dependent variable (*i.e.,* production, import, export, etc.)

a = Constant

b = Trend coefficient

t = Period in years (1, 2, 3…n)

3. Result and discussion

3.1 Pulses and nutrition

The nutritional status of major pulses, namely chickpea, black gram, green gram, horse gram, lentil, pigeon pea and cowpea is summarized in Table 1. The protein content of various pulses ranges from 20 to 25 percent; however, they have a limited amount of essential amino acids such as methionine, tryptophan and cysteine (Tiwari and Singh, 2012). Approximately 21-25 percent protein is present in pulses, nearly double the amount found in cereals (Singh, 2017). Pulses are high in vitamins such as vitamin A, vitamin C, vitamin B1, and vitamin B2, and minerals such as iron, zinc, calcium and magnesium. Lentil has the highest availability of vitamin A (450 IU), followed by chickpea (316 IU), pigeon pea (220 IU), horse gram (119 IU) and cowpea (lowest) (60 IU). As shown in Table 1, pulses contain nearly all the other vitamins.

TABLE 1: NUTRITIONAL LEVELS OF VARIOUS PULSES

(per 100 gm of pulses)

Food stuff	Chickpea	Black gram	Green gram	Horse gram	Lentil	Pigeon pea	Cowpea
Protein (%)	20	24	25	22	25	22	23
Vitamin A (IU)	316	64	83	119	450	220	60

Food stuff	Chickpea	Black gram	Green gram	Horse gram	Lentil	Pigeon pea	Cowpea
Vitamin C (IU)	3	00	00	1	00	00	00
Vitamin K (IU)	0.29	0.19	00	00	0.25	00	00
Vitamin B1 (IU)	0.30	0.41	0.72	0.42	0.45	0.45	0.50
Vitamin B2 (IU)	0.51	0.37	0.15	0.20	0.49	0.51	0.48

Source: Indian Council of Medical Research (ICMR).

3.2 Global scenario

The total area under pulses was recorded to be about 851.91 lakh ha, with production at 774.73 lakh tonnes and productivity at 909 kg/ha worldwide. India is ranked first in area and production, accounting for 35 percent and 25 percent of global area and production, respectively. On the other hand, Bahrain led the way in terms of productivity, with 18485 kg/ha. Thus, it is clear that India's productivity at 660 kg/ha is significantly lower than the global average of 909 kg/ha.

TABLE 2: AREA, PRODUCTION AND PRODUCTIVITY OF TOTAL PULSES

Country	Area (lakh ha)	Share (%)	Country	Production (lakh tonnes)	Share (%)	Country	Yield (kg/ha)
India	303.09	35.58	India	199.8	25.79	Bahrain	18485
Niger	54.7	6.42	Myanmar	59.77	7.72	Ireland	5886
Myanmar	42.03	4.93	Canada	58.28	7.52	Israel	5576
Nigeria	38.49	4.52	China	41.13	5.31	Belgium	4445
Brazil	32.09	3.77	Brazil	33.06	4.27	Tajikistan	3985
Canada	28.7	3.37	Ethiopia	26.13	3.37	Denmark	3952
China	23.85	2.8	USA	23.95	3.09	Trinidad	3919
Tanzania	20.68	2.43	Russia	22.94	2.96	UK	3755
Mexico	18.35	2.15	Australia	22.47	2.9	Netherlands	3639
Kenya	17.19	2.02	Nigeria	22.05	2.85	Switzerland	3638
Others	272.74	32.02	Others	265.15	34.22	Others	1068
World	851.91	100	World	774.73	100	World (India)	909(660)

Source: Annual Report, Directorate of Pulses Development, Ministry of Agriculture & Farmers Welfare, 2017-18.

3.3 Crop-wise global scenario of pulses

The area, production and productivity of major pulses (beans, chickpea, pigeon pea, pea, lentil, and other pules) is presented in Table 3. Beans have the most area under cultivation (35.93 percent), accounting for 31.64 percent of total world production, followed by chickpea, which has 139.81 lakh ha of cultivation and produce 137.31 lakh tonnes (Table 3). These two pulses (beans and chickpea) accounted for roughly half of the global pulse area and production. Pea (16.14 qt/ha) has the highest productivity in total pulses, followed by lentil (10.67 qt/ha) and chickpea (9.82 qt/ha).

TABLE 3: AREA, PRODUCTION AND PRODUCTIVITY OF MAJOR PULSES

Crop	Area (lakh ha)	Share	Production (lakh tonnes)	Share	Yield (qtl/ha)
Beans	306.13	36	245.16	32	8.01
Chickpea	139.81	16	137.31	18	9.82
Pigeon pea	70.33	8	48.90	6	6.95
Pea	69.32	8	111.86	14	16.14
Lentil	45.24	5	48.27	6	10.67
Other pulses	221.08	26	183.23	24	8.29
Total pulses	**851.91**	**100**	**774.73**	**100**	**9.09**

Source: Annual Report 2017-18, Directorate of Pulses Development, Ministry of Agriculture & Farmers Welfare.

3.4 National scenario

The area, production and productivity of major pulses in India is depicted in Table 4. The area under total pulses was 204.96 lakh ha in 2002-03, with 111.25 lakh tonnes of production and 543 kg/ha of productivity. The area under total pulses increased by 46.34 percent over the base year. It covered 299.93 lakh ha in 2017-18, while total pulse production increased by 126.83 percent and reached a milestone of 252.35 lakh tonnes of total pulse production. Total pulse productivity increased by 54.88 percent over the base year (2002-03). The area under major pulses such as pigeon pea, chickpea, and green gram increased by 31.91 percent, 78.82 percent and 41.19 percent, respectively, over the base year, while production increased by 94.60 percent, 150.88 percent and 131.72 percent, respectively. Pigeon pea, chickpea, and green gram productivity increased from 651 kg/ha, 717 kg/ha, and 288 kg/ha in 2002-03 to 960 kg/ha,1063 kg/ha, and 472 kg/ha in 2017-18.

TABLE 4: AREA, PRODUCTION, AND PRODUCTIVITY OF PULSES IN INDIA

(Area-lakh ha, Production-lakh tonnes, Yield-kg/ha)

Pulses		Period				
		2002-03	2006-07	2010-11	2013-14	2017-18
Pigeon pea	A	33.59 (100)	35.62 (6.04)	43.67 (30.01)	39.04 (16.23)	44.31 (31.91)
	P	21.86 (100)	23.14 (5.86)	28.61 (30.88)	31.74 (45.2)	42.54 (94.6)
	Y	651 (100)	650 (-0.15)	655 (0.61)	813 (24.88)	960 (47.47)
Chick pea	A	59.06 (100)	74.94 (26.89)	91.86 (5.4)	99.27 (68.08)	105.61 (78.82)
	P	42.37 (100)	63.34 (49.49)	82.21 (94.03)	95.26 (124.83)	106.3 (150.88)
	Y	717 (100)	845 (17.85)	895 (24.83)	960 (33.89)	1063 (48.26)
Green gram	A	30.15 (100)	31.94 (5.94)	35.08 (16.35)	33.83 (12.21)	42.57 (41.19)
	P	8.67 (100)	11.15 (28.6)	18 (107.61)	16.05 (85.12)	20.09 (131.72)
	Y	288 (100)	349 (21.18)	513 (78.13)	475 (64.93)	472 (63.89)
Other pulses	A	55.99 (100)	52.97 (-5.39)	55.72 (53.66)	53.66 (-4.16)	48.62 (-13.16)
	P	29.48 (100)	29.74 (0.88)	32.97 (11.84)	36.41 (23.51)	31.35 (6.34)
	Y	527 (100)	561 (6.45)	592 (12.33)	679 (28.84)	645 (22.39)

Pulses		Period				
		2002-03	2006-07	2010-11	2013-14	2017-18
Total pulses	A	204.96 (100)	231.92 (13.15)	264 (28.82)	252.18 (23.04)	299.93 (46.34)
	P	111.25 (100)	141.98 (27.62)	182 (63.96)	192.55 (73.08)	252.35 (126.83)
	Y	543 (100)	612 (12.71)	691 (27.26)	764 (40.7)	841 (54.88)

Source: Directorate of Pulses Development, Annual Report. 2017-18.
Note: Figures in the parentheses are the percent change over the base year 2002-03.

3.5 Pulses and total food grains production in India

Table 5 depicts the decadal contribution of pulses to total food grains in India from 1950-51 to 2017-18. The area under pulses increased from 19.09 mha to 29.99 mha with the pulses production increasing from 8.41million tonnes to 25.23 million tonnes from 1950-51 to 2017-18. The area under pulses to food grains increased slightly from 19.62 to 23.51 percent from 1950-51 to 2017-18, but the share of pulses production to food grains has been decreasing over time, from 16.55 mt in 1950-51 to 8.85 mt in 2017-18. Although the percent contribution of the area under pulses to food grains increased from 1950-51 to 2017-18, production decreased due to a sharp decline in the productivity share of major pulses to total food grains.

TABLE 5: CONTRIBUTION OF PULSES TO TOTAL FOOD GRAINS IN INDIA

Year	Total food grains		Pulses		Share to food grains (%)	
	Area (mha)	Production (mtonnes)	Area (mha)	Production (mtonnes)	Area (mha)	Production (mtonnes)
1950-51	97.32 (100)	50.82 (100)	19.09 (100)	8.41 (100)	19.62 (100)	16.55 (100)
1960-61	115.58 (18.76)	82.02 (61.39)	23.56 (23.42)	12.70 (51.01)	20.38 (3.87)	15.48 (-6.47)
1970-71	124.32 (27.74)	108.42 (113.34)	22.54 (18.07)	11.82 (40.55)	18.13 (-7.59)	10.90 (-34.14)
1980-81	126.67 (30.16)	129.59 (155.00)	22.46 (17.65)	10.63 (26.40)	17.73 (-9.63)	8.20 (-50.45)
1990-91	127.84 (31.36)	176.39 (247.09)	24.66 (29.18)	14.26 (69.56)	19.29 (-1.68)	8.08 (-51.18)
2000-01	121.05 (24.38)	196.81 (287.27)	20.35 (6.60)	11.08 (31.75)	16.81 (-14.32)	5.63 (-65.98)
2010-11	126.67 (30.16)	244.49 (381.09)	26.40 (38.29)	18.24 (116.88)	20.84 (6.44)	7.46 (-54.92)
2017-18	127.56 (31.07)	284.83 (460.47)	29.99 (57.10)	25.23 (200.00)	23.51 (19.83)	8.85 (-46.53)

Source: Directorate of Pulses Development, Annual Report 2017-18.
Note: Figures in the parentheses are the percent change from 1950 to 51.

3.6 Growth of pulses availability in India

Table 6 shows the compound annual growth rates (CAGR) of domestic pulse production, imports, and exports from 2009 to 2018. The total pulses production increased by 4.6 percent per year, rising to 252.40 lakh tonnes in 2018 from 145.66 lakh tonnes in 2009. The import of pulses increased significantly by 12.78 percent per year from 24.74 lakh tonnes to 82.96 lakh tonnes during the study period, while the export of pulses showed no significant growth. It shows that pulse availability has increased due to increased imports rather than a 4.6 percent annual increase in production.

TABLE 6: AVAILABILITY OF PULSES IN INDIA

Year	Production (lakh tonnes)	Import (lakh tonnes)	Export (lakh tonnes)	Availability (lakh tonnes)
2009	145.66	24.74	1.36	169.04
2010	146.62	35.10	1.00	180.72
2011	182.41	26.99	2.08	207.32
2012	170.89	33.65	1.74	202.80
2013	183.43	38.39	2.02	219.80
2014	192.53	30.49	3.43	219.59
2015	171.52	45.85	2.22	215.15
2016	163.48	57.98	2.56	218.90
2017	224.01	66.09	2.56	287.54
2018	252.40	82.96	1.35	334.01
CAGR	**4.6 *****	**12.78 *****	**5.49 NS**	**6.14 *****

Source: Annual Report 2016-17, Directorate of Pulses Development, Ministry of Agriculture and Farmers Welfare.
Note: *** indicates the significance at the 1 percent level.

3.7 Per capita availability of pulses

In 1951, the availability of pulses per capita per day was 60.70 gm per day and 22.10 kg per year, but by 2017 it had dropped to 52.90 gm per day and 19.30 kg per year. It clearly shows a 13 percent decline in per capita per day and per capita per year availability of pulses and a 40 percent gap in the availability of pulses in India from 1951 to 2017. It suggests that there is plenty of room for increasing pulses production in India to provide a nutritionally balanced diet for the country's ever-growing population (Table 7).

TABLE 7: PER CAPITA AVAILABILITY OF PULSES IN INDIA

Year	Pulses Availability		Requirement		Gap	
	Per capita per day (gm)	Per capita per year (kg)	Per day (gm)	Per year (kg)	Per capita per day (gm)	Per capita per year (kg)
1951	60.70 (100.00)	22.10 (100.00)	80	29.2	-19.3 (100.00)	-7.1 (100.00)
1961	69.00 (13.67)	25.20 (14.03)	80	29.2	-11 (-43.01)	-4 (-43.66)
1971	51.20 (-15.65)	18.70 (-15.38)	80	29.2	-28.8 (49.22)	-10.5 (47.89)
1981	37.50 (-38.22)	13.70 (-38.01)	80	29.2	-42.5 (120.21)	-15.5 (118.31)
1991	41.60 (-31.47)	15.20 (-31.22)	80	29.2	-38.4 (98.96)	-14 (97.18)
2000	31.80 (-47.61)	11.60 (-47.51)	80	29.2	-48.2 (149.74)	-17.6 (147.89)
2010	35.40 (-41.68)	12.90 (-41.63)	80	29.2	-44.6 (131.09)	-16.3 (129.58)
2017	52.90 (-12.85)	19.30 (-12.67)	80	29.2	-27.1 (40.41)	-9.9 (39.44)

Source: Annual Report, Directorate of Pulses Development, Ministry of Agriculture & Farmers Welfare, 2017-18.
Note: The figures in the parentheses are the percentage change over the base year 1951.

3.8 Dependence on pulses for food and nutritional security

There is stagnant growth in pulses production and continuous population growth. As a result, the per capita availability of pulses has decreased significantly. Initiatives such as expanding the area under cultivation while cultivating high yielding varieties, improving soil fertility at the farm level, implementing innovative interventions in the cropping system, and utilising rice fellow while intercropping pulses with other crops could be critical in pulses production. Although total pulses contribute 20 percent and 8.85 percent of total food area and production, respectively (Table 5), we import nearly 25 percent of our pulses to meet national demand.

4. Conclusions

Pulses are a good source of protein, vitamins, and minerals like iron, zinc, calcium, and magnesium. However, they have a low amount of essential amino acids like methionine, tryptophan, and cysteine. India ranks first in area and production of pulses, accounting for 35% and 25% of global area and production, respectively. However, the productivity of pulses (660 kg/ha) is significantly lower than the worldwide average of 909 kg/ha. Beans and chickpea account for roughly half of the global pulse area and production, while pea has the highest productivity in all of the pulses. With reference to India, the area under pulses increased by 46.34 percent in 2017-18, while total pulses production increased by 126.83%, with a productivity improvement of 54.88% over 2002-03. The area under pulses cultivation to total food grains increased slightly, but the share of pulses production to food grains has decreased over time due to decline in productivity of pulses. The availability of pulses has increased due to increased imports rather than a minor increase in production.

5. Suggestions

The area under different pulses has been increasing, however there is scope for productivity improvement. High yielding varities may be developed to improve the pulses production.

The availability of pulses per capita per day and per capita per year has decreased, indicating there is still potential for pulse production to meet India's ever-growing population's demand for a balanced diet.

Other food grains are also high in nutrients and could serve as a secondary source of nutrition to address not only food security but also nutritional security.

There is a reliance on imports to meet our needs. Therefore, government should provides policy framework to increase pulse production to meet the demand of an increasing population.

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Agro-Economic Research

Identification of Nodal Markets for Monitoring of Prices of Perishables

C.S.C. SEKHAR[1], NAMRATA THAPA[2] AND YOGESH BHATT[3]

Abstract

Effective monitoring of agricultural prices is crucial since large and frequent movements of prices impact producers' income; consumers' access to food and Governments' ability to plan exports/imports. Given that there are thousands of agricultural markets in India, the objective of this paper is to identify a set of nodal markets for effective price monitoring for TOP commodities (Tomato, Onion and Potato), based on a systematic econometric analysis. The study uses secondary data on weekly market arrivals and prices of these three perishable commodities from the AGMARKNET database for the period from January, 2010 to December, 2019. There are a total of 169 tomato markets, 211 onion markets and 180 potato markets for which data is available in the database. In the first stage based on market arrivals, 32 tomato markets, 25 onion markets and 29 potato markets were identified as major markets. From this set, in the second stage by using the VAR-GC analysis, nine tomato (Mulakalacheruvu, Patna, Tiphra, Bowenpally, Delhi, Ahmedabad, Chintamani, Solapur and Kolhapur); eight onion (Ahmedabad, Pimplagaon, Lasalgaon, Rahuri, Solapur, Chennai, Agra and Malegaon); and six potato (Jaipur, Jammu, Chennai, Ajmer, Indore and Raipur) markets were identified as the leading/nodal markets. Important peripheral and following markets were also identified. Thus, it will be administratively and logistically more feasible if policymakers focus on the nodal and peripheral markets (that have been identified) to understand the market price dynamics of these commodities. This will help in timely decisions on production planning, exports and imports.

Keywords: *Nodal markets, price monitoring, VAR-GC*

1. Introduction

Large and frequent movements in prices of agricultural products have wide implications for producers, consumers and the Governments. Such frequent movements impact producers' income, consumers' economic access to food and Governments' ability to plan exports/imports. Hence, monitoring of agricultural prices in general and food prices in particular becomes extremely important.

However, when the number of markets is large and conditions of supply and demand vary greatly, as is the case in a large country like India, this task becomes a lot more difficult. Is it possible to identify a smaller set of markets (called nodal markets hereafter) through a systematic analysis, to aid price monitoring? What is the role of these markets in price leadership? What are the lead-lag relationships among prices in these nodal markets and other markets?

Answers to these questions will help policymakers focus intensively on a small number of markets and effectively monitor prices in these markets, which in turn, can help in deciphering the price trends in other markets. This will greatly reduce the cost of monitoring and will improve operational efficiency. In the backdrop of the recent developments, particularly with rising food inflation due to supply disruptions because of Covid-19 and Russia-Ukraine war, the issue of market prices received by farmers has assumed renewed significance, as they have major implications for farmers' purchasing power.

Given the large variety of commodities consumed in India and a large number of markets, the present analysis is confined to three perishable

[1]AERU, Institute of Economic Growth, University of Delhi; email id: csekhar@iegindia.in
[2]AERU, Institute of Economic Growth, University of Delhi; email id: nmrtthapa@gmail.com
[3]AERC, University of Delhi; email id: bhatt.yogesh0@gmail.com

commodities – tomato, onion and potato, hereafter TOP commodities - which experienced frequent price fluctuations in the past and continue to experience almost every alternate year.

For the purpose of identifying nodal markets, the paper draws insights from the existing literature on lead-lag relationships in agricultural prices. With a few exceptions, studies identifying the lead-lag relationship of agricultural commodities across different markets for the purpose of food price monitoring are sparse. Miller (1980) and Spriggs *et al.* (1982) analyzed the lead-lag relationship in livestock and crops prices, respectively; Bessler and Brandt (1982) for livestock prices and other causal variables; Ziemer and Collins (1984) for both crops and livestock prices, but not particularly with a purpose of price monitoring. Though the context and objective of these studies vary, important insights can be drawn on the method of analysis used, which is Granger Causality. Araujo *et al.* (2012) and FAO (2017) explicitly deals with identifying lead-lag relationship for price monitoring which directly concerns the objective of this paper. Araujo *et al.* (2012) identifies leading markets for millet in African countries using Granger causality in a multivariate vector autoregressive (VAR) framework. Their findings indicate that monitoring all the markets during the harvest period does not add significant extra information. Rather, monitoring select leading markets during crucial periods of the year can help in forecasting future price crises. The only and the most recent study pertaining to India is by FAO (2017). Using VAR and Granger causality, the study analyses the markets for crops (wheat, paddy, arhar, soybeans and maize). Instead of using only price data as was done by earlier studies, the study uses market arrivals and price data for identifying the leading/ nodal markets.

Drawing from these studies, analysis was undertaken for TOP commodities which have not been considered in earlier studies such as FAO (2017). Data on market arrivals along with data on wholesale prices of these commodities were used. Granger causality test in a multivariate VAR framework was applied for identifying price leadership in a particular market.

1.1 Objectives of the study

The objectives of the study are:

- Identifying the nodal markets for each of the commodities.
- Quantifying the relationships between prices in the nodal markets and other markets.

2. Data sources and methodology

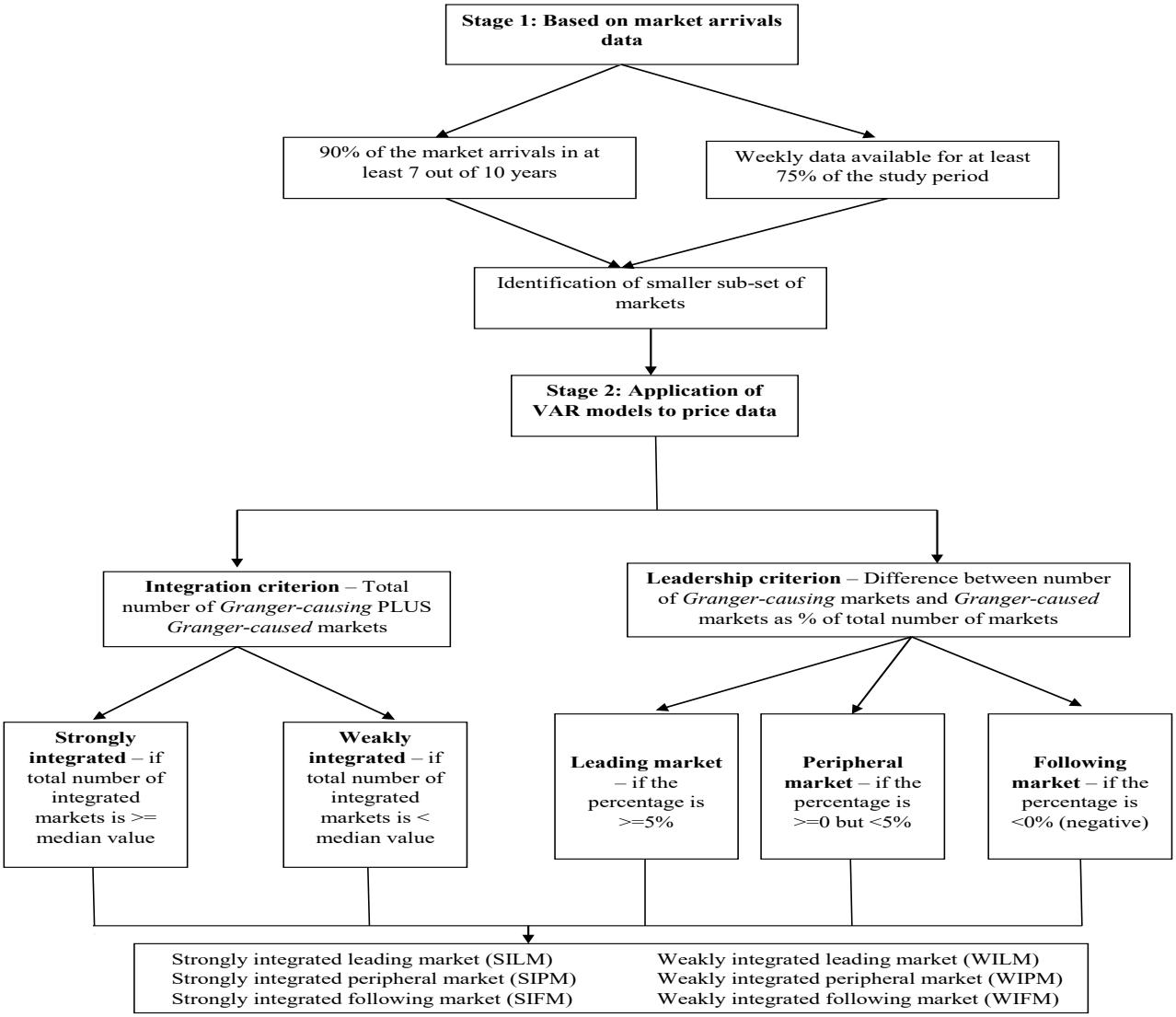
The study uses the AGMARKNET database on daily market arrivals and wholesale prices of TOP commodities provided by the Directorate of Marketing & Inspection (DMI), Ministry of Agriculture and Farmers Welfare, Government of India. The geographical coverage of the paper is All-India. Since there were long data gaps during the early years in many of the markets, data for the period beginning from the 1st week of 2010 to the last week of 2019 has been used. In case of tomato, this period is even shorter, from 1st week of 2016 to the last week of 2019, because of non-availability of continuous data. The terminal year of analysis is 2019. After 2019, particularly after the lockdown in March, 2020 due to Covid-19, there have been long gaps in the reportage of data in several markets.

The methodology is presented in Figure 1. The following two-stage procedure has been adopted in the selection of major markets:

Stage 1: Identification of initial set of markets based on market arrivals during the last ten years (2010-19)

All the markets that contribute 90% of the annual market arrivals and which possess weekly market arrival data for at least 75% of the study period have been selected.

Figure 1: Methodology: A schematic Diagram



Source: Designed by author

Stage 2: Identification of the nodal markets based on prices

From the set of markets identified in Stage 1, a smaller set of important nodal markets is identified using the Vector Auto Regression (VAR) and Granger-causality (GC), through the use of high-frequency weekly data on prices.

The estimated VAR model is of the following form

$$p_{it} = \sum_{i=1}^{k} \sum_{j=1}^{p} A_{ij} p_{i,t-j} + \sum_{i=1}^{k} X_{it} + \varepsilon_{it};$$

i = 1,…., k; j = 1….p, t = 1, . . ., T.

where,

p_{it} is the price in market i in time t

A_{ij} is a matrix of coefficients to be estimated

x_{it} is the vector of other covariates (market arrivals in this study)

ε_{it} is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

$E(\varepsilon_{it}) = 0$; $E(\varepsilon_{it}\varepsilon_{it}) = \Sigma$ (a positive semi definite matrix) for all $t = t$ and $E(\varepsilon_{it}\varepsilon_{it}) = 0$ for all $t \neq t$. The lag order p is selected using the Schwarz information criterion.

The VAR model takes into account the fact that prices are determined simultaneously in a number of markets. Each price is treated as endogenous and is expressed as a function of the lagged values of all of the prices in all the other markets. All the prices are first tested for non-stationarity by including time trend wherever appropriate. Plots of the price series are used to identify the possible presence of time trend in the series. Non-stationarity is tested assuming individual unit root processes (Im, Pesaran and Shin W-stat; ADF-Fisher Chi-square; and PP–Fisher Chi-square). All the prices were found to be stationary/trend-stationary. The VAR in prices is estimated in three specifications –i) using only prices (with no controls); ii) using prices along with total market arrivals as a control variable; iii) prices along with arrivals in major markets as a control variable. After estimating the VAR in levels, lag length tests were used to identify the optimum lag length. Granger-causality (GC) test is then used to identify the nodal markets for each commodity.

The GC test helps in identifying a statistically significant relationship, if any, between current prices in market 'i' and lagged prices in any other market. If P_1 and P_2 are prices in markets 1 and 2, then P_1 is said to be Granger caused by P_2 if lagged values of P_2 are significant and help in predicting P_1 and vice versa. It does not reveal the true causal relationship between prices but only indicates whether movements in one set of prices consistently precede the movements in the other set.

The importance of any market depends upon the total number of markets it is integrated with, and out of these, the number of markets in which it can influence the price. Thus, two criteria have been used in stage 2 to identify the nodal markets.

To illustrate, suppose the price of a market Granger-causes the current price in 'x' number of markets and the price in this market is Granger-caused by lagged prices in 'y' other markets, then, the following two criteria have been used to categorize the markets.

i) Integration criterion: Total number of markets integrated (with this market) = x+y

ii) Leadership criterion: Number of markets Granger-caused by this market relative to total number of markets = (x-y)/total number of markets.

A market is classified into two categories based on criterion 1 – weakly integrated and strongly integrated. A market is 'weakly integrated' if the total number of markets it is integrated with is less than the median value (of integrated markets). Otherwise, it is classified as 'strongly integrated'. For example, if a market x is integrated with 10 other markets and the median value is 12, then the market is categorized as 'weakly integrated'.

Similarly, a market is classified into three categories based on criterion 2 - leading/nodal market, peripheral market, following market. A market is a 'leading/nodal market' if the difference between the number of markets it is Granger-causing and the number of markets it is Granger-caused by is at least 5% of the total number of markets. If this difference is zero or greater but less than 5%, then the market is classified as a 'peripheral market'. It is classified as a 'following market' if the percentage is less than zero (if the number of markets it is Granger-causing is less than the number of markets it is Granger-caused by). For example, if there are total of 25 markets and if the market of our interest is Granger-causing prices in 10 markets and is Granger-caused by 5 markets, then the percentage difference is 20% ((10-5)/25). Since the difference is more than 5%, this market is classified as a leading/nodal market.

Combining both the criteria, we thus have six possible categories.

1. Strongly integrated leading market - SILM
2. Strongly integrated peripheral market - SIPM
3. Strongly integrated following market - SIFM
4. Weakly integrated leading market - WILM
5. Weakly integrated peripheral market - WIPM
6. Weakly integrated following market - WIFM

3. Results and discussion

There are a total of 169 tomato markets, 211 onion markets and 180 potato markets for which data is reported. Following the procedure outlined above, 32 tomato markets, 25 onion markets and 29 potato markets have been selected in stage 1. The details of the selected markets in stage 1 are as follows (Table 1).

TABLE 1: MARKETS SELECTED FOR ANALYSIS IN STAGE 1

(based on percentage of market arrivals and weekly arrival data)

S. No.	Onion	Potato	Tomato
1	Agra (UP)	Agra (UP)	Agra (UP)
2	Ahmedabad (Guj)	Ahmedabad (Guj)	Ahmedabad (Guj)
3	Bangalore	Ajmer (Raj)	Aligarh (UP)
4	Belgaum (Knt)	Aligarh (UP)	Bareilly (UP)
5	Chennai	Amritsar (Pb)	Binny Mill (Knt)
6	Delhi	Bangalore	Bowenpally (Telangana)
7	Devala (Mah)	Bareilly (UP)	Chennai
8	Dhulia (Mah)	Belgaum (Knt)	Chintamani (Knt)
9	Hubli (Knt)	Bhubneswer (Or)	Delhi
10	Indore (Mah)	Chennai	Indore (MP)
11	Jaipur	Delhi	Jalandhar (Pb)
12	Kolhapur (Mah)	Faizabad (UP)	Kanpur (UP)
13	Kolkata	Farukhabad (UP)	Khanna (Pb)
14	Kurnool (AP)	Hubli (Knt)	Kolar (Knt)
15	Lasalgaon (Mah)	Indore (MP)	Kolhapur (Mah)
16	Mahuva (Guj)	Jaipur	Kolkata
17	Malegaon (Mah)	Jammu	Mulakalacheruvu (AP)
18	Manmad (Mah)	Jodhpur (Raj)	Mumbai
19	Mumbai	Kanpur (UP)	Patna
20	Nagpur	Khanna (Pb)	Pune (Mah)
21	Pimpalgaon (Mah)	Kolkata	Raipur (Chgarh)
22	Pune (Mah)	Lucknow	Rajkot (Guj)
23	Rahuri (Mah)	Mumbai	Saharanpur (UP)
24	Solapur (Mah)	Patna	Solapur (Mah)
25	Yeola (Mah)	Pune (MS)	Tiphra (Chatt)
26		Raipur (Chgarh)	Varanasi (UP)
27		Rajkot (Guj)	Amritsar (Pb)
28		Surat (Guj)	Bhubneswer (Or)
29		Udaipur (Raj)	Dehradoon (UK)
30			Gudimalkapur (Telangana)
31			Jaipur
32			Lucknow
Total	**25 (Out of 211)**	**29 (Out of 180)**	**32 (Out of 169)**

Source: Computed by author

3.1 Tomato

Table 2 summarizes the results based on VARs based on prices. The interpretation of Table 2 is presented here. Let's consider the market in the first row, Mulakalacheruvu (AP). Column 2 denotes the number of markets that 'Mulakalacheruvu' is Granger-causing, which is 11. This means that the previous week's tomato price in Mulakalacheruvu is significantly influencing the current week's price in 11 other markets. In other words, Mulakalacheruvu is leading 11 other markets. Similarly, column 3 denotes the number of markets by which 'Mulakalacheruvu' is Granger-caused, which is 7. This means that there are 7 markets whose previous week's tomato price is influencing significantly the current week's price in Mulakalacheruvu, *i.e.* Mulakalacheruvu is lagging these 7 markets. For all the remaining markets, the numbers of Granger-causing and Granger-caused markets are identified.

Column 4 gives the total number of markets Granger-causing and Granger-caused. This number is 18, which is the sum of 11 (Granger-casing) and 7 (Granger-caused). This means that Mulakalacheruvu is integrated with 18 markets in all. This number is worked out similarly for all the remaining markets and the median value is given in the last row of column 4, which can be seen as 11. Thus the total number of integrated markets of Mulakalacheruvu, which is 18, is greater than the median value, which is 11. Thus, as per the 'integration criterion' discussed earlier, this market is classified as 'strongly integrated'.

Column 5 gives the difference between the number of markets Granger-causing and Granger-caused by as a percentage of total number of markets. This gives us a measure of whether a particular market is leading other markets or lagging them. For example, the number of markets Mulakalacheruvu is Granger-causing or leading is 11. The number of markets Mulakalacheruvu is Granger-caused by or lagging is 7. The difference between the numbers of these markets is 4. Since the total number of tomato markets is 32, the percentage of this difference to total number of markets works out to 12.5%, which is given in column 5. This percentage is greater than 5% and following the 'leadership criterion' discussed earlier, this market is categorized as a 'leading' market.

Thus combining the 'integration criterion' and the 'leadership criterion', Mulakalacheruvu is categorized as 'strongly integrated leading market (SILM)' (Column 8). The same procedure is followed for the remaining 31 markets. Following this process, we could identify ten leading markets (nine strongly integrated and one weakly integrated) for VAR specification with only prices. Other markets are categorized as peripheral or following markets. A similar analysis is carried out for the other two VAR specifications, namely, VAR with all market arrivals as control and VAR with major market arrivals as control and markets are categorized into six categories.

The categorization of markets in the three VAR specifications is presented in Table 3. The final categorization of the markets is based on the 'best of the three' results. For example, Kolar market is categorized as SIPM in VAR with prices; SILM in VAR with all market arrivals and as SIPM again in VAR with major market arrivals. Since two of the three specifications give the result 'SIPM', the market is categorized as SIPM. Following this procedure, from the set of 32 markets identified in stage 1, nine markets - Mulakalacheruvu, Patna, Tiphra, Bowenpally, Delhi, Ahmedabad, Chintamani, Solapur, Kolhapur – have emerged as leading/nodal markets at the national level (strongly integrated) and regional level (weakly integrated) (Table 4). About six peripheral markets – Kolar, Jaipur, Mumbai, Indore, Khanna and Chennai – have also been identified. The rest are following markets. Pune is one market where a clear categorization was not possible because the market seemed to fall into different categories in different specifications.

Two additional categorizations - one with VAR of prices plus all market arrivals as control; and prices plus major market arrivals as control have been prepared. The interpretation of those tables is exactly similar to that of Table 2. However, the detailed results of these tables are not presented here for reasons of brevity (Detailed Results can be seen in Sekhar *et al. (2022)*). The final categorization (Table 3 and Table 4) is the best of the three categorizations.

TABLE 2: VAR RESULTS BASED ON ONLY PRICES WITH 1 LAG (TOMATO)

Market (1)	Granger causing (2)	Granger caused by (3)	Total integrated markets (4) = (2)+(3)	% difference to total no. of markets (32) (5)=[(2)-(3)]/32	Test for integration (6)	Test for leadership (7)	Final market category (8)
Mulakalacheruvu	11	7	18	12.50	SI	LM	SILM
Patna	11	4	15	21.88	SI	LM	SILM
Raipur	3	5	8	-6.25	WI	FM	WIFM
Tiphra	14	5	19	28.13	SI	LM	SILM
Delhi	11	8	19	9.38	SI	LM	SILM
Ahmedabad	13	6	19	21.88	SI	LM	SILM
Rajkot	4	7	11	-9.38	SI	FM	SIFM
Binny Mill	7	9	16	-6.25	SI	FM	SIFM
Chintamani	8	5	13	9.38	SI	LM	SILM
Kolar	6	6	12	0.00	SI	PM	SIPM
Kolhapur	6	2	8	12.50	WI	LM	WILM
Mumbai	4	4	8	0.00	WI	PM	WIPM
Pune	3	3	6	0.00	WI	PM	WIPM
Solapur	7	4	11	9.38	SI	LM	SILM
Indore	3	3	6	0.00	WI	PM	WIPM
Bhubneswer	2	3	5	-3.13	WI	FM	WIFM
Amritsar	1	4	5	-9.38	WI	FM	WIFM
Jalandhar	5	6	11	-3.13	SI	FM	SIFM
Khanna	4	5	9	-3.13	WI	FM	WIFM
Jaipur	7	7	14	0.00	SI	PM	SIPM
Bowenpally	9	4	13	15.63	SI	LM	SILM
Gudimalkapur	0	4	4	-12.50	WI	FM	WIFM
Chennai	6	4	10	6.25	WI	LM	WILM
Dehradoon	2	7	9	-15.63	WI	FM	WIFM
Agra	3	6	9	-9.38	WI	FM	WIFM
Aligarh	6	14	20	-25.00	SI	FM	SIFM
Bareilly	10	9	19	3.13	SI	PM	SIPM
Kanpur	1	5	6	-12.50	WI	FM	WIFM
Lucknow	1	7	8	-18.75	WI	FM	WIFM
Saharanpur	4	3	7	3.13	WI	PM	WIPM
Varanasi	4	8	12	-12.50	SI	FM	SIFM
Kolkata	6	8	14	-6.25	SI	FM	SIFM
Median value			11				

Source: Computed by author
Note: SI–strongly integrated; WI-weakly integrated; LM-leading market; PM-peripheral market; FM-following market

TABLE 3: FINAL CATEGORIZATION OF MARKETS –TOMATO

Market	Only prices	All market arrivals (lag 1)	Major market arrivals (lag 1)	Final category
Mulakalacheruvu	SILM	SILM	SILM	SILM
Patna	SILM	SILM	SILM	SILM
Raipur	WIFM	WIFM	WIFM	WIFM
Tiphra	SILM	SILM	SILM	SILM
Delhi	SILM	SILM	SILM	SILM
Ahmedabad	SILM	SILM	SILM	SILM
Rajkot	SIFM	SIFM	SIFM	SIFM
Binny Mill	SIFM	SIFM	SIFM	SIFM
Chintamani	SILM	SILM	SILM	SILM
Kolar	SIPM	SILM	SIPM	SIPM
Kolhapur	WILM	WILM	WILM	WILM
Mumbai	WIPM	SIFM	WIPM	WIPM
Pune	WIPM	WIFM	WILM	Not Clear
Solapur	SILM	SILM	SILM	SILM
Indore	WIPM	WIPM	WIFM	WIPM
Bhubneswer	WIFM	WIFM	WIFM	WIFM
Amritsar	WIFM	WIFM	WIFM	WIFM
Jalandhar	SIFM	SIFM	WIFM	SIFM
Khanna	WIFM	WIPM	WIPM	WIPM
Jaipur	SIPM	SIPM	SIPM	SIPM
Bowenpally	SILM	SILM	SILM	SILM
Gudimalkapur	WIFM	WIFM	WIFM	WIFM
Chennai	WILM	WIPM	WIPM	WIPM
Dehradoon	WIFM	SIFM	WIFM	WIFM
Agra	WIFM	SIFM	SIFM	SIFM
Aligarh	SIFM	SIFM	SIFM	SIFM
Bareilly	SIPM	SIFM	SIFM	SIFM
Kanpur	WIFM	WIFM	WIFM	WIFM
Lucknow	WIFM	SIFM	WIFM	WIFM
Saharanpur	WIPM	WIFM	WIFM	WIFM
Varanasi	SIFM	SIFM	SIFM	SIFM
Kolkata	SIFM	SIPM	SIFM	SIFM

Source: Computed by author

TABLE 4: TOMATO MARKETS (TOTAL 32)

	Leading/Nodal	Peripheral	Following
Strongly integrated (Nationally important)	Mulakala Cheruvu (AP), Patna (Bih), Tiphra (Chg), Bowenpally (Tel), Delhi, Ahmedabad (Guj), Chintamani (Kar), Solapur (Mah)	Kolar (Kar), Jaipur (Raj),	Varanasi (UP), Rajkot (Guj), Binny Mills (Kar), Jalandhar (Pun), Agra (UP), Aligarh (UP), Bareilly (UP), Kolkata (WB),
Weakly integrated (Locally important)	Kolhapur (Mah)	Mumbai (Mah), Indore (MP), Khanna (Pun), Chennai (TN),	Raipur (Chg), Bhubaneswar (Ori), Sahranpur (UP), Kanpur (UP), Amritsar (Pun), Gudimalkapur (Tel), Dehradun (UK), Lucknow (UP)
Not clear	Pune (Mah)		

Source: Computed by author

3.2 Onion

The interpretation of Table 5 is exactly as explained in section 3.1. Two additional categorizations as in case of tomato - one with VAR of prices plus all market arrivals as control; and prices plus major market arrivals as control have been prepared. The interpretation of those tables is exactly similar to that of Table 2. However, the detailed results of these tables are not presented here for reasons of brevity (Detailed results can be seen in Sekhar *et al. (2022)*). The final categorization (Table 6 and Table 7) is the best of the three categorizations.

From the set of 25 markets identified in stage 1, eight markets - Ahmedabad, Pimplagaon, Lasalgaon, Rahuri, Solapur, Chennai, Agra and Malegaon – have been identified as leading/ nodal markets at the national and local levels. Additionally, seven markets - Bangalore, Mumbai, Yeola, Jaipur, Mahua, Dhulia and Indore – have emerged as the peripheral markets. The rest are following markets.

TABLE 5: VAR RESULTS BASED ON ONLY PRICES (ONION)

Market (1)	Granger causing (2)	Granger caused by (3)	Total integrated markets (4) = (2) + (3)	% difference to total no. of markets (25) (5) = [(2)-(3)]/25	Test for integration (6)	Test for leadership (7)	Final Market category (8)
Kurnool	4	10	14	-24	1	3	SIFM
Delhi	9	11	20	-8	1	3	SIFM
Ahmedabad	19	11	30	32	1	1	SILM
Mahuva	5	5	10	0	2	2	WIPM
Bangalore	9	12	21	-12	1	3	SIFM
Belgaum	4	4	8	0	2	2	WIPM
Hubli	7	4	11	12	2	1	WILM
Devala	6	10	16	-16	1	3	SIFM
Dhulia	6	5	11	4	2	2	WIPM
Kolkata	3	10	13	-28	1	3	SIFM
Lasalgaon	8	5	13	12	1	1	SILM
Malegaon	8	6	14	8	1	1	SILM
Manmad	1	8	9	-28	2	3	WIFM
Mumbai	13	10	23	12	1	1	SILM
Nagpur	5	8	13	-12	1	3	SIFM
Pimplagaon	8	6	14	8	1	1	SILM
Pune	4	8	12	-16	2	3	WIFM
Rahuri	11	5	16	24	1	1	SILM

Market (1)	Granger causing (2)	Granger caused by (3)	Total integrated markets (4) = (2) + (3)	% difference to total no. of markets (25) (5) = [(2)-(3)]/25	Test for integration (6)	Test for leadership (7)	Final Market category (8)
Solapur	21	6	27	60	1	1	SILM
Yeola	5	7	12	-8	2	3	WIFM
Indore	6	6	12	0	2	2	WIPM
Jaipur	7	6	13	4	1	2	SIPM
Chennai	15	13	28	8	1	1	SILM
Agra	14	9	23	20	1	1	SILM
Kolkata	3	10	13	-28	1	3	SIFM
Median value			13	0.00			

Source: Computed by author

TABLE 6: FINAL CATEGORIZATION OF MARKETS – ONION

Market	Only prices	All market arrivals	Lasalgaon + Pimplagaon + Malegaon + Yeola arrivals	Final category
Kurnool	SIFM	WIFM	WIFM	WIFM
Delhi	SIFM	SIFM	SIFM	SIFM
Ahmedabad	SILM	SILM	SILM	SILM
Mahuva	WIPM	SIPM	WIPM	WIPM
Bangalore	SIFM	SIPM	SIPM	SIPM
Belgaum	WIPM	WIFM	WIFM	WIFM
Hubli	WILM	WIFM	WIFM	WIFM
Devala	SIFM	SILM	WIFM	SIFM
Dhulia	WIPM	WIPM	WIPM	WIPM
Kolkata	SIFM	WIFM	WIFM	WIFM
Lasalgaon	SILM	WILM	SILM	SILM
Malegaon	SILM	WILM	WILM	WILM
Manmad	WIFM	WIFM	WIFM	WIFM
Mumbai	SILM	SIPM	SIPM	SIPM
Nagpur	SIFM	SILM	SIFM	SIFM
Pimplagaon	SILM	SILM	SILM	SILM
Pune	WIFM	WIFM	WIFM	WIFM
Rahuri	SILM	SILM	SILM	SILM
Solapur	SILM	SILM	SILM	**SILM**
Yeola	WIFM	SILM	SIPM	**SIPM**
Indore	WIPM	WIPM	WIPM	**WIPM**
Jaipur	SIPM	SIPM	SILM	**SIPM**
Chennai	SILM	SIFM	SILM	**SILM**
Agra	SILM	SILM	SILM	**SILM**
Kolkata	SIFM	SIFM	SIFM	**SIFM**

Source: Computed by author

TABLE 7: ONION MARKETS (TOTAL 25)

	Leading/Nodal	Peripheral	Following
Strongly integrated (Nationally important)	Ahmedabad (Guj), Pimplagaon (Mah), Lasalgaon (Mah), Rahuri (Mah), Solapur (Mah), Chennai (TN), Agra (UP)	Bangalore (Kar), Mumbai (Mah), Yeola (Mah), Jaipur (Raj)	Delhi, Devala (Mah), Nagpur (Mah), Kolkata (WB)
Weakly integrated (Locally important)	Malegaon (Mah)	Mahua (Guj), Dhulia (Mah), Indore (MP)	Kurnool (AP), Belgaum (Kar), Hubli (Kar), Kolhapur (Mah), Manmad (Mah), Pune (Mah)
Not clear			

Source: Computed by author

3.3 Potato

The interpretation of Table 8 is exactly as explained in section 3.1. Two additional categorizations as in case of tomato - one with VAR of prices plus all market arrivals as control; and prices plus major market arrivals as control have been prepared. The interpretation of those tables is exactly similar to that of Table 2. However, the detailed results of these tables are not presented here for reasons of brevity (Detailed results can be seen in Sekhar *et al. (2022)*). The final categorization (Table 9 and Table 10) is the best of the three categorizations.

From the set of 29 markets identified in stage 1, six markets - Jaipur, Jammu, Chennai, Ajmer, Indore, Raipur - markets have emerged as the leading/nodal markets at the national and local levels, based on the VAR-GC analysis using prices. In addition, six markets – Delhi, Rajkot, Kolkata, Khanna, Bangalore and Farukkabad - have been identified as peripheral markets.

TABLE 8: VAR RESULTS BASED ON ONLY PRICES (POTATO)

Market (1)	Granger causing (2)	Granger caused by (3)	Total integrated markets (4)=(2) + (3)	% difference to total no. of markets (29) (5)=[(2)-(3)]/29	Test for integration (6)	Test for leadership (7)	Final market category (8)
Patna	8	9	17	-3	1	3	SIFM
Raipur	10	7	17	10	1	1	SILM
Delhi	12	10	22	7	1	1	SILM
Ahmedabad	6	11	17	-17	1	3	SIFM
Rajkot	8	8	16	0	1	2	SIPM
Surat	5	6	11	-3	2	3	WIFM
Jammu	15	8	23	24	1	1	SILM
Bangalore	3	3	6	0	2	2	WIPM
Belgaum	4	5	9	-3	2	3	WIFM
Hubli	6	8	14	-7	2	3	WIFM
Mumbai	7	9	16	-7	1	3	SIFM
Pune	4	5	9	-3	2	3	WIFM
Indore	13	5	18	28	1	1	SILM
Bhubneswer	5	8	13	-10	2	3	WIFM
Amritsar	5	5	10	0	2	2	WIPM
Khanna	6	5	11	3	2	2	WIPM

Market (1)	Granger causing (2)	Granger caused by (3)	Total integrated markets (4)=(2) + (3)	% difference to total no. of markets (29) (5)=[(2)-(3)]/29	Test for integration (6)	Test for leadership (7)	Final market category (8)
Ajmer	14	5	19	31	1	1	SILM
Jaipur	17	10	27	24	1	1	SILM
Jodhpur	4	11	15	-24	2	3	WIFM
Udaipur	6	9	15	-10	2	3	WIFM
Chennai	16	6	22	34	1	1	SILM
Agra	8	9	17	-3	1	3	SIFM
Aligarh	4	14	18	-34	1	3	SIFM
Bareilly	9	12	21	-10	1	3	SIFM
Faizabad	4	8	12	-14	2	3	WIFM
Farukhabad	7	8	15	-3	2	3	WIFM
Kanpur	10	12	22	-7	1	3	SIFM
Lucknow	8	8	16	0	1	2	SIPM
Kolkata	8	8	16	0	1	2	SIPM
Median value			16	-3.448			

Source: Computed by author

TABLE 9: FINAL CATEGORIZATION OF MARKETS – POTATO

Market	Only prices	All market arrivals	Major market arrivals	Final Category
Patna	SIFM	WIFM	SILM	Not Clear
Raipur	SILM	SILM	SILM	SILM
Delhi	SILM	SIPM	SIPM	SIPM
Ahmedabad	SIFM	WIFM	SIFM	SIFM
Rajkot	SIPM	SIPM	SILM	SIPM
Surat	WIFM	WIFM	WIFM	WIFM
Jammu	SILM	SILM	SILM	SILM
Bangalore	WIPM	WIPM	WIFM	WIPM
Belgaum	WIFM	WIFM	WIFM	WIFM
Hubli	WIFM	SIPM	WIPM	Not Clear
Mumbai	SIFM	SIFM	WIFM	SIFM
Pune	WIFM	WIFM	WILM	WIFM
Indore	SILM	SILM	SILM	SILM
Bhubneswer	WIFM	WIFM	WIFM	WIFM
Amritsar	WIPM	WIFM	WIFM	WIFM
Khanna	WIPM	WIPM	WIFM	WIPM
Ajmer	SILM	SILM	SILM	SILM
Jaipur	SILM	SILM	SILM	SILM
Jodhpur	WIFM	WIFM	WIFM	WIFM

Market	Only prices	All market arrivals	Major market arrivals	Final Category
Udaipur	WIFM	WIFM	SIPM	WIFM
Chennai	SILM	SILM	WIFM	SILM
Agra	SIFM	SIFM	SIFM	SIFM
Aligarh	SIFM	SIFM	SIFM	SIFM
Bareilly	SIFM	SIFM	SIPM	SIFM
Faizabad	WIFM	WIFM	WIFM	WIFM
Farukhabad	WIFM	WIPM	WIPM	WIPM
Kanpur	SIFM	SIFM	SIFM	SIFM
Lucknow	SIPM	SIFM	WIFM	Not Clear
Kolkata	SIPM	SIPM	SIFM	SIPM

Source: Computed by author

TABLE 10: POTATO MARKETS (TOTAL 29)

	Leading/Nodal	Peripheral	Following
Strongly integrated (Nationally important)	Jaipur (Raj), Jammu (J&K), Chennai, Ajmer (Raj), Indore (MP), Raipur (Chg)	Delhi, Rajkot (Guj), Kolkata (WB)	Ahmedabad (Guj), Mumbai (Mah), Kanpur (UP), Bareilly (UP), Aligarh (UP), Agra (UP)
Weakly integrated (Locally important)		Khanna (Pun), Bangalore (Kar), Farukkabad (UP)	Udaipur (Raj), Jodhpur (Raj), Bhubaneswar (Ori), Faizabad (UP), Surat (Guj), Amritsar (Pun), Belgaon (Kar), Pune (Mah)
Not clear (Important on a few criteria)	Patna (Bih), Lucknow (UP), Hubli (Kar)		

Source: Computed by author

4. Conclusion and policy implications

A two-stage procedure based on market arrivals and prices has been used for identifying the nodal markets. From a total of 169 tomato markets, 211 onion markets and 180 potato markets for which data is reported in AGMARKNET, 32 tomato markets, 25 onion markets and 29 potato markets have been selected in stage 1 based on market arrivals. From this set of markets, about nine tomato (Mulakalacheruvu, Patna, Tiphra, Bowenpally, Delhi, Ahmedabad, Chintamani, Solapur, Kolhapur); eight onion (Ahmedabad, Pimplagaon, Lasalgaon, Rahuri, Solapur, Chennai, Agra, Malegaon); and six potato (Jaipur, Jammu, Chennai, Ajmer, Indore, Raipur) markets have emerged as the leading/nodal markets based on the VAR-GC analysis using prices. Peripheral and following markets have also been identified.

The major policy implication is that it will be administratively and logistically more feasible if policymakers focus on the nodal and peripheral markets that have been identified in the study to discern the market price dynamics of perishable commodities. This will help in timely decisions on production planning, exports and imports.

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Commodity Review

Foodgrains

Procurement of Rice

The total procurement of rice during Kharif Marketing Season 2022-23 up to 15.11.2022 is 52.10 million tonnes as against 59.20 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 2022-23 (up to 15.11.2022) 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 figure 2.

TABLE 1: PROCUREMENT OF RICE IN MAJOR STATES

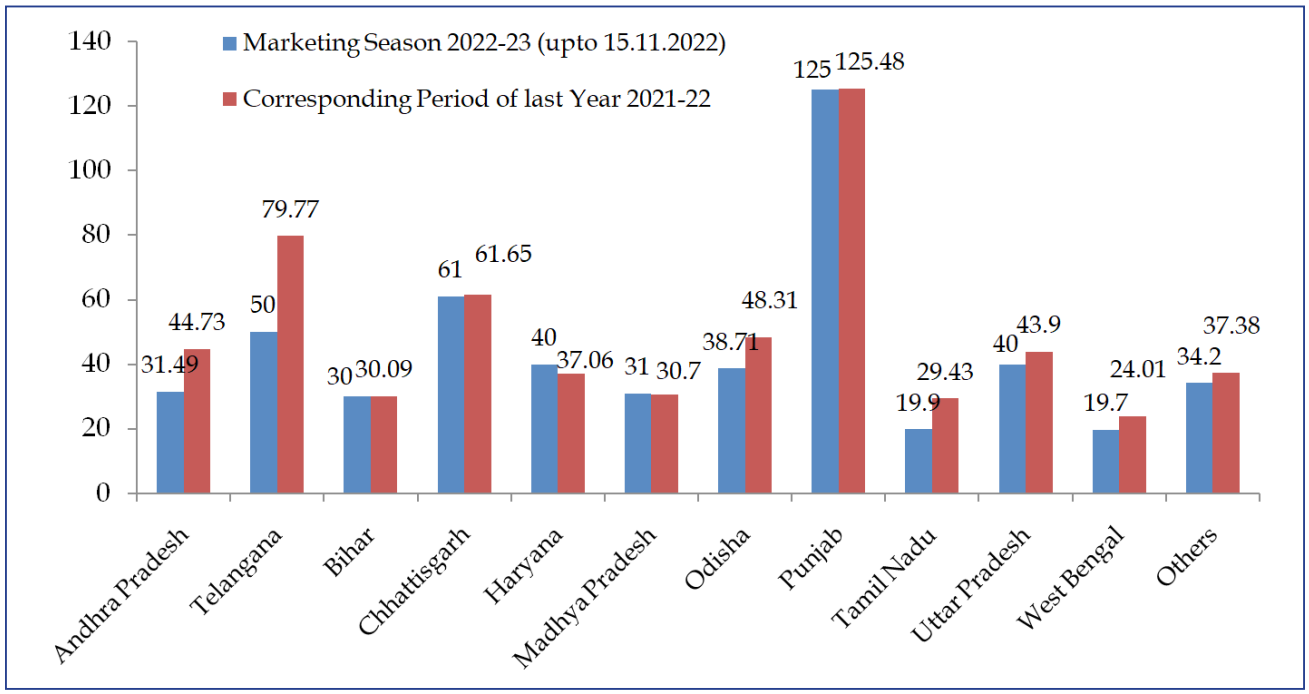
(in lakh tonnes)

State	Marketing season 2022-23 (up to 15.11.2022)		Corresponding period of last year 2021-22	
	Procurement	Percentage to Total	Procurement	Percentage to Total
1	2	3	4	5
Andhra Pradesh	31.49	6.0	44.73	7.5
Telangana	50	9.6	79.77	13.5
Bihar	30	5.8	30.09	5.1
Chhattisgarh	61	11.7	61.65	10.4
Haryana	40	7.7	37.06	6.3
Madhya Pradesh	31	6.0	30.70	5.2
Odisha	38.71	7.4	48.31	8.2
Punjab	125	24.0	125.48	21.2
Tamil Nadu	19.9	3.8	29.43	5.0
Uttar Pradesh	40	7.7	43.90	7.4
West Bengal	19.7	3.8	24.01	4.1
Others	34.2	6.6	37.38	6.3
All India	**521**	**100.0**	**592.51**	**100.0**

Source: Department of Food & Public Distribution, Govt. of India.

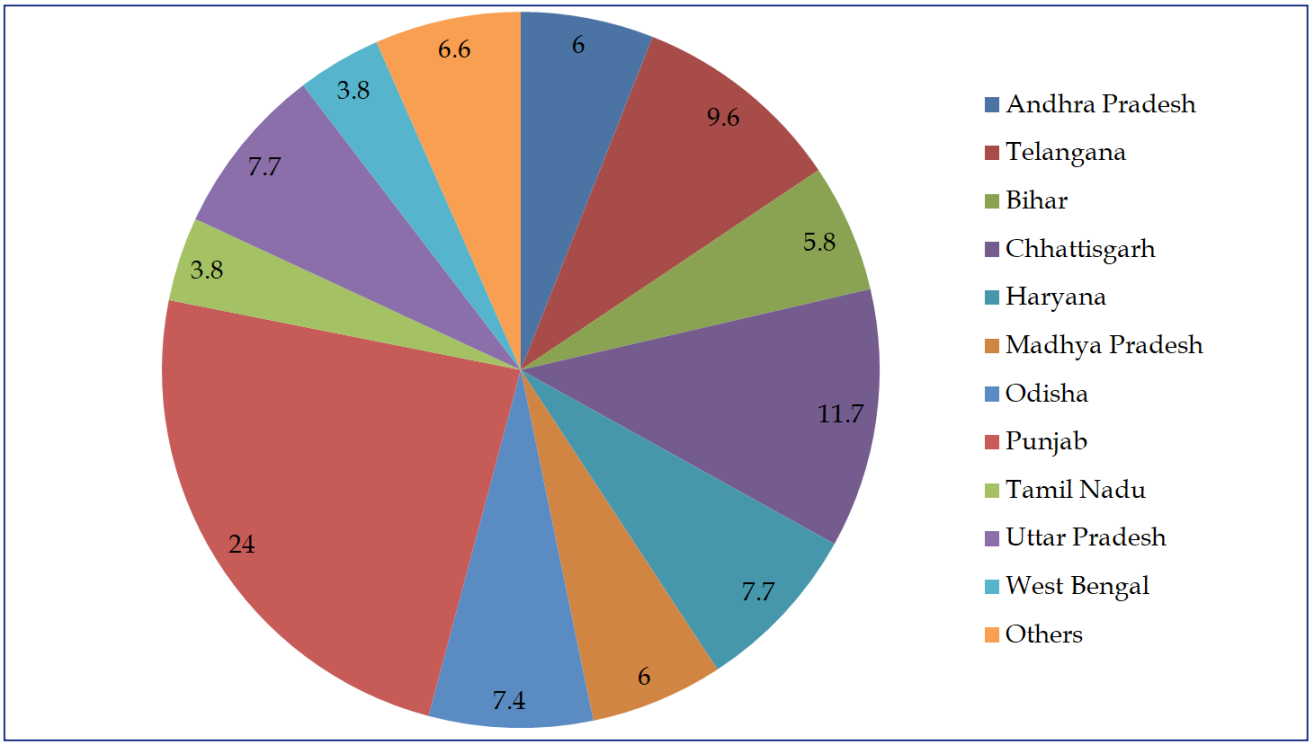
Figure 1: Procurement of Rice in major States

(In lakh tonnes)



Source: Department of Food & Public Distribution, Govt. of India.

Figure 2: Percentage Share of Different States in Procurement of Rice during Marketing Season 2021-22 (up to 15.11.2022)



Source: Department of Food & Public Distribution, Govt. of India.

Procurement of Wheat

The total procurement of wheat during Rabi Marketing Season 2022-23 up to 18.10.2022 is 18.79 million tonnes as against 43.01 million tonnes during the corresponding period of last year. The details are given in Table 2. Figure 3 depicts the comparison of procurement of wheat during the marketing season 2022-23 (up to 18.10.2022) with the corresponding period of last year. The percentage share of different states in procurement of rice has been given in figure 4.

TABLE 2: PROCUREMENT OF WHEAT IN MAJOR STATES

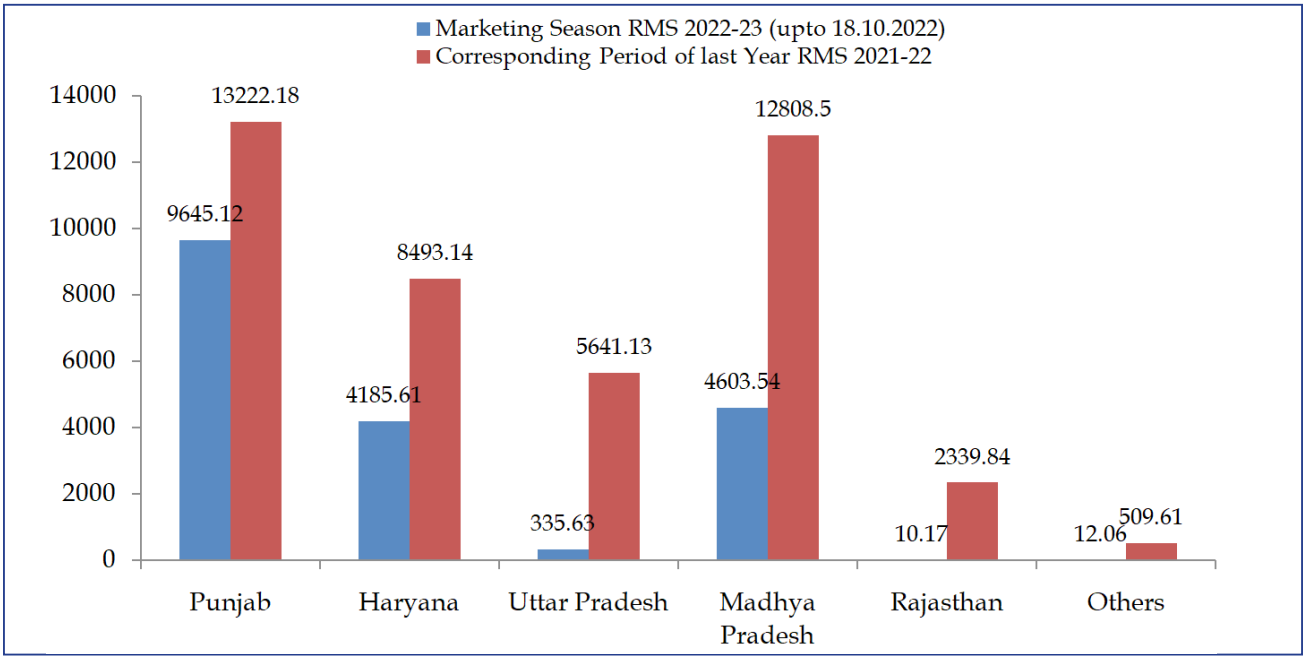
(in thousand tonnes)

State	Marketing season 2022-23 (upto 18.10.2022)		Corresponding period of last year RMS 2021-22	
	Procurement	Percentage to Total	Procurement	Percentage to Total
1	2	3	4	5
Punjab	9645.12	51.3	13222.18	30.7
Haryana	4185.61	22.3	8493.14	19.7
Uttar Pradesh	335.63	1.8	5641.13	13.1
Madhya Pradesh	4603.54	24.5	12808.50	29.8
Rajasthan	10.17	0.1	2339.84	5.4
Others	12.06	0.1	509.61	1.2
All India	**18792.13**	**100.0**	**43014.40**	**100.0**

Source: Department of Food & Public Distribution, Govt. of India.

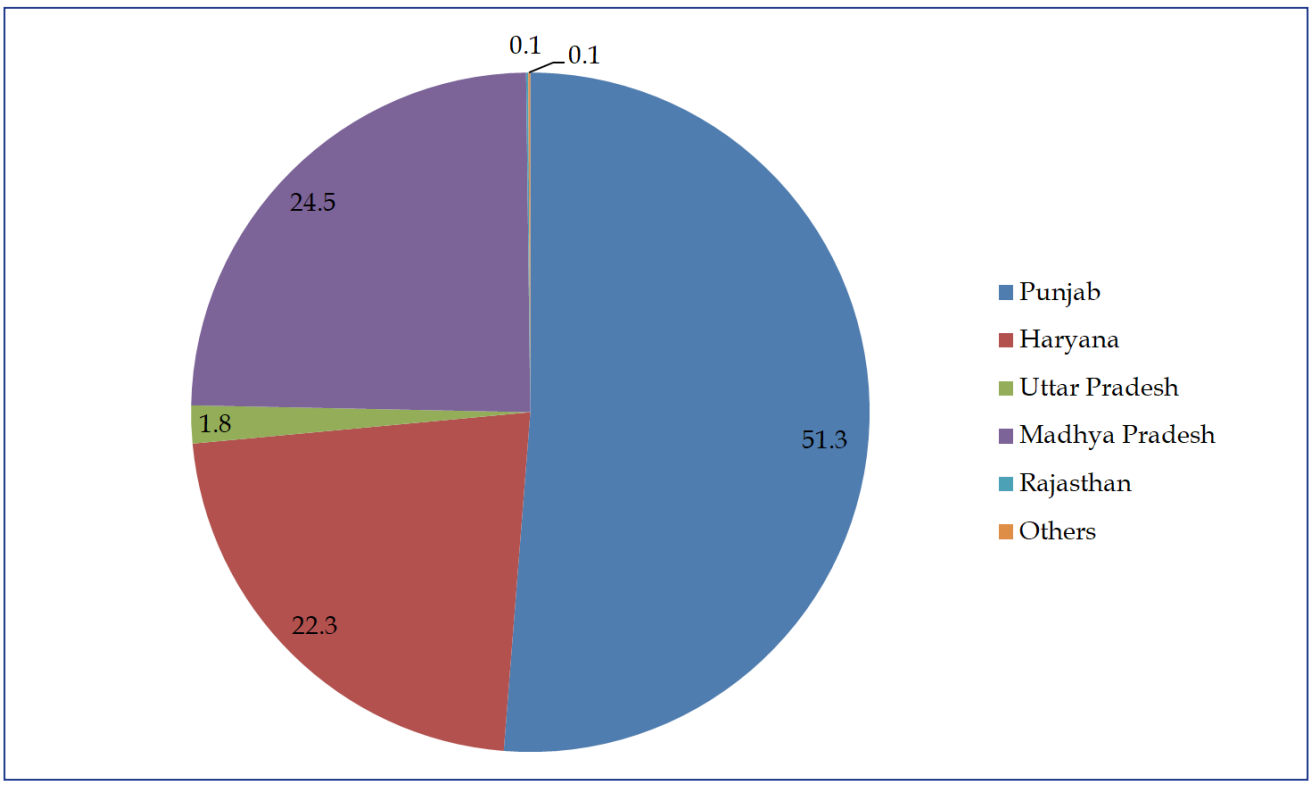
Figure 3: Procurement of Wheat in major States

(In thousand tonnes)



Source: Department of Food & Public Distribution, Govt. of India.

Figure 4: Percentage Share of Different States in Procurement of Wheat during Marketing Season 2022-23 (up to 18.10.2022)



Source: Department of Food & Public Distribution, Govt. of India.

Commercial Crops

Oilseeds

The Wholesale Price Index (WPI) of nine major oilseeds as a group stood at 189 in October, 2022, showing a decrease of 3.62 percent over the previous month and a decrease of 5.36 percent over the corresponding month of previous year.

The WPI of individual oilseeds showed a mixed trend. The WPI of groundnut seed (0.06 percent), gingelly seed (sesamum) (1.65 percent) and niger seed (0.91 percent) increased over the previous month. However, the WPI of rape & mustard seed (0.40 percent), cotton seed (1.28 percent), copra (coconut) (1.08 percent), safflower (2.02 percent), sunflower (7.50 percent) and soybean (8.33 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 174.2 in October, 2022, which shows a decrease of 0.34 percent over the previous month. Moreover, it decreased by 6.99 percent over the corresponding month of previous year. The WPI of mustard oil (2.38 percent), soybean oil (1.06 percent), sunflower oil (1.47 percent), groundnut oil (1.16 percent) and rapeseed oil (0.19 percent) increased over the previous month. However, the WPI of copra oil (1.43 percent) decreased over the previous month while the WPI of cotton seed oil showed no change over the previous month.

Condiments & Spices

The WPI of condiments & spices (group) stood at 191.4 in October, 2022, showing an increase of 0.10 percent over the previous month and an increase of 18.44 percent over the corresponding month of previous year. However, the WPI of black pepper decreased by 0.60 percent, chillies (dry) decreased by 0.52 percent and turmeric decreased by 3.39 percent over the previous month.

Fruits & Vegetable

The WPI of fruits & vegetable as a group stood at 231 in October, 2022, showing an increase of 7.14 percent over previous month and an increase of 10.95 percent over the corresponding month of previous year.

Potato

The WPI of potato stood at 296.6 in October, 2022, showing an increase of 4.11 percent over the previous month. Moreover, it increased by 44.97 percent over the corresponding month of previous year.

Onion

The WPI of onion stood at 205.1 in October, 2022, showing an increase of 17.74 percent over the previous month and a decrease of 30.02 percent over the corresponding month of previous year.

Tea

The WPI of tea stood at 172.1 in October, 2022, showing a decrease of 2.88 percent over the previous month and an increase of 13.82 percent over the corresponding month of previous year.

Coffee

The WPI of coffee stood at 156.7 in October, 2022, showing no change over the previous month. However, there is an increase of 30.37 percent over the corresponding month of previous year.

Sugarcane

The WPI of sugarcane stood at 210.1 in October, 2022, showing an increase of 5.16 percent over the previous month. Moreover, there is an increase of 7.03 percent over the corresponding month of previous year.

Raw Cotton

The WPI of raw cotton stood at 181 in October, 2022, showing a decrease of 10.17 percent over the previous month and an increase of 27.92 percent over the corresponding month of previous year.

Raw Jute

The WPI of raw jute stood at 274.8 in October, 2022, showing a decrease of 0.72 percent over the previous month and a decrease of 1.61 percent over the corresponding month of previous year.

Wholesale Price Index of commercial crops is given in Table 3. A graphical comparison of WPI for the period of October, 2022 and September, 2022 is given in figure 5 and the comparison of WPI during the October, 2022 with the corresponding month of last year has been given in figure 6.

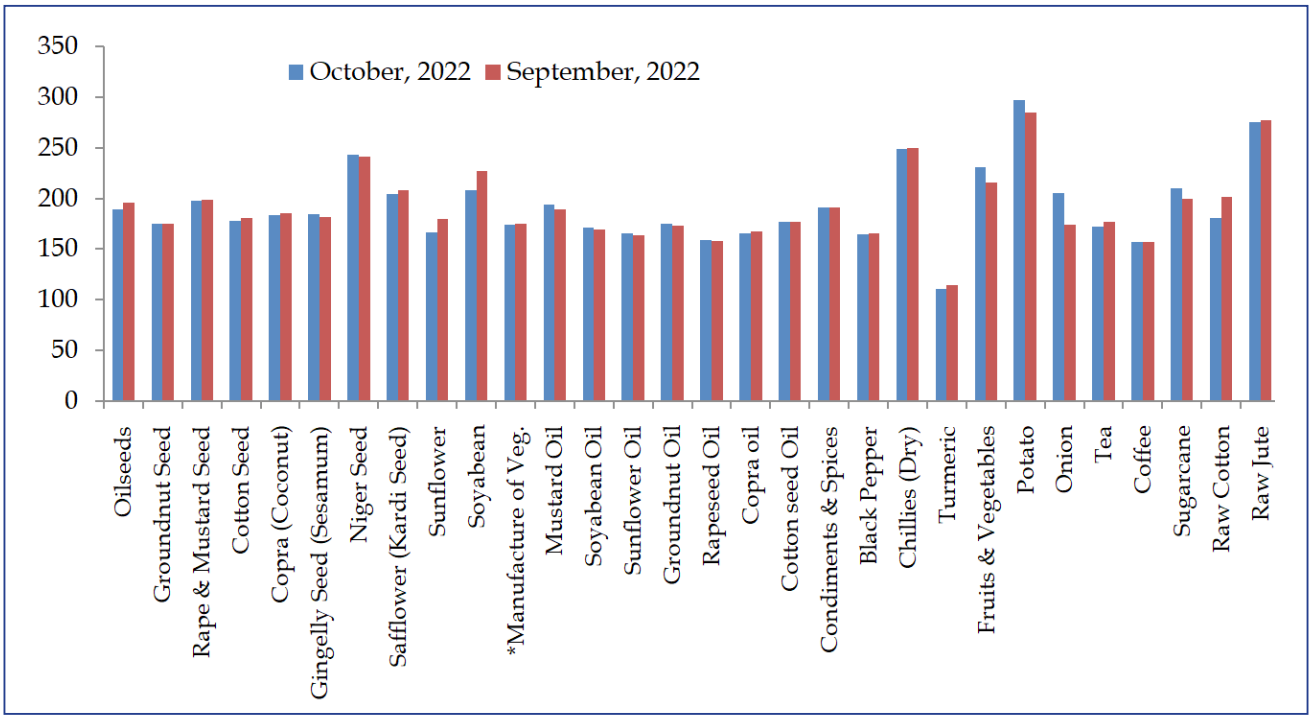
TABLE 3: WHOLESALE PRICE INDEX OF COMMERCIAL CROPS

(Base Year: 2011-12)

Commodity	Oct-22	Sept-22	Oct-21	Percentage variation over the	
				Month	Year
Oilseeds	189.0	196.1	199.7	-3.62	-5.36
Groundnut Seed	175.3	175.2	160.4	0.06	9.29
Rape & Mustard Seed	197.4	198.2	224.0	-0.40	-11.88
Cotton Seed	178.0	180.3	182.3	-1.28	-2.36
Copra (Coconut)	183.2	185.2	207.3	-1.08	-11.63
Gingelly Seed (Sesamum)	184.9	181.9	184.9	1.65	0.00
Niger Seed	243.0	240.8	251.9	0.91	-3.53
Safflower (Kardi Seed)	204.0	208.2	193.9	-2.02	5.21
Sunflower	166.5	180.0	171.5	-7.50	-2.92
Soybean	208.0	226.9	230.6	-8.33	-9.80
Manufacture of Vegetable and Animal Oils and Fats	174.2	174.8	187.3	-0.34	-6.99
Mustard Oil	193.8	189.3	232.5	2.38	-16.65
Soybean Oil	171.3	169.5	180.6	1.06	-5.15
Sunflower Oil	165.7	163.3	160.2	1.47	3.43
Groundnut Oil	175.0	173.0	160.6	1.16	8.97
Rapeseed Oil	158.5	158.2	192.7	0.19	-17.75
Copra oil	165.3	167.7	187.1	-1.43	-11.65
Cotton seed Oil	177.3	177.3	174.9	0.00	1.37
Condiments & Spices	191.4	191.2	161.6	0.10	18.44
Black Pepper	164.7	165.7	145.0	-0.60	13.59
Chillies (Dry)	248.5	249.8	158.8	-0.52	56.49
Turmeric	111.0	114.9	117.2	-3.39	-5.29
Fruits & Vegetables	231.0	215.6	208.2	7.14	10.95
Potato	296.6	284.9	204.6	4.11	44.97
Onion	205.1	174.2	293.1	17.74	-30.02
Tea	172.1	177.2	151.2	-2.88	13.82
Coffee	156.7	156.7	120.2	0.00	30.37
Sugarcane	210.1	199.8	196.3	5.16	7.03
Raw Cotton	181.0	201.5	141.5	-10.17	27.92
Raw Jute	274.8	276.8	279.3	-0.72	-1.61

Source: Office of the Economic Advisor, DPIIT, Ministry of Commerce, Govt. of India.

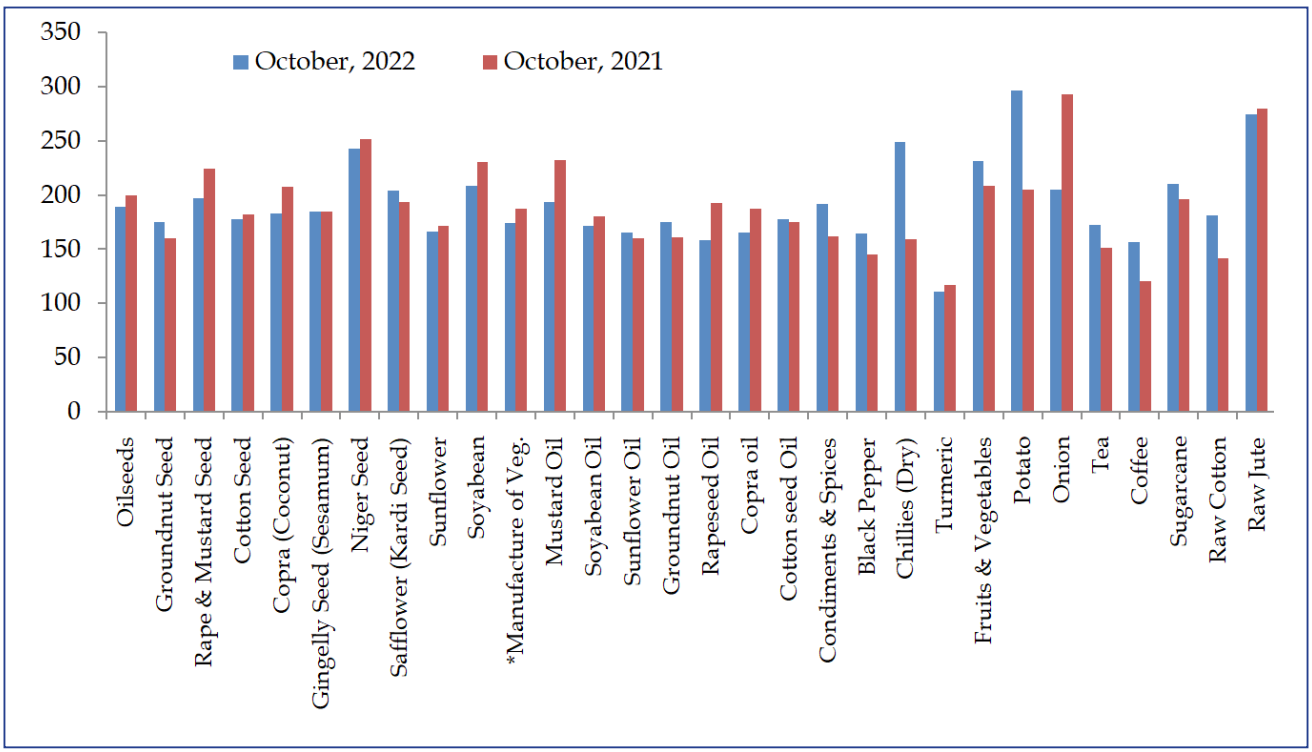
Figure 5: WPI of Commercial Crops during October, 2022 and September, 2022



*Manufacture of Vegetable, Animal Oils and Fats.

Source: Office of the Economic Advisor, DPIIT, Ministry of Commerce, Govt. of India.

Figure 6: WPI of Commercial Crops during October, 2022 and October, 2021



*Manufacture of Vegetable, Animal Oils and Fats.
Source: Office of the Economic Advisor, DPIIT, Ministry of Commerce, Govt. of India.

Statistical Tables

Prices

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

(All Prices in Rupees)

Commodity	Variety	Unit	State	Centre	Oct-22	Sep-22	Oct-21
Wheat	PBW 343	Quintal	Punjab	Amritsar	NA	2310	2165
Wheat	Dara	Quintal	Uttar Pradesh	Chandausi	2310	2285	1925
Wheat	Lokvan	Quintal	Madhya Pradesh	Bhopal	2380	2160	2043
Jowar	-	Quintal	Maharashtra	Mumbai	3600	3600	3000
Gram	No III	Quintal	Madhya Pradesh	Sehore	4360	4201	4325
Maize	Yellow	Quintal	Uttar Pradesh	Kanpur	2315	2375	1675
Gram Split	-	Quintal	Bihar	Patna	6300	6400	6670
Gram Split	-	Quintal	Maharashtra	Mumbai	6500	6500	6600
Arhar Split	-	Quintal	Bihar	Patna	9650	9470	9580
Arhar Split	-	Quintal	Maharashtra	Mumbai	10200	10000	9200
Arhar Split	-	Quintal	NCT of Delhi	Delhi	9850	9700	9500
Arhar Split	Sort II	Quintal	Tamil Nadu	Chennai	9800	9500	9100
Gur	-	Quintal	Maharashtra	Mumbai	4800	4750	4500
Gur	Sort II	Quintal	Tamil Nadu	Coimbatore	4900	4900	4500
Gur	Balti	Quintal	Uttar Pradesh	Hapur	3800	3500	3600
Mustard Seed	Black (S)	Quintal	Uttar Pradesh	Kanpur	6280	6380	7650
Mustard Seed	Black	Quintal	West Bengal	Raniganj	6500	6400	7200
Mustard Seed	-	Quintal	West Bengal	Kolkata	7200	6950	8600
Linseed	Bada Dana	Quintal	Uttar Pradesh	Kanpur	7800	7800	7500
Linseed	Small	Quintal	Uttar Pradesh	Varanasi	7630	7750	7750
Cotton Seed	Mixed	Quintal	Tamil Nadu	Virudhunagar	3000	3100	3300
Cotton Seed	MCU 5	Quintal	Tamil Nadu	Coimbatore	4125	4050	3900
Castor Seed	-	Quintal	Telangana	Hyderabad	NT	NT	NT
Sesamum Seed	White	Quintal	Uttar Pradesh	Varanasi	10670	10380	9300
Copra	FAQ	Quintal	Kerala	Alleppey	7600	7750	10150
Groundnut	Pods	Quintal	Tamil Nadu	Coimbatore	7200	6800	4500

Wholesale Prices of Certain Agricultural Commodities and Animal Husbandry Products at Selected Centres in India - *Contd.*

Commodity	Variety	Unit	State	Centre	Oct-22	Sep-22	Oct-21
Groundnut	-	Quintal	Maharashtra	Mumbai	11500	12000	9000
Mustard Oil	-	15 Kg.	Uttar Pradesh	Kanpur	2400	2430	2450
Mustard Oil	Ordinary	15 Kg.	West Bengal	Kolkata	2325	2220	2800
Groundnut Oil	-	15 Kg.	Maharashtra	Mumbai	2400	2440	2150
Groundnut Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	2700	2650	2500
Linseed Oil	-	15 Kg.	Uttar Pradesh	Kanpur	2575	2360	2290
Castor Oil	-	15 Kg.	Telangana	Hyderabad	2850	2625	2100
Sesamum Oil	-	15 Kg.	NCT of Delhi	Delhi	2550	2500	3050
Sesamum Oil	Ordinary	15 Kg.	Tamil Nadu	Chennai	3750	3550	3300
Coconut Oil	-	15 Kg.	Kerala	Cochin	1920	1950	2445
Mustard Cake	-	Quintal	Uttar Pradesh	Kanpur	2800	2900	2950
Groundnut Cake	-	Quintal	Telangana	Hyderabad	NT	NT	NT
Cotton/Kapas	NH 44	Quintal	Andhra pradesh	Nandyal	10000	10000	8000
Cotton/Kapas	LRA	Quintal	Tamil Nadu	Virudhunagar	7200	8300	5800
Jute Raw	TD 5	Quintal	West Bengal	Kolkata	5850	6000	6500
Jute Raw	W 5	Quintal	West Bengal	Kolkata	5850	6000	6650
Oranges	Big	100 No	Tamil Nadu	Chennai	2000	2400	2300
Oranges	Nagpuri	100 No	West Bengal	Kolkata	600	NA	500
Banana	-	100 No.	NCT of Delhi	Delhi	417	417	417
Banana	Medium	100 No.	Tamil Nadu	Kodaikkanal	590	580	592
Cashewnuts	Raw	Quintal	Maharashtra	Mumbai	55000	65000	90000
Almonds	-	Quintal	Maharashtra	Mumbai	70000	55000	55000
Walnuts	-	Quintal	Maharashtra	Mumbai	125000	125000	72500
Kishmish	-	Quintal	Maharashtra	Mumbai	16000	16000	23000
Peas Green	-	Quintal	Maharashtra	Mumbai	7000	7000	8000
Tomato	Ripe	Quintal	Uttar Pradesh	Kanpur	3200	2600	3800
Ladyfinger	-	Quintal	Tamil Nadu	Chennai	2000	1500	2900
Cauliflower	-	100 No.	Tamil Nadu	Chennai	3000	4000	3200

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

Commodity	Variety	Unit	State	Centre	Oct-22	Sep-22	Oct-21
Potato	Red	Quintal	Bihar	Patna	1830	1700	1220
Potato	Desi	Quintal	West Bengal	Kolkata	2000	2150	1700
Potato	Sort I	Quintal	Tamil Nadu	Mettuppalayam	5041	4474	2837
Onion	Pole	Quintal	Maharashtra	Nashik	1700	1150	2000
Turmeric	Nadan	Quintal	Kerala	Cochin	11000	11000	12000
Turmeric	Salam	Quintal	Tamil Nadu	Chennai	11800	12000	12000
Chillies	-	Quintal	Bihar	Patna	21850	21150	15500
Black Pepper	Nadan	Quintal	Kerala	Kozhikode	47300	47500	43000
Ginger	Dry	Quintal	Kerala	Cochin	15500	15500	19000
Cardamom	Major	Quintal	NCT of Delhi	Delhi	57750	57700	57200
Cardamom	Small	Quintal	West Bengal	Kolkata	155000	157500	155000
Milk	Buffalo	100 Liters	West Bengal	Kolkata	6500	6500	6000
Ghee Deshi	Deshi No 1	Quintal	NCT of Delhi	Delhi	61698	60030	59333
Ghee Deshi	-	Quintal	Maharashtra	Mumbai	58000	50000	40000
Ghee Deshi	Desi	Quintal	Uttar Pradesh	Kanpur	47500	47000	41600
Fish	Rohu	Quintal	NCT of Delhi	Delhi	13000	14000	10000
Fish	Pomphrets	Quintal	Tamil Nadu	Chennai	51000	53000	44000
Eggs	Madras	1000 No.	West Bengal	Kolkata	5260	4900	5000
Tea	-	Quintal	Bihar	Patna	27400	27400	26500
Tea	Atti Kunna	Quintal	Tamil Nadu	Coimbatore	11168	11356	11235
Coffee	Plant-A	Quintal	Tamil Nadu	Coimbatore	49000	49000	37500
Coffee	Rubusta	Quintal	Tamil Nadu	Coimbatore	24000	24000	20600
Tobacco	Kampila	Quintal	Uttar Pradesh	Farukhabad	9050	8750	8500
Tobacco	Raisa	Quintal	Uttar Pradesh	Farukhabad	4400	4350	4250
Tobacco	Bidi Tobacco	Quintal	West Bengal	Kolkata	13200	13300	13200
Rubber	-	Quintal	Kerala	Kottayam	14500	13700	16500
Arecanut	Pheton	Quintal	Tamil Nadu	Chennai	92000	92000	81000

Source: DPIIT, Ministry of Commerce and Industry, Govt. of India

Crop Production

Sowing and Harvesting Operations Normally in Progress During the Month of November, 2022

State	Sowing	Harvesting
(1)	(2)	(3)
Andhra Pradesh	Paddy, Jowar (in some areas), Bengal Gram, horsegram, condiment, spices and potato	Kharif paddy, ragi, other Kharif cereals ginger and groundnut
Assam	Rabi paddy, gram, mustard, winter vegetables and potato	Kharif paddy, jute, tea and winter potato
Bihar	Wheat, Barley, Gram, rapeseed & mustard & sweet potato	Kharif paddy and Potato
Gujarat	Paddy, wheat, gram pulses and potato.	Paddy, Kharif, jowar, groundnut, bajra and cotton
Himachal Pradesh	Wheat, barley and gram	Winter paddy, rabi kharif, sugarcane, ginger (dry), chillies (dry), tobacco, cotton, tumeric and sunnhemp
Jammu & Kashmir	Wheat (in Kashmir), barley, linseed, rapeseed and mustard	Maize (in Jammu)
Karnataka	Bengal gram, potato and rabi paddy	Kharif paddy, jowar, bajra, ragi, groundnut and sweet potato
Kerala	Paddy, pulses & sweet potato	Kharif paddy, sugarcane, ginger and tapioca
Madhya Pradesh	Wheat, barley, gram, rabi pulses, potato, rapeseed, mustard and castored	Kharif paddy, jowar, bajra, ragi, kharif, pulses, potato, chillies, tobacco, cotton sweet potato and turmeric
Maharashtra	Wheat, gram, barley, jowar and pulses	Kharif paddy, jowar, groundnut, bajra, cotton and sugarcane
Manipur	_	Winter paddy, tur, groundnut, sesamum, sweet potato and tumeric
Orissa	Wheat, sugarcane, tobacco, mustard gram and linseed	Kharif paddy, groundnut, sugarcane, cotton and sunnhemp
Punjab	Wheat, barley, gram & linseed	Jowar, bajra, maize, cotton and sugarcane

Sowing and Harvesting Operations Normally in Progress During the Month of November, 2022

State	Sowing	Harvesting
(1)	(2)	(3)
Rajasthan	Wheat, barley, gram, potato, tobacco, rapeseed, mustard and lineseed	Paddy, jowar, bajra, sugarcane and cotton
Tamil Nadu	Rabi paddy, jowar, cotton tobacco, horsegram, chillies, rapeseed and mustard	Kharif paddy, kharif jowar, cumbu ragi, maize, groundnut (unirrigated), cotton varagu, samai, tapioca & ginger
Tripura	Pulses, potato, rapeseed and mustard	Winter rice
Uttar Pradesh	Wheat, barley, gram, lineseed and cotton	Kharif paddy, jowar, bajra, sugarcane, groundnut, cotton, tobacco and sunnhemp
West Bengal	Wheat paddy, wheat, barley, linseed, rapeseed, mustard and potato	Winter paddy, sugarcane, sesamum and cotton
Delhi	Wheat, barley, gram, pulses, tobacco, lineseed, rapeseed and mustard	Jowar, kharif pulses, sugarcane, sesamum and sweet potato

(K) – Kharif (R) – Rabi

Note to Contributors

The Journal brought out by the Directorate of Economics and Statistics, Ministry of Agriculture & Farmers Welfare aims at presenting an integrated picture of the food and agricultural situation in India on month to month basis.

Articles on the State of Indian Agriculture and allied sectors are accepted for publication in the Directorate of Economics & Statistics, Department of Agriculture & Farmers Welfare's monthly Journal "Agricultural Situation in India". The Journal aims to provide a forum for scholarly work and disseminate knowledge; provide a learned reference in the field; and provide platform for communication between academic and research experts, policy makers. Articles in Hard Copy as well as Soft Copy (publication.des-agri@gov.in) in MS Word may be sent in duplicate to the Editor, Publication Division, Directorate of Economics & Statistics, M/o Agriculture & Farmers Welfare, 103, F-Wing, Shastri Bhawan, New Delhi-110001 along with a declaration by the author(s) that the article has neither been published or submitted for publication elsewhere. The author(s) should furnish their email address, phone no. and their permanent address only on the forwarding letter so as to maintain anonymity of the author while seeking comments of the referees on the suitability of the article for publication. The Article should be prepared according to the following guidelines:

(a) Articles should not exceed five thousand words (including footnotes), typed in double space on one side of foolscap paper in Times New Roman font size 12.

(b) Typescript should be arranged in the following order: title, abstract, introduction, data or methodology, text, conclusions, policy suggestions, and references.

(c) Abstract (with keywords) is required and should not exceed 300 words in length.

(d) The title page should contain the title, author name(s) and institutional affiliation (s).

(e) The text should follow UK English and number bullets should be used wherever required.

(f) Reference List should be given in alphabetical order of surname. The American Psychological Association (APA) style for reference lists should be followed. For example:

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