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Agricultural Market Intelligence system in support of supply chain management in India: A vivid review

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Introduction

Basically, the market intelligence in agriculture is not just a mere technique or method of collecting certain set of information but an attentive and determined process like of fetching agriculture data, extracting insights and providing it to the respective farmers, agriculture departments and market functionaries (e.g., traders) for decision making.. In other words, we can imply the system as predicting certain valuable information in response to the market scenario. Some fraudulent aspects are also to be included in this system which sometimes creates a sort of hesitation in the mind of the customers which encircles lack of food safety (food poisoning), high perish ability with less expiry time, harsh additives and ingredients (Banafa, 2017). Currently, the farm to fork concept is highly in demand by the consumers which creates a new era of agribusiness with digitization so thus many regulations are bought into account to create a transparency without any opaque veil (Kirwan, *et al*., 2017). Lack of information and predictions of concrete news have more or less got demolished with several channels which includes top to bottom approach and vice - versa. The main change in the marketing scenario in the rural community was high variance in prices, remote locality etc. So, the farmers should be aware of the price and customer behavior. Therefore, market intelligence plays amajor role in all aspects to maintain a healthy and sustainable enterprise (National Restaurant Association, 2017). The agri-food value chain is a very critical system which plays a critical role in from the raw harvesting of the product to the ultimate processing till it is reached to the targeted consumers. Thestakeholders who are involved in the whole process sustains and manages the commodity to meet the ongoing demands of the customers maintaining the food safety and standard (Leng, *et al*., 2018). As talking of the modern-day business in agriculture technology culminate the venture of trading at an indistinct way like it includes transfer of technology (TOT), Internet of things (IoT) and the Information and communication technology (ICT).

At present scenario agriculture plays a major role in the employment sector in India. As being declared by the economist study that in the financial year of 2006-2007, agriculture has acquired 18 percent of India's (Gross Domestic Product) GDP (Arjun, 2013). Nearly 70% of the Indian population lives in rural area where agriculture is the main source of income and via this ongoing situation perpetual sectors, concepts and models of farm to fork system, globalization and liberalization, establishments of organizations like KVKs has been put that serves as a new

descriptive status to India (Singh and Sonker,2014). Technology has been proven to be a boon in the agricultural market system that is providing a vast directory of information to the farmer's regarding the market and livelihood problems (Rao, 2011).

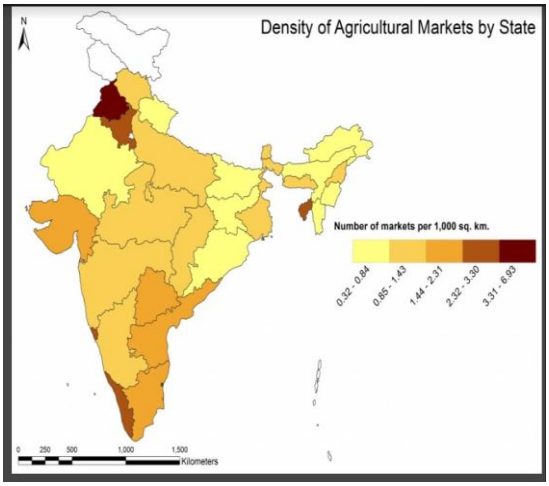

Fig. 1 A spatial exploration of the Agricultural Markets in India (Sivasubramanian, 2021).

The figure states that agricultural market density study of India of different states. The frame between (0.32-0.84) includes the states of Arunachal Pradesh, Jharkhand, Bihar, Orissa, Manipur, Assam, Uttarakhand, Andaman & Nicobar Island, Rajasthan and Mizoram has a comparatively low market density. The frame of (0.85-1.43) Himachal Pradesh, Meghalaya, Uttar Pradesh, Madhya Pradesh, Karnataka, Sikkim, Maharashtra, West Bengal, Nagaland and Chattisgarh had a relative higher market density. The frame between 1.44 - 2.31 includes Andhra Pradesh, Tamil Nadu, Gujarat, Telangana and Dadra and Daman Haveli and Daman and Diu as a comparative more market density than the last two frames. Frame having margin of (2.32-3.30) which includes Harayana, Tripura, Kerala and Goa with Punjab with the most densified frame of (3.31-6.93) having the higher number of markets. At last the unmarked slot in the map which demonstrates Jammu and Kashmir having a zero position in the market density. States like Punjab and Haryana have been very much privileged from the modernization of markets and predominant in growing rice and wheat. This phenomenon helps to rise the density of regulated markets. In the north-eastern states like Mizoram, Manipur, Assam and Arunachal Pradesh due to poor technological/infrastructural hindrance they were having lower market densities. Understanding, this crucial step of identifying the mandis have been a great deal of questions towards agricultural, economic and social interconnectedness.

Research Methodology

This information has been prepared through various documents and website resources. The information has been taken care of and properly analyzed to give a highlight to the marketing conditions in terms of information and intelligence, describing the underlying concepts and variouslessons, ideas, and insights useful for developing and strengthening agriculture market intelligence system in our country. It is very important that the farmer should be able or should have an accessto the selling of goods at reasonable price which is not below than the Minimum Support Price (MSP).

Table 1. Criteria for inclusion or exclusion of the review papers in the present studies

Inclusion criteria	Rationale
Articles were published in peer-reviewed journals, conference proceedings and the book chapters in English	Peer-reviewed journals, conference papers and Book-chapters considered to have better quality than non -peer-reviewed articles.

Articles were published between 2009 to 2021	The year 2009 was selected as the starting point at the term market intelligence
Judge relevance by fully reading all remaining abstract, introduction and conclusion	The remaining abstract, conclusion totally focusing on market intelligence role in India
Judge relevance by fully reading all remainingarticles	Articles focusing on the application of market intelligence in agri-food system are being Selected

Discussions

Agricultural Market situation in India

An analysis was made before and after Covid which came with certain outcomes of food shortages, as the food exporting countries became more conscious regarding the restrictions of the on-going pandemic. It entailed many products including dairy and meat and lastly it also suffered from the out-numbering of labors (Ramakumar, 2020). In India food crisis was faced before the era of green revolution, but it bought a boon to production between 1965-1967 with the high yielding varieties. This condition was faced in several installments and it stood firm during every crisis and proved its appropriateness (Acharya, 2009). Several marketing portals has opened their ways towards productive and sustainable marketing which serves a better slot for customer satisfaction and producer efficient selling and overall maintaining the Sustainable Development Goals (SDGs) such a portal is e-Nam working under the APMC organization and meeting all the requirements of operations among farmers. The several marketing portals which are to be mentioned are as follows: (Bisen and Kumar, 2018). ‘

Public Sector Online Portals for Effective Agricultural Marketing:

Sl. No	Portals	Use/Application	Governing body	Business model
1	Agmarknet	Government portal on agriculture marketing reinforced by connecting networks.	Government	G2C
2	e-Nam	A pan India electronic portal creates digital links with APMCs.	Government	B2B
3	mKrishi	An ICT tool used to serve as an agri-business advisory body.	Private	B2C
4	mkisan	It is a national e-governance plan providing service through kiosks, agri-clinics and mass media.	Government	G2C
Private Sector Agricultural Marketing Portals:				
1	Dehaat	Connects farmers to suppliers and buyers on a single platform.	Semi-government	B2B
2	Ninja Cart	Supply Chain Company with leveraging innovative technology	Semi-government	B2B
3	BigBasket	Online grocery store in India, an online supermarket for all daily needs	Semi-government	Both B2B and B2C
4	Grofers	Linked with blinkit is an Indian instant delivery service	Private	D2C (Direct-to-consumer)

Market Intelligence system in India

The marketing intelligence has played a significant role with the commencement of (DMiS) Distributor’s Marketing Intelligence System. The competition in business has increased many alternative pathways for the distributors in the channel. The role of the distributors apart from just as a delivery is also creating promotional strategies (Thangraja, 2016).

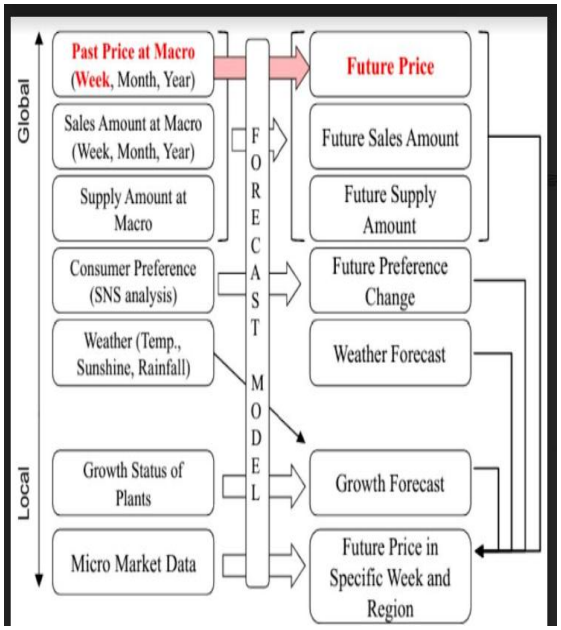

Fig. 2 Agricultural Market Intelligence Price Forecasting (Kurumatani, 2020)

This is a whole forecasting network. This framework depicts that upon receiving the past data of price-time series, sales promotion and supply amount, consumer preference, weather, growth and product cycle status with specific regions the forecast model generates the future values, price volatility, upcoming consumer behaviour. The study has been performed keeping in mind the local along with the global areas.

Components of Agriculture Market Intelligence

i. **Price**: Price is basically a paid amount or token for any sort of service. Different commodities have acquired multiple sets of prices with various offers and discounts in case of processed products. The timely information and strategic tools used in the helps the consumers to know regarding the volatility of the prices.

ii. **Product**: The products are the services or the materials for which the price is being paid to the seller. The market intelligence provides information about different standards of product for e.g. the standards, quality along with grading and sorting parameters so a comparable measurement can be done in the market for a better flow of price meeting the demands of the consumer.

iii. **Place**: A site for the price and product exchange, not only exchanging is being bought where activities like bidding, advertisements and stress sales also takes place. The market area is the place which varies region to region, and due to the alarming providence of the intelligence it has created a good interface of goods dealing, pricing and a suitable place for business.

iv. **Period**: Seasonality is a big barrier to the agriculture business system. The intelligence service keeps it role in continuance by supplying a wide range of information linking to the correct time for sell so it would result in earning high returns (Yadav and Meena, 2020).

Status of Market Intelligence

Agriculture marketing intelligence has been a great support to the market information chain and has been the only major linkage between producers, markets and processors. Presently, it's also filling the gap to serve as the center of commercialization for the farmers who are practicing subsistence farming (Shailaza and Meena, 2020). Currently, market intelligence system of agriculture has uplifted itself to implement several forecasting and deep learning techniques

which proves to be a genuine news generator.

Techniques commonly used in Market intelligence

i. **PoC (Market Intelligence System Proof of Concept):** A drastic technological step has been taken towards the market intelligence aspects of agriculture which is helpful in the datasets for few agricultural commodities. The system gives a concrete evidence of daily weather data, market price and then transforms the encrypted the database into simplified method for a understandable purpose (Shrivasthava et. al, 2019).

ii. **Auto-Regressive Integrated Moving Average** (**ARIMA**): The ARIMA Model checks the time series data in association to stationary objects or concepts that basically means the parameters which are constant in nature. The series study is considered to be stationary if the mean and the autocorrelation structures are constant over time. A new opportunistic operation has been proposed in the ongoing decade which bought a shipment policy that increased the potential of farmer's entry in the secondary market where it mitigated the price volatility and accounted the probability of increased profit (Flores and Villalobos, 2013).

iii. **Recurrent Neural Network (RNN):** This technique is majorly used in the yield prediction of different crops. In this study, majorly done in Punjab for Wheat Production. It verifies the amount and attributes of the respective to be dispatched in the market. The RNN has several variants and the multi-diversified data has been proven to be efficient in using the technique in full-fledged manner (Bali and Singhla, 2021).

iv. **Contract farming**: It is a less old method but nowadays being hugely implemented in the agriculture food system in a huge basis. Contract farming which is a deal being done between a grower and a buyer under certain legal basis is helpful in participation of the domestic firms and has opened the gates towards globalization. Under this system the landowners have contracts with agri-business marketing firms, who decides on the prices, timing, quality and amount of the produce to be delivered (Singh, 2003).

v. **Domestic and Exports Market Intelligence Cell** (**DEMIC**) was established in November 2004 Centre for Agriculture and Rural Development Studies (CARDS) in Tamil Nadu Agricultural University, Coimbatore. It was being formed in order to disseminate timely and ongoing prices of the market and allowing a linkage between several stakeholders in the food channel system.

From an advantageous point of view Agriculture Marketing has been playing an operational role in the growth of industrialization by incorporating the concept of consumer-resources oriented market (Helm et. al, 2014). The Agriculture Market Intelligence has been proved to be very helpful in implanting a good relational linkage between online retailers with word of mouth (WOM)

(Soni, 2019). The digital transformation in the field of Artificial Intelligence has been proved to be a critical factor unleashing the enterprise business disruption (Chintalapati, 2022).

Channels of marketing intelligence

The importance of the distribution channel lies in all the operations which after the harvesting and the post-harvest technology are to be circulated to different sellers. It enlists wholesaler, food handlers, retailer distribution and the relational chain among the actors of the agricultural market should be lucid and flexible for an efficient working (Segetlija et. al, 2011). The focus should be turned towards the weaker sections of the society which will help to increase the equitable development. FAO has considered some help to the farmers by serving the marketing information system (Crowder, 1997). Types of market intelligence includes Competitor Intelligence, Product Intelligence, Market Understanding, and Customer Understanding.

Inter-relation of market intelligence and Supply Chain Management

The Supply Chain Management experts claim that a proper focused efforts on the management of the firm's supply chain create a very good and effective functioning of every other allied and connected bodies. The Agricultural firms need to focus on the relationships among the suppliers and should effectively monitor the movement and storage of goods to increase profitable outcomes. Market Intelligence plays an important role in the all forms and areas starting from industry, cluster, company, niche, market and so on. As market intelligence generates concrete future news so it also helps in having an information regarding the suppliers, competitors and consumer behavior and the market functionality. Thus, they procure a huge amount of benefit in constructing their next strategic moves and the competitive cycle of marketing goes on. The Supply Chain Management (SCM) has been considered a major gear within the domain of marketing which is working towards aforesaid management anchorage (Kozlenkova et. al, 2015).

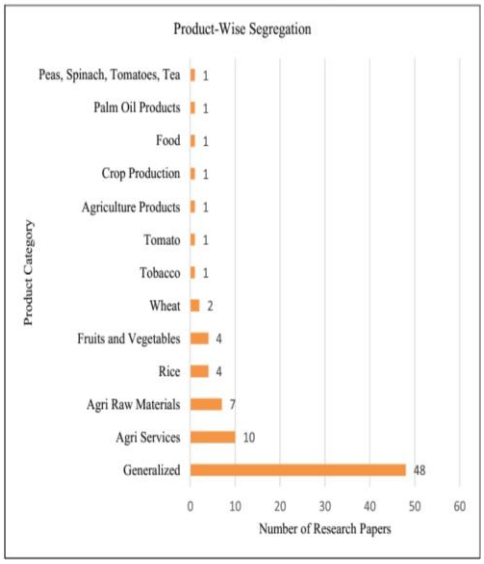

Fig. 3 number of studies found on crop-wise study of supply chain management

The service supply chain agriculture plays an important role from the procurement of the raw materials to timely and efficient supply of goods with proper processing and sorting. A kind of segregation of the product has been found in this study of the SCM which denotes from the generalized products to specific products in the whole food value chain. The study which has been done in a span of 10 years (2010-2020) denotes that the products in the graph with categorization faces certain improper practices in the food system which needs to be more particular in the service and also measures the amount of waste, warehousing profile and gradient facilities in specific regions. The Supply Chain Management is still in a

developmental phase and not that much effective and proficient in nature (Khandelwal et. al, 2021).

Chain models in the Supply Chain Management of Agriculture which includes

Business to Business (**B2B**): The e-commerce platform has been very much efficient dealing in within the organizational structure of the agribusiness entities. Three dominant factors has up come in the channeling model which are Industry Structure, Product Complexity, High-touch nature of transactions

These potential factors are the circumstantial future of the business-to-business commerce in the sector of agriculture (Leroux et.al, 2001). The Alibaba portal is the biggest example of B2B model in every aspects rather than agriculture. It is totally a wholesale segment where the bulk transactions are being performed (Jiang and Murmann 2022).

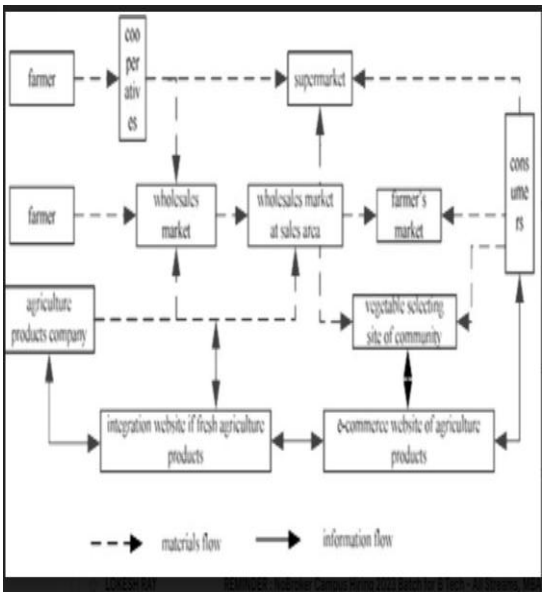

Fig.4 B2B and B2C supply chain framework

This Figure shows the flow of products in different channels with a multi sectoral chain of Business to Business, Business to Customer. It shows starting from the farmer how everything is inter-linked with cooperatives, supermarkets, wholesalers, online E-commerce portals, the model not performs the role of raw materials in the business bases but also as a part of market intelligence it delivers the market information for better upliftment of enterprises and firms.

Business to **Customer** (**B2C**): The notion of connecting customers from the agricultural point of view is to help farmers, stakeholders and entities to surplus the income with efficient production. The role of E-commerce marketplace helps in the transaction at a very drastic positive level with knowing the availability of goods, and the ease of assessing the online site (Soegoto and Nurgaha, 2020). Many other activities are being performed apart from selling which includes logistics, storage and grading sorting in a whole.

Customer to **Customer** (**C2C**): It is also performed in certain second hand transaction in various flea markets, it includes a third-party logistical service which also adds as an overhead charge in the business. Through the block-chain technology which is a type of disturbed ledger technology (DLT) that consists of growing list of records, known as the blocks, which are then securely linked together via cryptography which is an encrypting mechanism. The adoption of the blockchain technology in the field of agriculture has achieved a critical mass attraction from every person in the system like the government, end-point customers, stakeholders and farmers. The study recommends that the integration of the blockchain is very much playful in the customer area of agribusiness activities. In the

C2C channel the customers are not only consumers but also play the role of prosumers (Sengupta and Kim, 2021).

E-**choupal model**: that is basically an internet-based intervention working under the supervision of Indian Tobacco Company (ITC). ITC itself has channelized for the farmers to sell their produce directly to the organization, also access to valuable information to

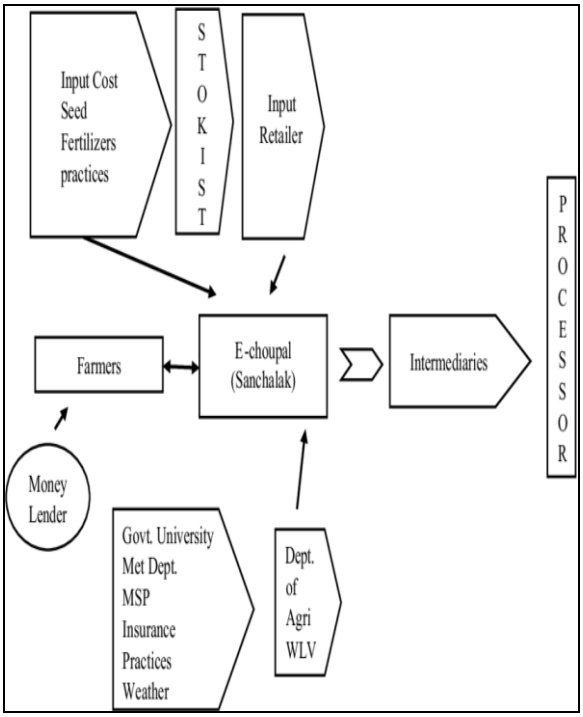

Fig.5 E-Choupal Framework (Madan et al., 2016)

quantify their decisions. Further, ITC is providing training-based skills to the farmers (Chen et. al, 2013).

It figure shows that E-choupal an extension intermediary working in the Agricultural marketing aspect and being surrounded by the government bodies. The E-choupal modal is being interpreted and controlled by the Sanchalak who is main authority in the whole portal chain. It performs the role starting from raw materials supply, market information, farmer's friend and delivering the ideas in the Agricultural financing zone (Madan et al., 2016).

Details Supply Chain & Value chains of Agri-produce

A supply chain basically refers to the food system processes which links several intermediaries in between from the producer to consumer and in the food chain apart from the processed products all other products are being mentioned. A food value chain mainly includes those products which are generally processed and being made ready to cook-or-eat. The artificial intelligence being used to collect information about agri-food system to prepare a business model. Firstly, it extracts data from online sources then it analyzes and transforms the data normal format. On the contrary, it prepares a sustainable business model for a successful agri-food system (Vaio et. al, 2020). Market Intelligence added a concrete support to the agri-value chain supply system and bought a flow of multi-diversified food items, channels, concepts and technologies. It emphasized soulfully on the food security maintenance with proper screening of the food items before being dispatched in the market (Opara, 2003). It has been concluded via different studies that information sharing and supply chain integration (SCI) plays a major role in proper functioning of AI (Artificial Intelligence) in the agriculture food chain which influences the SCRM (Supply Chain Risk Mitigation) that is a modular concept got implemented in the year of 2021 for avoiding sort of disruption in the food chain (Nayal et. al, 2021). A question was raised during the pandemic whether the food supply chain is at all resilient to the catastrophic outbreak. The question generalizes with present government policies related to food supply and provides some suggestive measures regarding the food distribution system (Nasereldin et. al,

2020). Critical lack of labor was being witnessed, results from the study clearly states national food security as a lengthy issue as admitted by the respondents in the survey (Luckstead et. al, 2021).

Hindering factors in flow of market intelligence for effective supply chain

i. Barriers in the path of supply chain overshadow the role of small startups (rural entrepreneurship) and creates a list of hindrances in the financing mechanism which tends to distort the chain in a certain way (Ataei et. al, 2020).

ii. Technology and logistics-induced emissions of harmful gases tends to deploy the effective green supply chain management agenda (GSCM) which is a practice around 101 countries.

iii. The shooted-up carbon content obstructs the GSCM practices which is a framework of eco-friendly agricultural system (Li et. al, 2021).

iv. The Food Supply Chain (FSC) faces hindrances on aspects of sociological, financial, environmental issues and actors' performance efficiency which retards the growth of the chain and causes reduced profitability and customer dissatisfaction (Sharma et. al, 2022).

v. Study has confirmed that there is still a lack or gap of information being circulated among the farmers regarding market information and price volatility. Farmers were the major victims in the scenario whereas the traders were enjoying a competitive advantage. Thus, as a suggestive measure it has been proposed that the SAUs (State Agricultural Universities), Krishi Vigyan Kendras, State Department of Agriculture will play the major role in disseminating information to the farmers (Vaidelu and Kiran, 2013).

vi. Another, issue of market intelligence lies in the proper functioning of the food chain system, so a good and efficient linkage among stakeholders, farmers/producers, processors, should be maintained. As per recommendations the focus should be more on huge sale of the products with remunerative prices (Shinde, 2018).

Suggestive Measures

Various steps have been initiated by government which includes the subtraction of the middlemen from the marketing channels. In order to achieve more momentum in the area of increasing market efficiency government is working on execution of latest rule and enforcement (Sharma and Burrak, 2019).

i. Globalization and liberalization has created a turbulent weather in the ongoing marketing processes so WTO (World Trade Organization) is working profoundly to boost the exports and increase the margin of the Indian market (Koccher, 2014).

ii. To reduce the gap of information gain among the farmer regarding Agriculture a new strategy has been set-up which is the Reuters Market Light (RML), basically a text message service which can be accessed by different demo-graphical people. It provides information of market prices, consumer behavior, fluctuations etc., (Parker et. al, 2016). Agricultural price forecasting using neural network which

is an innovative information delivery system.

A success story from Punjab: it has been recorded which states the role market intelligence in Agriculture. The humongous production of Basmati rice decreased the viability of the rice with low returns as the market got crashed, therefore, government of India decided to reduce the area under Basmati and informed the farmers through print or electronic media. Thus, Agriculture Market Intelligence Centers (AMIC) in India played a major role in improving the returns of basmati growers and just ultimately joined hands in achieving the national agenda of food security (Sidhu et. al, 2014)

Conclusion

A Market Intelligence with utmost efficiency is needed in the prevailing market circumstances to develop the agricultural sector as a whole which would help in the supply of various outlets and incentives for the production increment. Non availability of this sort of system would lead to invalidity of most of the programmes governed by the Government of India (GOI). It is to be expected that the large hefty production of the agricultural sector would source from the diversification of various farming systems which includes all the allied sectors of agriculture also for e.g., piggery, duckery, fishery and many more which defines that the incorporation of the advanced technology of farming along with certain indigenous tactics we can reach the summit of sustainable agriculture with the help of agricultural marketing intelligence.

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