Tobacco Research 49(2): 91-98, 2023

MARKET INTELLIGENCE AND VALUE CHAINS FOR COMMERCIAL FARMING

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(Received on 25th October, 2023 and accepted on 21th December, 2023)

In India, the Green Revolution improved food grain production but was not reflected in a proportional improvement in the farming society's standard of living. The time has come to concentrate more on agricultural marketing policies and programmes rather than agricultural production policies. It should also be recognized that land is a natural resource and fixed in its supply. Many initiatives have been taken up both at the state and national level to improve the condition of farmers, both technology-wise and in input and output marketing. The efforts in production could be converted into income only if a reasonable price is realized by growers. It could be made possible if the producers are empowered by providing information on the marketing of their products and inputs as well. It is evident that there exist excess intermediaries in the marketing channel, which makes the supply chain longer than optimal,especially in commercial crops. This has led to system inefficiencies, providing less income to the farmers, and becoming more costlier to the consumer. To solve these problems, there is a need for clear market information both market news and intelligence,to provide knowledge and information to the farmers and also to the consumers. It wasnoticed that, in all sectors, market intelligence gained importance, but in agriculture at a slow pace.

Market Intelligence System in India

In view of its importance in agricultural sector, the Agricultural Prices Enquiry Committee (1954) recommends the Directorate of Economics and Statistics, Ministry of Agriculture (DESMOA) to set up 14 Market Intelligence Units (MIU) in the capitals of Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal (desagri.gov.in). These market intelligence units are intended to assist the DESMOA in the formulation, implementation, and review of the agricultural price policy relating to procurement, marketing, storage, transportation, imports, exports, credit, etc. The units furnish regular reports on market arrivals, off-takes, stocks, crop prospects, and the outlook of market prices. They are also required to give their appraisal of the production of various kharif and rabi crops at regular intervals to help prepare crop forecasts. Though the data to be supplied by the MIUs is of great utility, the units have ceased to be effective in discharging their functions, mainly due to a lack of proper direction and control of their activities (mospi.gov.in).

Agricultural Market Intelligence helps in ensuring that produce goes to markets where there is a demand for it. It shortens marketing channels cuts down on transport costs and helps ensure that each marketing transaction is a fair one and that all participants share the risks and benefits. The consumption requirements of the Indian population were satisfactorily met with the increased production of crops after the Green Revolution and further technological improvements. The small farmer-producers should be assured of a fair price for their produce, failing which they may lose the incentive to increase agricultural production (Reardon et al, 2011).To realise the remunerative returns and to prevent the ill effects of volatile prices farmers must be aware of the price behaviour of major agricultural commodities. Market information and intelligence are important to enable farmers to join the possible value chains to reap the benefits of a dynamic marketing system. The different sources of present market information sharing is shown in Figure 1.

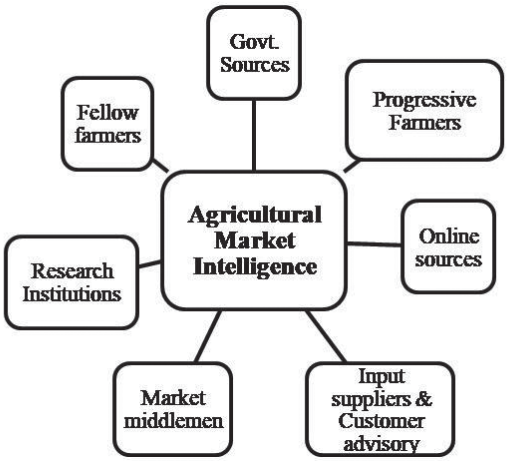

Fig 1: Different Sources of Market Intelligence

Changing Dynamics in Market Intelligence

In the dynamic world trade environment, the dissemination of trade-related information and intelligence is crucial. However, agricultural marketing in the country, with a particular focus on market intelligence, has not received adequate attention. The wide fluctuation in prices for agricultural commodities within a season and between markets are the routine risks faced by farmers. These fluctuations have some regular patterns: seasonal, cyclical, and secular, but every year they depart from these patterns quite erratically. The seasonal indices analysis of various crops revealed thatturmeric prices were high in the months of January and February, whereas arrivals were high in the months of May and June. In the case of chilli, prices were high in the months of October and November, whereas arrivals were high in the month of February.Over time, it has become a fact that irrespective of crop, prices and market arrivals showan indirect relationship.Most of the price forecasts could not cover all factors responsible for price fluctuations, including those determining erratic behaviour. The broad policy reforms in terms of the modified APMC Act in 2003 and e-NAM in 2015 have not paid adequate attention to improvingmarket intelligence. Furthermore, market developments with a specific focus on farmer-producer organizations is still in the nascent stage which needs immediate attention for their self-reliance. Also, the potential benefits of machine learning techniques, artificial intelligence, and satellite data have hardly been reaped. There are many questions that need to be addressed in agricultural market intelligence:

- To what extent has the available marketing intelligence been used by the farmers?
- What market intelligence the traders use for discovering prices?
- How important is market intelligence for the agricultural sector?
- What will make the farmers to gain knowledge about marketing?

To answer these questions, there is a need for research at the gross root level and government involvement in developing the institutional base.

Commercial Farming

Commercial farming, an important pillar of modern agriculture, is critical to supplying worldwide demand for food, raw resources, and exports.It can be defined as farming that focuses on producing agricultural products for sale in the market rather than solely for subsistence purposes. The need for an increase in productivity and incomes of small holdings and the promotion of non-farm activities for these farmers is obvious (B Swaminathan, K C Sivabalan, 2016). Commercial farmers optimise productivity and contribute to economies of scale by focusing on farming a single crop across large regions aiming comparative advantage principle. In general, commercial crops are in high demand because they are exported to other countries as well and domestic companies use it as raw ingredients to produce localculinary items.

In commercial farming, the Indian farmer uses high quantities of fertilizers, pesticides, and insecticides to boost crop yield. Depending on the crop, it varies among areas. For instance, rice is a subsistence crop in Orissa, but it is a commercial crop in Haryana, Punjab, and West Bengal.Chilli, turmeric, coffee, cotton, raw jute, sugarcane, tea, tobacco, soybean etc., are some of the major commercial crops of India.

The production of commercial crops has increased with the use of hybrid/high-yielding

variety seeds, proper use of fertilizer and intensive use of plant protection chemicals in Andhra Pradesh. AP is one of the major producers of commercial crops on account of its diverse climatic conditions and the productionof commercial crops has increased in recent years(P Naveen and A Bharathi Devi, 2022).

Nowadays, there has been a transformation in agriculture from the stage of subsistence tomarket-oriented due to the changes in the economy and the changed farm households' requirements other than fulfilling the need for food (S Angles and M Chinnadurai, 2018). Today's agriculture has been metamorphosised into market-led agriculture rather than the production-oriented. Market-led agriculture needsan entirely different approach, where market-led research and market-ledextension are two eyes of it. In agriculture, pioneering institutes like ANGR Agricultural University some other state agricultural universities and a few private institutions have initiated basic work on market intelligence and providingrequired information to the farmers. The results are reaching the farmers and creatinga positive effect in achieving the objective of better profit and improvement in the livelihood status of the farmers but at a slow pace. However, there are many hurdles in developing the estimates under the market intelligence for crops which makes it tedious and affects the effectiveness of the market/price-related communications. The major problems faced were the non - non-availability of the data, improper maintenance of thesecondary data available, large variations in the quality of produce, price quotes in the forward markets,non-availability of international prices etc.

AMIC at ANGRAU

Agricultural Market Intelligence Centre (AMIC)wasan initiative by ANGRAgricultural University, Guntur, AP,which aims to forecast the price information of principal agricultural crops and disseminate the market information to the stakeholders of the state. By using superior time-series models (ARIMA, VAR) and machine learning algorithms (ANN) the centre estimates the future market prices and then standardizes these values to minimum errorsby considering influential factors like sowing area, market arrivals, and the primary data from market intermediaries.The released forecast bulletins were uploaded to *angrau.ac.in* and University monthly magazine Vyavasayam, Rythu Bharosa magazine of Govt of AP displayed in 10776 RBKs at village level, phone calls, news dailies, TV & Radio broadcasts, voice message services by Reliance Foundation etc. The price forecasts released by the centre were evaluated through impact assessment on a regular basis. When compared to the real market prices, the accuracy of the estimates for the agricultural crops under research ranged from 86.54 to 96.38%. Farmers were taking advice by calling to the AMIC centre and to other institutes of ANGRAU. The growers who adopted the advice were studied for the economic impact of AMIC advice followed regularly. The study conducted during 2022-23 revealed that turmeric and chillies farmers who adopted the AMIC advice benefited with an amount of Rs. 1276 and Rs. 1568 per quintal of sale proceeds (Table 1).

As a part of AMIC, fact sheets/crop outlook reports were prepared by AMIC regularly about recent information about area, production, productivity particulars of world, India, Andhra Pradesh, and its districts; export and import scenario, procurement and consumption pattern, price behaviour of crops and they were uploaded to ANGRAU portal.The chilli and turmeric crop outlook reports can be viewed at *angrau.ac.in* website.

Market Price Forecasting Methodology

Agricultural product price forecasting uses scientific methods to estimate or judge the trend and level of agricultural product price changes over a period of time in the future based on historical data and current information. Traditional methods like regression analysis and grey model prediction methods were initially used as they are relatively simple and easy to understand and implement, but the prediction effect is poor for nonlinear, non-smooth, and high-dimensional data, and they require more a priori knowledge and assumptions. In the mid-nineties, the univariate time series analysis, which refers to a statistical method of modelling and analysing agricultural commodity prices based on the regularity presented by the

Table 1: Profit/loss attained to farmer by following the AMIC advice

Name of the Crop	No. of farmers Provided the AMIC advise	No. of farmers followed the AMIC advise	Total Acreage of the farmers (in Ha.)	Average Yield (in quintals/ Ha.)	Total yield of follower farmers	Total sale proceeds (in Rs)	Profit/loss of the follower farmers (Rs/qtl/ farmer)	Net profit of sale proceeds of follower farmer (in Rs.)
Ground nut	61	42 (69 %)	32.86	32.82	1078.47	7321700.24	851	917773.89
Blackgram	89	55 (62 %)	48.63	15.56	756.68	5432982.50	796	602319.51
Turmeric	62	44 (71 %)	22.36	47.86	1070.15	6482966.28	1276	1365510.89
Chilli	101	51 (50 %)	65.25	18.69	1219.52	25483142.16	1568	1912211.28
Bengalgram	53	29 (55 %)	30.25	14.75	446.19	2050677.75	226	100838.38
Greengram	68	41 (60 %)	22.59	10.98	248.04	1981577.18	512	126995.56
Redgram	52	39 (75 %)	19.68	8.16	160.59	1218226.64	1101	176808.27
Total/Average	**486**	**301 (62 %)**	**265.76**	**148.82**	**4979.63**	**49971272.75**	**904.29**	**4503012.43**

price itself over time, and extrapolating future data from existing data, was used. Presently, time series models likeAuto Regressive Moving Average (ARMA), Autoregressive Integrated Moving Average (ARIMA), Seasonal Auto-Regressive Integrated Moving Average (SARIMA), Auto-Regressive Conditional Heteroskedasticity (ARCH), Generalized Auto Regressive Conditional Heteroskedasticity (GARCH), etc are noteworthy.

'Univariate' Box-Jenkins models, also referred to as ARIMA models. Univariate or single series means that forecasts are based only on past values of the variable being forecast, they are not based on any other data series (Brockwell and Davis, 2011). The ARIMA methodology is carried out in three stages, viz. identification, estimation, and diagnostic checking (Figure 2). Parameters of the tentatively selected ARIMA model at the identification stage are estimated and the adequacy of the tentatively selected model is tested at the diagnostic checking stage. If the model is found to be inadequate, the three stages are repeated until a satisfactory ARIMA model is selected for the time series under consideration. Most of the standard software packages, like SAS, SPSS, R and e-Views contain programs for fitting of ARIMA models. For price forecasting in AMIC, ARIMA and SARIMA models were employed for the data.

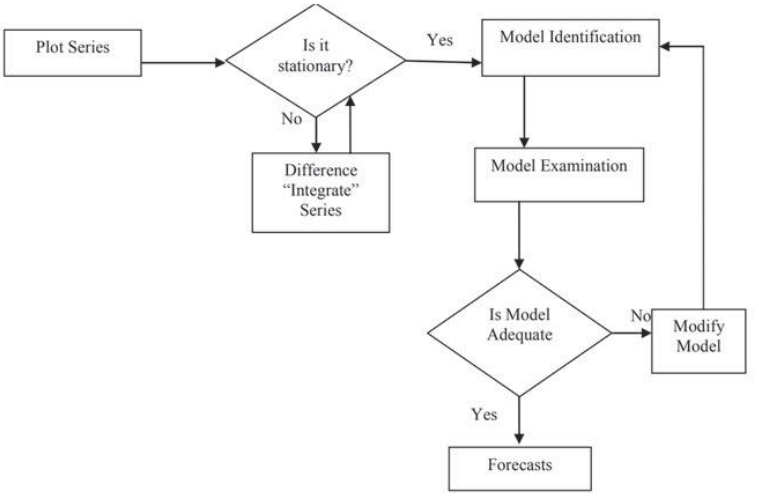

Fig 2: Box-Jenkins methodology for ARIMA model

Nowadays, due to advancements in science and technology, intelligent methods are employed to forecast for highly accurate values. These methods handle complex data with high accuracy and generalization, but require large amounts of data and computational resources, but sometimes lack interpretability and stability. Therefore, understanding the characteristics of each forecasting method and choosing the appropriate algorithm to build a price forecasting model is a key issue to be solved for good agricultural price forecasting research. The AMIC centre also employs machine learning techniques like Artificial Neural Network (ANN) and Support Vector Machine (SVM) approaches for forecasting. The process of Network Training and Forecasting is presented in Fig 3. ANN is a multivariate non-linear non-parametric data-driven self-adaptive statistical method. The main advantage of the neural network is its flexible functional form and universal functional approximator (Haykin, 1999; Jha et al., 2009). With ANN, there is no need to specify a particular model form for a given data set.

The ANN, structure for a particular problem in time series prediction includes the determination of thenumber of layers and thetotal number of nodes in each layer. It is usually determined through experimentation as there is no theoretical basis for determining these parameters. The time series data can be modelled using ANN by providing the implicit functional representation of time, whereby a static neural network like a multilayer perceptron is bestowed with dynamic properties. A neural network can be made dynamic by embedding either long-term or short-term memory, depending on the retention time, into the structure of a static network. It has been proved that neural networks with one hidden layer can approximate any non-linear function given enough nodes at the hidden layer and adequate data points for training.

These are machine-generated estimates which will mostly consider the previous price data, which provides the direction for price forecast estimates decision. The validity of these estimates should be coupled with the current Intelligence of the other stakeholders in the market. The need-based information on the realistic expectations of the intermediaries in the trade is being used and finally, the forecast estimateswill be released after the validation byan agricultural statistician.

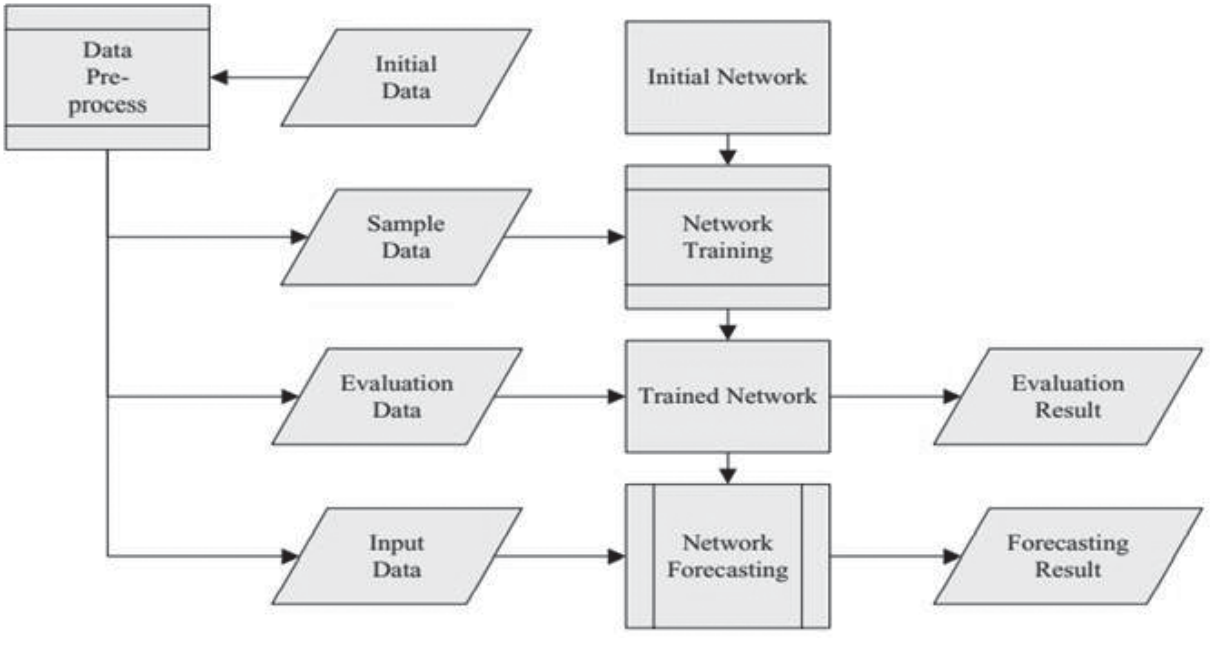

Fig 3: Process of Network Training and Forecasting

Supply Chain and Value Chains:

Supply chains are primarily concerned with the flow of products and information between supply chain member organizations—procurement of materials, transformation of materials into finished products, and distribution of those products to end customers.Around 90 per cent of produce is traded in the market by way of retailers and wholesalers and only 10 per cent within the village (Samshimastung and Giribabu 2016).

Some of the common supply chains in agriculture are below

Channel I Producer '! Village Merchant '! Commission agent '! Wholesaler '! Secondary Wholesaler '! Cold Storage '! Retailer '! Consumer

Channel II Producer '! Commission Agent '! Wholesaler/ Processor '! Dealer '! Retailer '! Consumer

Channel III roducer '! Village Merchant '! Whole seller Cold Storage '! Exporter '! Overseas Buyer '! Consumer

A value chain, on the other hand, refers to the process of producing or adding value to the ultimate product at every stage, from production to distribution (Fig 4).With rising incomes, the demand for high-value agricultural crops in India has increased over the years. Therefore, it is essential to develop value chains that can handle the pre and post-harvest requirements of such commodities.

A value chain is a series of interconnected activities that aim to increase the value of a product; it comprises actors and actions that improve a product while connecting commodities producers to ultimate consumers and markets. Participation in agro-food value chains benefits the agricultural and food industries by enhancing returns to farmers and food manufacturers throughout the value chain. Indian agriculture is gradually transitioning away from traditional farming and towards high-valuehorticulture and livestock production (poultry, dairy, and fisheries).

As the population urbanises, earnings grow, and consumer patterns change, there is an increase in demand for fresh and processed products of all sorts. The development of an

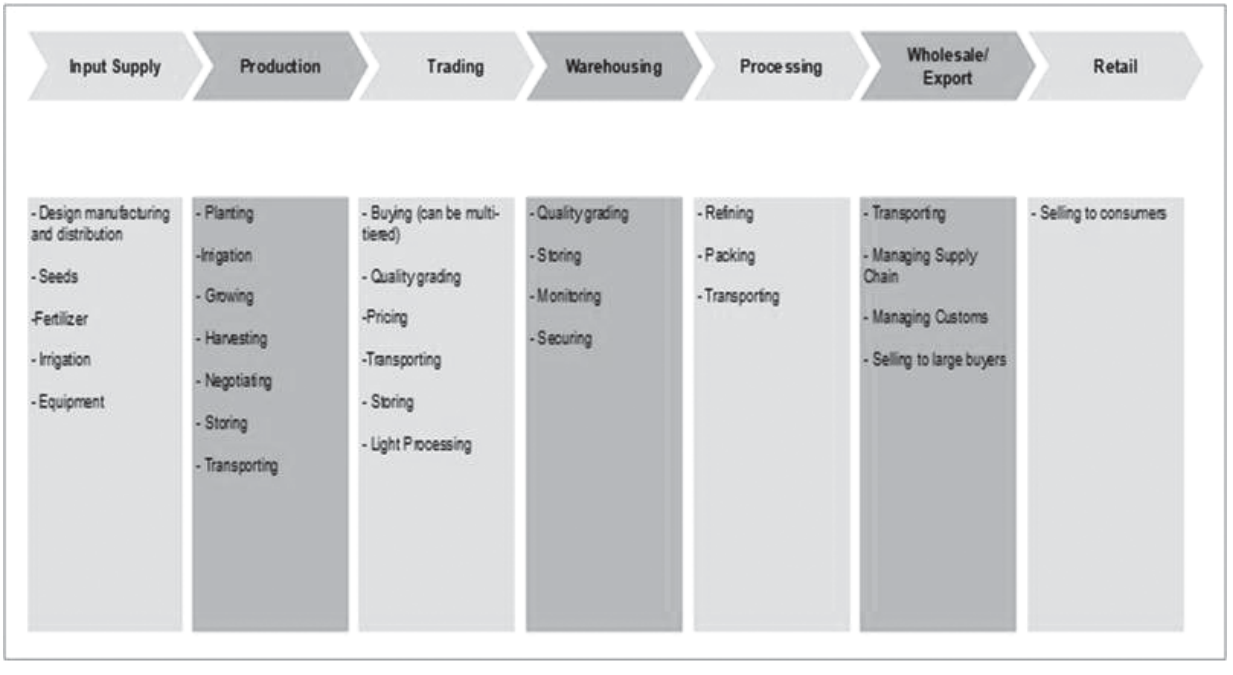

Fig 4: Representation of agricultural value chain

effective value chain network from "farm to fork" can help reduce agricultural production spoilage while also assisting farmers in capturing value as products preserve quality and give additional advantages to consumers. The value-added products of chilli include chilli powder, sauces, paste, pickles etc., whereas value-added products of turmeric includeOleoresin/Extract, Haldi Drops, Curcumin Powder, Turmeric Milk etc.,

The value chains should be competitive financially and environmentally sustainable. The value chains should be inclusive to ensure the participation of marginal and small farmers. Awareness needs to be created among farmers that exporting value-added products is more beneficial than merely participant of the supply chain. The proper value chain can identify the requirement of the product form at the consumer level so that it can lead in the direction of product development research, and technology modification in production and processing. A massive thrust to food processing and other agro-based industries will add value to the product thereby increasing the income of farmers, creating employment opportunities, and diversifying the rural economy and faster rural industrialization (Raj Bala Grewal, 2015).

Linkage of Market Intelligence with supply/ value chain

Market Intelligence is important for the management of a competitive supply chain. The monopoly of intermediaries can be reduced with a better market intelligence system. If a proper supply chain is established, farmers will think of value chains. Bombarding of product market intelligence is vital for the creation of competition in trade and can lead to the development of new value chains with growers' voluntary involvement.

Agriculture transformation scenario

Agricultural transformation is the process of increasing agricultural production, commercialising farming, and building linkages with other sectors of the economy. In the process of development, Indian farmers change from the subsistence level to a marketable surplus level and finally,it's time to adapt value addition with commercial farming. Commercial agriculture is essential, otherwise, we might all be obliged to live in the countryside and devote all of our time and energy to traditional/subsistence farming. Today, it is essential to adopt sustainable technology that not only boosts agricultural output but also guarantees social and environmental impact at every level. Many owned farmers were unable to cultivate their own lands, hence looking for better tenancy services. Tenant farmers will not continue farming if they incur continuous losses. If not commercialized with market information &and value chain building, sustainability of production systems at the gross root level will pose a lot of challenges and continuation of production with economies of scale with suitable products in a specific region will beaffected.

CONCLUSION

There are many studies which showed the potential to increase the profit of the farmers through the provision of market intelligence to the needy farming community. Thus, there is a need for intensive initiatives in the research and investment in the market intelligence aspects to help the millions of farmers and to make them continue farming.

Agricultural Market Intelligence is an important and useful instrument, and it should be strengthened and extended to all the states. The MIUs established by GoIapparently have not been able to function in the manner envisaged. Their operations and staff requirements should be re-evaluated and appropriate measures shall be taken to streamline the units. The aim of MI is not only for information dissemination but also can restructuring/developingthe supply chain leading to the streamlining of present channels.

Way Forward

- Dynamics in the process of forward linkages should be stabilized to develop confidence at the gross root level to produce commercial crops.
- Proper value chains at the farmers' level can only be developed with the help of FPO.Need-based development of agribusiness enterprises with proper infrastructure and logistics for distinct markets must be improved.

- The marketing opportunities need to be identified prior to the production of commercial crops. The situation is in such a way that marketing is being searched after the production of commodities which is a vice-versa process and policy needs to be developed in a proper way.
- The real commercialization of farming can be achieved by the integration of farmers into the value chain of respective agricultural commodities through clustersto ensure better incomes with a larger share of the consumer's rupee.
- Corporates in agricultural commodity retail chains can play a crucial role along with public sector agencies to connect the growers and make them part of the value chain by creating awareness and providing technical support.
- Development of specific clusters for commercial agriculture with specialized farming systems coupled with continuous market intelligence can pave the way to create profitable value chains for the growers possibly through Public-Private partnerships.
- Voluntary participation by the growers by realizing the benefits of commercial value chains can motivate the farmers to form groups so that a strong FPO mode of development is possible.
- Even though different sources of price-related knowledge are available, the scientific, authentic, procedural, and authentic dissemination of the required market information is necessary to adopt the improved technologies and realize better net returns by the farmers.

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