International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Role of Disruptive Innovations and Agripreneurship as Drivers of Sustainable Agricultural Development, for Future India

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Abstract
Agriculture continues to play an important role in the economy of Indian farmers. More than 55% of the rural population are either directly or indirectly dependent on agriculture for their livelihood. Also, despite strong demand pull for agri sector, challenges such as growing population, smaller land holding, lack or poor adoption of improved agricultural practices, complex supply chain involving several intermediaries, and inadequate service to the end customer at the last mile continue to limit the sustained growth. From a scenario of `*Green Revolution*' and `*Food Security*', we should now move towards safeguarding the `*Income Security*' of farmers. To overcome these challenges it is imperative to ensure that there is continuous innovations in the agricultural sector by way of introduction of (1) novel disruptive technologies to solve farm related problems and enable quick decision making by farmers which will improve the overall yield and productivity of crops and (2) encourage the spirit of Agripreneurship and in turn increase employment opportunities and income levels, among rural youths. Agripreneurship refers to the process of adopting modern farming techniques with a business acumen. In other words, it is the concept of transforming an agricultural idea or vision into a commercial business proposition for the benefit of farming community at large. The present paper highlights the role of some of the novel disruptive innovations that are adapted across value chain to solve `*Farm to Fork*' problems along with the concept of Agripreneurship, for the sustainable agricultural development, for future India.

Keywords: Agripreneurship, Disruptive Innovations, Sustainable Agriculture

1.Introduction

Agriculture continues to be the backbone of India's economy supporting more than 55% of the rural population, either directly or indirectly for their livelihood. Despite the significant progress of agriculture in our country, the productivity per acre of land continues to remain at low levels. For instance, with 11% of total Global agriculture, food grain acreage at 15% and contribution to production a mere 8.7%, it a humongous task to increase the production of food grains to another 50%, by 2050 to meet the growing population [1]. Also, despite strong demand pull for agri sector, challenges such as growing population, smaller land holding, lack or poor adoption of improved agricultural practices, vagaries of climatic conditions, complex supply chain involving several intermediaries, and inadequate service to the end

customer, at the last mile continue to limit the sustained growth. From a scenario of `*Green Revolution*' and `*Food Security*', we need to move towards safeguarding the `*Income Security*' of farmers.

To overcome these challenges, it is imperative to ensure that there is continuous innovations in the agricultural sector by way of introduction of novel disruptive technologies to solve farm related problems and enable quick decision making by farmers, which will improve the overall yield and productivity of crops. It is expected that changes in the technology and improvement in infrastructure will lead to paramount changes to the overall operating efficiencies of the agricultural sector. It is expected that by the year 2030, there will be significant improvements in bridging the gap between villages and markets with widespread penetration of cheap, speed internet data transfer, digital user engagement, efficient logistic and supply chain management, and improvement of farmers income through rural agrientrepreneurship [2].

2.Methodology

This present paper is a review based on systematic collection of recent publications in detail, on the subject of `Disruptive Innovations in agriculture and on Agripreneurship, as drivers of Sustainable Agricultural Development.' For literature collection, search was done on the topic using an on-line database of Google Scholar, Wiley online library and other search engines.

3.Restults and Discussions

3.1. Concept of Agripreneurship

Agripreneurship is the concept of transforming an agricultural idea or vision into a commercial business proposition for the benefit of farming community at large. Agripreneurship is the process by which farmers convert their agricultural operations into a profitable venture by efficient utilization of farm inputs and resources, adopt new technologies, introduce new products to suit the immediate needs of the market [3,4]. Such agribusiness operations often consist of the involvement of individual farmers, farm producer organizations (FPO), cooperatives, and other professional farmers groups across a network of agricultural value chain such as traders, suppliers, transporters etc. In other words, an Agripreneur or Agrientrepreneur is considered as a committed and creative leader constantly seeking new opportunities to expand, improve, and diversify his business for higher profitability [5]. For instance, an `entrepreneur-farmer' as the one who challenges the `*status quo*' and serves as a `change agent', whereas a `producer-farmer' remain contented with routine farm operations [6]. Agrientrepreneurs are also considered to be proactive, risk taking and farsighted individuals, who have the right kind of skills and managerial competence [7]. The agripreneurial oriented behavior of farmers are attributed to a set of collective, innovative and proactive leadership trait(s) which they exhibit and put into practice against other competitors [8], in order to transform farm business, to a more sustainable one [9].

3.2. Small farmers and adoption of new technology

Studies have shown that opportunity for any innovation actually lies among the small and poor people which comprise of around 70% of the populations of developing countries, including India [10]. It is reported that there are more than 121 million agricultural holdings in India and out of which 99 million comprise of small and marginal farm holders [11]. In addition, the small farming community can be segmented [12] into, vulnerable farmers (who are net buyers – 30 to 50%), market neutral smallholders (who are weather dependents – 20 to 30%), commercial smallholder farmer (who are bulk traders – 15 to 20%), and Agripreneurial farmers (who are the actual producer of crops – 1 to 2%). Thus, the segment

consisting of Agripreneurs ie; 1 to 2%, make the bulk of farmers in the country. They are the progressive farmers who have the desire to innovate and excel to become more competitive at marketplace and in turn exhibit their `Agripreneurial' talents for sustainable agricultural development.

Agripreneurial development aids in changes in the standards of living for farmers since any significant improvement in crop production or introduction of new technology also result in better sales of the farm produce [13]. Though successful agripreneurs exhibit greater self-confidence, they are also prone to unfavorable situations such as climatic conditions, occurrence of pests and diseases, fluctuation in market prices of produce etc. In the context of existing dynamic and competitive environment, the overall profit realization of farmers not only depends on the crop agronomical practices but also on the personal skill sets and agripreneurial behavior of farmers [14]. Thus, the gamut of agripreneurial behavior model of small farmers consists of an integration of his (a) demographic and personal background, (b) agripreneurial orientation and attitudinal factors, and (c) agripreneurial environment and resourcefulness factors [15, 14]. Changes in agriprenurial development also result in improvement of the profitability of farm businesses of small and marginal farmers, due to adoption of newer technologies and shifting from traditional practices to modern approaches of farming eg. precision farming, organic farming etc. [4]. Also, successful agripreneurs tend to take risks, display positive attitudes, are self-motivated, have high aspirations, and are completely different from their traditional counterparts, in improving the efficiency of their farm business operations [8, 16]. Studies [17], also revealed that successful agripreneurs adopted innovative practices, took calculated risks and exhibited increased efficiency to improve the productivity of their farm.

3.3. Identifying Gaps in Agriculture Value Chain

An important aspect in the technology integration across the agriculture value chain is to try and identify the gaps that are existing in the `*farm cycle*' or `*Farm to Fork*' operations. Some of the critical gaps include.

3.3.1. Selection of Crops: Traditionally, the cultivation begins when farmers decide on the type of crops that need to be cultivated on their farm. Such practices are unscientific and often result in poor crop agronomy, leading to low yields and profitability for farmers. For information, the choice of any crop for a particular farm depends on several factors like the type of soil and its nutrient status, the weather conditions or micro-climate prevailing, water availability, prevalence of pests and diseases attacking the crop plants, the demand for a specific type of crops in the local markets and so on. On the other hand, `Precision Farming' or `Digital Farming' techniques of cultivation involve analyzing available crop data and taking right decisions at the right time during each stage of the farming cycle [18]. This will ensure higher yields and profitability of crops, resulting in higher income for farmers.

3.3.2. Tracking cost of production: An important aspect of implementation of digital farming is to track the cost of production. This involves working out the cost of production for all crops that are likely to be cultivated during the particular season, such as estimation of optimum quantity of high quality seeds to be used for sowing along with enrichment of soil nutrient status (organic and inorganic supplements), to sustain the crops during the period of their growing cycle. Likewise, an estimation of the ideal moisture status of each crop will help to decide the optimum supply of water through drip irrigation.

3.3.3.Real time data analysis: In traditional cultivation practices a farmer himself must take all his decision based on `gut feelings' or `age old, tested practices' etc., which often lead to failure of crop, resulting in low yields and profits, from farm operations. On the other hand, resorting to modern methods of farming systems involves usage of `real time data analysis, which enables farmers to minimize risk and

optimize resource utilization. Such real time actionable insights on the choice of crops to be cultivated based on soil type, IoT enabled soil sensors for assessing moisture levels of soil, mapping soil profile using drones, installation of automated drip irrigations etc. will not only enable farmers to take quick decisions but also improve the yields and productivity of farming in a sustainable manner.

3.3.4. Data supported harvest technology: It is estimated that around 60 per cent of the wastage of food crops occur between the field and the consumer in India [19]. Traditional farming practice involves the harvest of crops by farmers by judging the colour, size, and shape of produce etc. Switching over to any data based harvesting decisions involving IoT analytical tools to capture the real time harvest of crop produce will facilitate farmers to decide whether the standing crop is ready for harvest or not. Also, decision-based harvesting tools will enable farmers to estimate not only the correct stage and time of harvesting but also harvest the crop at its peak nutritional value levels. For instance, harvesting crops like sugarcane, grapes, pineapple etc. can be done at peak sugar content levels ie; Brix levels, and not based on the size or maturity of the standing crops.

3.3.5. Technology during post-harvest and logistics: The post-harvest and logistical is vital stage in the supply value chain since any improvement in this area will directly result in an increase in the monetization for farmers. Critical decision such as whether to sell the produce at the local *mandi* or to a distant market for better price realization can be made based on actual data. Some of the advantages farmers can get include real time traceability of the produce from, farm gate to end customers, networking with Farmer Producer Organizations (FPO) for better price value of produce, brand building, accountability of better quality products and so on.

4. Disruptive Innovative Agricultural Technologies for Future India

A list of some of the novel disruptive innovative agricultural technologies along with areas of their implementation, for the future India, is provided in Table, 1.

S.No	Disruptive Technologies	Areas of Implementation
1	**Big Data Analysis**	Farm Management, solutions, Risk mitigation & forecast solutions, CRM & Input channel solutions, Traceability & compliance
2	**Market Linkage Model**	Agri inputs markets platforms, Real time solutions for farmers, updated agricultural information, Quality, availability and price checks, Farm to fork supply chain
3	**Farming as a Service (FaaS)**	On-demand harvesting, Digital payments, Market linked pricing, enhancing technology to reach farmers, Agricultural Machinery platforms
4	**IoT Enabled Technology**	Vertical farming monitoring solutions, Hydroponics farming, Aeroponic systems
5	**Engineering-Led Innovations**	Cost-effective value-added machinery, Technology solutions to small farmers
6	**Other Miscellaneous Innovations**	Agro based products industrial machinery, Boosting secondary agriculture etc.

Table: 1 Major Disruptive Agricultural Technology (DAT), for the future of India [Source:25,24]

4.1.Digital Farming Technology : The need for digitalization in Indian Agriculture is well recognized and concerted efforts are in progress to identify key gaps in the supply value chain, from `farm to fork'(Table, 2). Some of the available tools for implementation in this area include using drones for remote sensing, soil sensors for assessing moisture levels of soil, artificial intelligence or machine learning algorithm for developing actionable insights for decision making and so on. For example, the Government of India supported Mahalonobis National Crop Forecast Centre (MNCFC), utilizes spatial and geospatial technological solutions for providing quick solutions across agricultural sectors [13].

FINANCING	Usage of electronic apps, Loan disbursement, Credit assessment, risk mitigation
FARM INPUTS	Agri Inputs data, Agri extension services & consultancy, Real time crop-based weather information
FARMING	IoT based precision farming, aerial mapping & soil survey, Assessment of moisture level of soil, Equipment rental, Pest & Disease management system, Forecasting of weather, Decision on timely harvest & storage
SELLING & DISTRIBUTION	Tracking prices across markets, Demand forecasting, RFID supply chain management, Traceability,

Table: 2 Application of Digital Technology across Value Chain [Source:19]

4.2.ICT in Agriculture sector: The role of ICT is very vital in the dissemination of agricultural information. Of late, many progressive farmers have started consulting advanced tools that provide actionable insights on soil, weather and other agronomical practices. Through ICT, it is now possible to deliver quick, fast, reliable, accurate, and user-friendly information to the customers, even at the last mile. Such real time information will facilitate vital crop-based decisions to increase productivity and improve prosperity of farmers [20]. Some of the ICT initiatives in Indian agriculture is depicted in Table 3. Further, to handle the ongoing demand in technology adoption, investment in infrastructure like high-speed broadband network internet connectivity involving telco-driven, provider-driven, and farmer -driven tools [21], at village level is essential. This will lower farm production costs and improve profits of farmers thereby resulting in better resilience and sustainability.

4.3. Farming as a Service (FaaS): Such farm-based solutions provide a `data-driven-decision' tool to increase efficiency and productivity of crops. For example, studies have shown that the software tool helps to convert the fixed upfront costs into variable costs for farmers thereby boosting the overall farm productivity. Presently, FaaS is available in areas such as (a) Farm Management Solutions eg. Information sharing, analytics and precision tools (b) Production assistance ie; on-site resources to assist crop production, pest and plant protection solutions, on demand harvesting, equipment rentals and (c) Access to markets – aiding farming in cost effective sourcing of agri inputs such as seeds, plant protection chemicals, fertilizers, market pricing, digital payments etc. [22].

4.4. Market Linkages, Contract Farming and Farmer Producer Organizations (FPO): A good market linkage is essential for farmers to gain competitive advantage in the market. For instance, traditionally farmers have consistently faced decrease in prices of their produce, owing to poor market linkages coupled with the involvement of middlemen and traders, who virtually reduced the margin pie of

farmers. The advantage of opening-up market linkages for farmers is to ensure that local farmers will be able to participate and sell more competitively and realize

SECTOR	INITIATIVES	DESCRIPTION
GOVERNMENT	**AGRISNET**	Block level network to facilitate agricultural officers, agri extension workers and other agribusiness related developments
	AGMARKNET	Provide information on daily arrivals & prices across APMC markets
NON-GOVERNMENT	**DIGITAL GREEN**	Agri information is disseminated through digital video for farmers eg. TV, Laptop etc.
PRIVATE	**e-CHOUPAL**	An initiative by ITC. Provide a one-stop solution to farmers on agri practices, inputs, weather data, sales, prices etc., at village level.

Table: 3 ICT initiatives in Indian Agriculture[Source:20]

better prices for their farm produce. Such opening-up of market linkages through the Prime Minister's recent *Athmanirbar Bharat* scheme reduces the activity of middlemen and provide free access to farmers to sell outside APMC markets, have tie-ups with FPO, and also enter into contract farming agreements.

4.4. Fintech Platform and e-Mobile in Agriculture for farmers: Application of Fintech platform enable farmer to digitally connect and access information on financial, agricultural services, and other government related schemes and details about crops and crop cycle etc. For example, facilities such as `Kisan Credit Cards' and `e-payment' enable farmers to avail direct and convenient money transfers, mobile bill payments, mobile wallets and so on. Likewise, usage of e-Mobiles serves as a platform for transmitting information via SMS real time crop advisory updates, timely weather data, market prices across agricultural markets, and information on latest agri news to farmers.

4.5. Agrepreneurship through Agriclinics and Agribusiness Centers: Entrepreneurship is reported as an important strategy for employment generation and a 1% increase in entrepreneurial activity is expected to reduce poverty to an extent of 2% [23]. Also, agripreneurship development in rural areas will enable better employment opportunities for youths, particularly from the point of view of promotion of Micro, Small, and Medium Enterprises (MSME). In this regard, imparting hands-on training for agricultural graduates and other rural youths to enable them to set-up their own agriclinics and agribusiness centers in rural areas for self-employment will improve income generation as well as reduce unemployment. For example, organizations such as NABARD, MANAGE, and SFAC are engaged actively in imparting training on extension activities leading to self-employment and funding for youths who are interested to set-up their own centers, offering a `one-stop' solution to farmers.

4.6. **Agri Start-ups**: Agri Start-ups are the latest, meaningful technological solutions for offering solutions in the agri value chain. The Start-up technology can be in the form of a product, service, or an application [24]. Start-ups are in different sectors such as Supply Chain (Listing platforms, e-distributor), infrastructure (drip irrigation systems, agri components), finance (e-payments, lending), farm data analytics (remote sensing software, farm management solutions), and information platforms (information

dissemination). A list of successful agri Start-ups is provided in Table 4.

Name of Start-up	Year	Location	Technology Used	Objectives
CROPIN	2010	Bengaluru	Big data, AI, RS	Traceability, Value/ac
CHERUVU	2014	Hyderabad	Machine Learning	Sustainability of Farmers
KHEYTI	2015	Hyderabad	Green House cultivation	Low-cost solutions
NINJAKART	2015	Bengaluru	B2B, e-Commerce	Efficient SCM
DRONE	2017	Bengaluru	Robotics, Mapping Tech.	Mapping technology
FASA	2018	Bengaluru	AI, IoT, Machine Learning	Increase Income of farmers

Table: 4 List of successful Agri Start-up's in India

In March 2015, under the Make in India programme, the MSME Ministry launched `A Scheme for Promotion for Innovation, Rural Industry & Entrepreneurship (ASPIRE), an initiative with the objective of improving the network and incubation centers to accelerate, innovation and entrepreneurship, in agro industry [13].

4.6. Post-harvest Storage Technology: Post-harvest storage facility is one of the new and emerging areas of investment and employment opportunities for aspiring agripreneurs. Setting up of modern infrastructures for storage of fresh fruits and vegetables eg. Cold chains help to preserve and protect harvested crops from quality deterioration and retain their marketable value. Cold chains are part of the value chain and consist of a series of hi-tech technology involving controlled temperature, humidity, storage and logistics, from the point of production to consumption ie; *farm to fork* [26]. Likewise, setting up of facilities for the preservation and storage of seeds eg. Germplasm, Foundation seeds, commercial seeds etc., in a well-protected and controlled environment, to retain its viability and germination percentage, particularly during seasonal failure is another emerging investment opportunity for young agripreneurs. Proper seed storage also helps conserve and preserve the genetic potentials of important traditional crop varieties, which are in the verge of extinction.

5. Conclusion

The adoption of disruptive innovative practices along with Agripreneurship will help to create a new normal, paradigm shift from the present subsistence cultivation to commercial precision farming which not only increases the income and profitability of farmers but also enhance the value for all the stakeholders who are involved in agricultural operations. Further, for success and sustainability it is imperative to reduce the gap in value chain and improve connectivity to remain closer to the needs of farmers. There is a need for the present talented pool of young entrepreneurs to seriously pursue agriculture as a business venture and come out with a mix of viable technological ideas to solve problems and increase the income security of farmers (*Make in India campaign*). Also, for a sustainable development of Agriperneurs, a robust Industry-Academic-Government partnership and investments are needed.

References

1. IAAIR 2020. Indian Agriculture and Allied Industry Report, May, 2020. www.ibef.org
2. Ominivore. (2020). Vision 2030 Report. *www.ominivore.vc*.

3. Schumpeter, J. A (2000) Entrepreneurship as Innovation. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference In Entrepreneurship, Available at SSRN: https://ssrn.com/abstract=1512266.
4. Firlej, K. (2001). Konferenja Navukowa, Karkow (English Abstract).
5. FAO.(2012). Entrepreneurship in Farming, Rome Stenholm, P & Hytti, U. (2014). In search of legitimacy under institutional pressures: A case Study of producer and entrepreneur farmer identities. *Journal of Rural Studies*, 35,133-142.
6. Bairwa, S.L, Lakra, K, Kushwaha, S, Meena, L.K, & Kumar, P. (2014). Agripreneurship Development as a tool to upliftment of agriculture. International Journal of Scientific and Research Publications, 4, pp 1-4.
7. Lans, T, Seuneke, P & Klerlox, L. (2013). Agricultural Entreprneurship. In: Carayannis, E.G (ed.) Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship. Springer, New York, pp 44-49.
8. Faria, J.R & Mixon, Jr.G. (2016). Farmer-Entrepreneur, Agricultural Innovation and Explosive Research and Development.
9. Prahalad, C.K & Stuart, L.H. (2002). Future at the bottom of the Pyramid. *Strategy+Business*. Vol 26.
10. Willer, H, Lernoud, J & Kilcher, L.(2013). The World of organic agriculture. Statistics and Emerging Trends 2013. Research Institute of Organic Agriculture (FIBL) & Bonn International Federation of Organic Agriculture Movements (IFOAM), Frick, Switzerland.
11. Ferris, S & Geyer, L. (2016). Agricultural Entrepreneurship. In, ` Global Forum for Rural Advisory Services' (GFRAS), Ed. Caryer O'Mahoney, pp 261.
12. Singh, R.B. (2019). Agricultural Transformation – A Roadmap to New India. National Academy of Agricultural Sciences (NAAS), New Delhi.
13. Raman, K, Rani, J & Krishnapriya, V. (2019.) Agripreneurship Behaviour of small organic vegetable growers, in India. Restaurant *Business*, 118(1), pp 48-56.
14. Misra, S & Kumar, S.E. (2000). Resourcefulness: A Proximal Conceptualization of Entrepreneurial Behaviour. *The Journal of Entreprneurship*. 9(2), pp 135-154.
15. Sullivan, P. (2017). Agri-entrepreneurs and Their Characteristics. In, `Enabling Agri-entrepreneurship and Innovation- Empirical Evidence and Solutions for Conflict Regions and Transforming Economies (eds. Chan et al.).
16. Dejardin, M, Nizet, J & Dam, D.V. (2015). Entrepreneurial functions by Organic Farmers. In, P Kyro (ed.), The Handbook of Entrepreneurship and Sustainable Development Research. Chetenham, Edward Elgar Pub. Ltd., pp 392-401
17. FACE. (2020). Food and Agriculture Centre Excellence)- Advanced Technologies Reshaping Indian. Agriculture – Technology Led Resilience for Aatmanirbhar Bharat. White Paper: 1, Digital Agriculture. CII. Cycles. Adm. Sci., 6(13), pp 2-11.
18. McKinsey Report. (2018). Harvesting Golden Opportunities in Indian Agriculture – Focus food Security to farmers' income security by 2025.July 2018. www.mckinsey.*com*.
19. Shalendra, K.C, Gummagolmath, & Sharma P. (2011). ICT Initiatives in Agriculture – An Overview. *Ind. Jn.of Agri. Econ*. 66(3). Pp 489-496.
20. Goedde, L, Katz, J., Menard, A & Revellat, J. (2020). Agriculture's connected further: How technology can yield new growth. Mckinsey & Company, Dec 9th, 2020.

21. Mitchell, C, Sehgal, S, Chopra, P & Mathur, H. (2018). Indian Farming: Next Big Moment- Farming as a Service. *www.bain.com*
22. Singh, M.P. (2014). Entrepreneur and Economic Development: A study of role of various forms of entrepreneurs in economic development. *Global Journal of Multidisciplinary Studies*. 3(5), pp 26.
23. Anand, A & Raj, S. (2019). Agri Startups: The Ray of Hope in Indian Agriculture. MANAGE. Discussion Paper No. 10, Hyderabad. pp 120.
24. FICCI Report. (2018). Agri start-ups: Innovation for boosting the future of agriculture in India, November 2018, pp 30.
25. Negi, S & Anand, N. (2015). Issues and Challenges in the supply chain of fruits & Vegetables sector in India: A Review. International Journal of Managing Value and Supply Chain. 6(2), pp 47-62.