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Agricultural Development and Digitization – An Exploratory Study of Adoption of Technology from a Farmers Producers Organization Perspective

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***Abstract*: When all the sectors of the economy registered negative growth during the last 3 years owing to the pandemic, the agriculture sector was the only sector that continued growing positively. This growth underlined the vital role that agriculture plays in overall economic development of the country. Farmers Producers Organizations played a significant role in facilitating this growth as they established a direct connection with the customers leveraging on diversified tools of technology. Platform of Farmers Producers Organizations (FPOs) were put into service to mend the fractured supply lines and they were given exposure to outreach of technology to address their extension related matters and product marketing. With the advent of the FPOs during the last decade or so, an awareness is created about leveraging technology and automating the process at the farmers' level to optimize capacity utilization and facilitate improvement of processes at the field level. Adoption of technology not only facilitates enhanced output, it also trims down the input cost, thereby increasing profit in the hands of the farmers. For Small and Marginal Farmers (SMF), pooling of agricultural technical innovations helps him cut down his input and marketing cost and obtain a better price realization. Faster adoption of technology by SMF would provide better price realization and qualitative enhancement in the value chain. Three critical components- manpower, capital and weather advisory of agriculture can be better managed with technological advances in the field.**

***Keywords*: DESAI (Diploma in Agriculture Extension Services for Input Dealers), Doubling Farmers' Income (DFI), Farmers Producers Organizations (FPOs), IoT (Internet of Things), National Commodity & Derivatives Exchange Limited (NCDEX), National Agricultural Market E-NAM, POPI (Producer Organization Promoting Institutions), Ram Rahim Pragati Producers Company Limited (RRPPCL), Rashtriya e-Market Services (ReMS), Small and Marginal Farmers (SMF), Unified Marketing Platform (UMP).**

1. Introduction

Until the time physical markets were operating, adoption of technology by the FPOs was evolving. Evolution gathered pace, when the country went into a lockdown mode arising out of pandemic and all the operations came to a standstill. SMFs had a reluctance in coming to a digital platform, but it was expedited after the lockdown when the inventories were not moving initially and subsequently a market emerged for specialized produce. Value chain underwent a transformation and the major players in the value chain (SMF) started adopting outreach of technology to reach out to the consumers and also ensure better inventory management. In the nascent state of their operations, FPOs were given exposure to technical support in the form of extension services through mobile-based applications and its outreach encouraged FPOs to adopt technologies on a wider canvas. Exposure to technology and through its usage, members of the FPC are now able to interact with the government officials in a seamless manner. Exposure to different forms of technology for the members of FPO has facilitated the creation of strong community institutions and qualitative human capital. For the women farmers' interface with technology in the form of Video Conferencing has provided them opportunities to learn about farm assets and skills and after forming Women FPOs they have adopted electronic trading of commodities through National Agricultural Market E-NAM. In the present context in which transformation is going on in the economy, it is worth underlining that the Doubling Farmers' Income (DFI) committee also pointed out that the FPO model has the potential to give a different dimension to farming as also agriculture.

2. Literature Review

One of the key objectives of formation of FPOs has been to develop capabilities in the members of the FPOs to start trading of the commodities on their own and to leverage technology platforms and associate with future trade to have better price realization. In a study undertaken by ICRIER to understand the level of association of FPOs in the Future Markets of India, it was found that the association of FPOs with the future trade between 2016-2018 was only 0.0004 %. In absolute terms for the overall agri-trade of Rs. 417.4 billion in National Commodity & Derivatives Exchange Limited (NCDEX) in May 2018, only Rs. 19.4 million came from FPO trade. The study pointed out that FPOs are uniquely positioned to take advantage by associating with the futures market as they can procure, aggregate and maintain standards of the commodities

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for future trade. The study further underlines the potential of FPOs to associate with future markets, as there is an urgent requirement for introducing forward looking cropping patterns, as it would have an impact on the planting decisions to be undertaken by the farmers based on the future's prices rather than prices of preceding years. (Tirtha Chatterjee et. al, 2019)

Ram Rahim Pragati Producers Company Limited (RRPPCL), an all-Woman FPO and having tribal women as members is India's first FPO to be enlisted on NCDEX and paved the way for other Women FPOs to associate with NCDEX. Increasing participation of Women FPOs in the commodities trade has the potential for women FPO members to register themselves in the land records at the local level and carve an identity of their own as farmers having access and control over local resources. Registration of names in land records is a way forward for women empowerment as in the initial stages when RRPPCL tried to initiate trade it met with stiff resistance from intermediaries who opposed women's entry in trading, as they were not primary producers. (Access Development Services Annual Report 2019).

A new perspective is added to the FPO research by trying to understand the dynamics of socially responsible supply networks in operations management, an area still in its infancy through study of Harrington et., al. This paper has tried to study the socially responsible behavior of the FPOs factoring in the premise of societal needs, social impacts, and the manner in which the FPOs behave strategically to such societal requirements. A new area of approach has been adopted which is the need of the hour as the societal pressures are a veritable template through which SMFs conduct their business and day-to-day life. The paper has argued that pressure at the societal level accentuates complexities and throws up ambiguous challenges in functioning of the FPOs that could have an overriding bearing on environmental and supply chain management processes. Social disruption is an unintended consequence being focused upon as aggregation in the form of FPOs is having a bearing on the established dynamics at the rural level, specifically the moneylenders and the individual input suppliers and the individual buyers. Factoring in the previous research undertaken on multi-organisational network concepts of operation and supply network stages of emergence in technology commercialization, the paper has argued for creation of a Socially Responsible Supply Network Framework at the institutional level that would execute the following: (i). Capacity building promotion across FPO frameworks, (ii) Facilitate setting up of linkage between FPOs Networks and Markets, (iii) hand-hold technological adoption matrix and (iv) create a new design template for FPOs which would look into standardizing FPO matrix. (Harrington, et all, 2019)

McKinsey in a study has documented in detail how digital innovation is transforming agriculture in India. The report points out that with adoption of digital technologies Indian agriculture is now moving towards "income revolution", which can capture the entire value chain for the farmer and enhance his income. The paper advocates leveraging digital technologies to enhance productivity and release land for growing high value crops like fruits and vegetables and for dairy. To achieve it, extension has to incorporate digital tools and connectivity to facilitate extension advisory in real-time at the doorstep of farmers. Digital technologies have the potential to trigger a paradigm shift in Indian agriculture from being production centric to being income centric. A simple mobile phone has transformed marketing of products and now the growers are searching for better price realization of their products leveraging mobile phones. FPOs are growing incrementally at the rate of 18% per year. Usage of digital technologies has injected transparency arising as a by-product of aggregation. Mechanics of aggregation is now shared through digital platforms and all data is shared among all the members of the group(s). According to the report now, about 30% of the produce of the FPOs is sold through digital platforms. Digitisation of agriculture has the potential to make agriculture attractive for a very large segment of the population as digitisation brings value to agriculture, hitherto unexplored or unrealized. Traceability is one of the ingredients of value added to the agriculture construct for the growers in particular the FPOs. With other sectors of the economy flattening out as far as making a business proposition is concerned, it is agriculture, which is going to provide a win-win situation for all the stakeholders. Precision technologies have the potential to increase efficiencies and provide better return to the farmers. The challenge to adoption is customisation of the application base, specifically in the local languages for an average farmer to use it and this has a cost associated with it. (Boettiger et. al McKinsey, May 22, 2019).

Centre for Sustainable Development, Columbia University in a working paper underlined that digital agriculture has the potential to increase efficiencies in agriculture and enhance income from agriculture globally. The study has advocated about harnessing the power of Farmers Collective to ensure success of Digital Agriculture in India. Adoption of digital technology would have a multiplier effect on the complete value chain. From IOT (Internet of Things) associated implements and sensors that capture data and image recognition technologies that facilitate assaying, grading and sorting to gene sequencing in seed production, deployment of such array of technologies would facilitate digitisation at a faster pace. As all the processes entailed require management at the aggregate level and are nearly impossible to execute at the individual level, an aggregate mass to implement these new forms of technology is available only through the FPOs. The paper has detailed different kinds of digital tools for agriculture and the manner in which it can be adopted. The challenges for implementation of digital technologies emanate from the comparative farm size between the USA and in India. In India, the average farm size is about 1 hectare, in the USA, it is 179 hectares, in Australia, it is 4331 hectares, and in Europe, it is 16.1 hectare. The deployment of technology using Artificial Intelligence has a cost and the data management from the kind of technology used is a challenge in implementation of Digital technologies on a wider scale. Factoring in the challenge emanating from the cost component of digital technologies, the paper has suggested for customisation of the technologies suited to Indian ground realities. For it to be successful the

implementers need to focus upon low cost technology, ease of portability of the hardware, setting up a digital platform for sharing farm machinery and agriculture equipment, and policy initiatives in sync with digital technologies. A case in point illustrated is that of Aadhar based data by "Rythu Bandhu" a digital platform for regulated agriculture leveraging on Aadhar enabled data. Through this initiative, the government of Telangana has proposed to introduce a regulated crop environment based on inputs like supply, demand and price at the time of harvest. Overall opportunities for expansion of digital technologies hinge on upstream (input and production processes) and downstream (post-harvest and value addition) which can only be channelized through the FPOs. Through the platform of FPOs, innovative technologies can be made available to the farmers even having the smallest denomination of the land. (Beriya, Columbia University, CSD, 2020).

Arguably, the oldest industry of civilization, agriculture is experiencing winds of change in its circle of life. It is now at the technological crossroads. The navigation of the technological crossroads if done successfully would be able to handle increasing demands and disruptive trends. Upstream and downstream connectivity in a seamless manner is the need of the hour. Connectivity is vital, as it would lead to structured crop monitoring, monitoring of warehouse and equipment for inventory management, farming by drone and livestock monitoring, all these four components are matters of vital concern for the FPOs to grow and for them, and therefore, adopting connectivity is of vital importance. The challenge is huge and there is $500 billion at stake. Transformation of the world's oldest industry can be accomplished when FPOs adopt the mechanics of connectivity. (Goedde, et al. Agriculture's connected future: How Technology can yield new growth, McKinsey October 09, 2020)

It is the rising investor interest and the affordability of technologies, which is leading the digital revolution in India. Cost, quality and reliability of the produce are the three aspects, which SMFs struggle with, and the adoption of technologies through the platform of FPOs has the potential to bring down costs both upstream and downstream), facilitate adoption of quality parameters and also present a reliable platform to compete in the market. By adoption of technology in the operations, the voluminous data so generated has the potential to facilitate real-time insights about farming to farmers, help faster decision-making, yield improvement by cutting down production costs. Start-ups in the rural development space have an opportunity to provide solutions that are affordable, and scalable to other developed and developing geographies. 3Is-Investment, Innovation and Infrastructure have the potential to bring India at par with the global leaders in agriculture and FPOs are in a definitive advantageous position to do so. (Maitra et al, Arthur DeLittle, August, 2021).

A joint initiative between NABCONS (Nabard Consultancy Services) and CII came out with a case study of 25 successful FPOs from different parts of the country. The report underlined that in the business planning of the technology platforms FPOs are given a role of eminence for diversification of economy and is facilitating in creation of islands of excellence, which need to be shared for broad banding. Adoption of technology at the FPO level would facilitate the advancement of skill sets and contemporary management practices, which will help in taking a leap for FPOs to evolve as a structured apparatus with backward and forward integration. Deployment of a digital is the way forward for the FPO at all levels of business activities that they are engaged in and being planned for the future. Adoption of technology would facilitate the introduction of traceability of agricultural produce, which has become an element of eminence in post-Covid scenario. As per the report, the Godavari Valley Farmers Producers Company Limited from Hingoli in Maharashtra was able to have a turnover of Rs.10 crores within the very first year of its inception. This result was facilitated because of the adoption of trading through NCDEX. The FPC scouts for buyers on the platform and then shares the requirements with the sellers. As the demand is coming through the platform of NCDEX, an awareness about quality, grading and sorting is created and it helped in having a turnover of Rs. 10 crores. Having established its equity through NCDEX, the FPC has now ventured into exports. (CII-NABCONS FPO Report, 2022)

A Manage discussion paper has highlighted how the DESAI (Diploma in Agriculture Extension Services for Input Dealers) have silently enabled the farmers to overcome the supply chain disruptions resulting from the lockdown in different parts of Karnataka. EAS (Extension Advisory Services) were severely impaired and the service provided by DESAI threw up an opportunity to enhance and strengthen this node of the value chain. DESAI provided three kinds of EAS- field extension, market extension and virtual extension. During the lockdown, it was the virtual extension, which emerged as the binding link for the farmer with the extension advisory. While the farmers raised their concerns through the phone, members of DESAI provided the help through WhatsApp in the form of supporting pictures and videos. The DESAI were also able to link through the FPOs and FPCs to provide extension advisory from one-point source to all the members in one go rather than undertaking the same with individual farmers and underlines how extension has the potential to change farming dynamics if it is able to progressively associate with the FPOs. These para extension workers trained through DESAI need mainstreaming into the existing extension services. It would help in a new extension paradigm, which would be a complementary apparatus between the public extension and the EAS through DESAI. This study has policy implications and the government may take up this initiative for implementation all across the country to strengthen the extension services in different parts of the county. (Manage Discussion Paper-2 Extension advisory services during COVID-19 - A case of DAESI input dealers from Karnataka state:2020). Incidentally the same kind of model was implemented in 24 South Parganas by KVK South, 24 Parganas. (Rai, Impact of Covid 19 Pandemic of Indian Agriculture- A Case Study of Karnataka from a FPO Perspective, IJRAR, July 2018, Vol-5, Issue No. 3).

Table 1
Technology adopted by Farmers Producer Companies of Karnataka - A Sample Study of 100 FPOs

S.No.	Name of the FPO	District	Accounting software	Marketing software
1	Bagalkote Raithara FPCL (F)	Baglakote	Tally ERP 9	Nil
2	K-Melkunda FPCL	Bidar	Nil	Nil
3	Shri Amoghsiddeshwara FPCL	Bijapur	Vyapar	Vyapar
4	Itkal FPCL	Gulbarga	Nil	Nil
5	Bhoosiri FPCL	Haveri	Nil	Nil
6	Medhini FPCL	Haveri	MIFOS /FINNOVA	Nil
7	Kolaramma FPO	Kolar	Nil	Nil
8	Mudigyaneshwara FPCL	Raichur	Nil	Nil
9	Swastya FPCL	Raichur	IFPO /Vyapar	IFPO /Vyapar
10	Divyajyothi Maribasavalingeshwar FPCL	Raichur	Nil	Nil
11	Benagal FPO	Udupi	Nil	Nil
12	Bhoomathe Kalanjiam Jeevidham FPCL	Kalaburagi	Nil	Nil
13	Afzalpur Producer Company Limited	Kalaburagi	Nil	Nil
14	Panchalingeshwar FPC, Belagavi	Belagavi	Nil	Nil
15	Mahant Farmer Producer Company Limited, Belagavi	Belagavi	Nil	Nil
16	Somalingeshwar Farmer Producer Co.Ltd, Belagavi	Gadag	Nil	Nil
17	Sri Basaveshwara FarmerProducer Organisation, Belagavi	Belagavi	Nil	Nil
18	Magadi FPCL, Mandya district	Ramanagar	ifpo	Nil
19	Kampu Agriculture Horticulture Crop Producer Co.Ltd,	Dakshina Kannada	ifpo	Nil
20	Basavasagar Producer Company Limited	Raichur	Tally ERP 9	Nil
21	Bettageri Bhuvanmitra FPCL, Belagavi District	Belagavi	Nil	Nil
22	Bhuvanamandara Farmers Producer Company Limited	Kodagu	Tally ERP 9	Nil
23	Chittapur Kalanjia Jeevidham Pcl	Kalaburagi	Nil	Nil
24	Bhumivadaya Farmers Producer Company Limited	chikkamagalur	Nil	Nil
25	Rann Farmer Producer Company Limited	bagalkote	Vyapar	vyapar
26	Nagamangala Farmer Producer Company Limited	Mandya	Samundra Networks & Tally	Samundra Networks
27	Nidagal Farmers Producer Company Limited	Tumkur	Nil	Nil
28	Suvarnamukhi Sauharda Sahakari Niyamita	Tumkur	IFPO/ POS machine	Nil
29	Raita Mitra Farmer Producer Company Limited	Belagavi	Nil	Nil
30	KrushikMitra Farmers Producer Company Limited	Belagavi	Nil	Nil

S.No.	Name of the FPO	Extension software	other technology	Women FPO
1	Bagalkote Raithara FPCL (F)	Nil	Nil	No
2	K-Melkunda FPCL	Nil	Nil	No
3	Shri Amoghsiddeshwara FPCL	Vyapar	Nil	No
4	Itkal FPCL	Nil	Nil	No
5	Bhoosiri FPCL	Nil	Nil	No
6	Medhini FPCL	Nil	Soil testing - Krishitantra	No
7	Kolaramma FPO	Nil	Nil	No
8	Mudigyaneshwara FPCL	Nil	Nil	No
9	Swastya FPCL	IFPO /Vyapar	Nil	No
10	Divyajyothi Maribasavalingeshwar FPCL	Nil	Nil	No
11	Benagal FPO	Nil	Nil	No
12	Bhoomathe Kalanjiam Jeevidham FPCL	Nil	Nil	Yes-100%
13	Afzalpur Producer Company Limited	Nil	Nil	Yes-100%
14	Panchalingeshwar FPC, Belagavi	Nil	Nil	No
15	Mahant Farmer Producer Company Limited, Belagavi	Nil	Nil	No
16	Somalingeshwar Farmer Producer Co.Ltd, Belagavi	Nil	Nil	No
17	Sri Basaveshwara FarmerProducer Organisation, Belagavi	Nil	Nil	No
18	Magadi FPCL, Mandya district	Nil	Nil	No
19	Kampu Agriculture Horticulture Crop Producer Co.Ltd,	Nil	Nil	No
20	Basavasagar Producer Company Limited	Nil	Nil	No
21	Bettageri Bhuvanmitra FPCL, Belagavi District	Nil	Nil	No
22	Bhuvanamandara Farmers Producer Company Limited	Nil	Nil	No
23	Chittapur Kalanjia Jeevidham Pcl	Nil	Nil	Yes-100%
24	Bhumivadaya Farmers Producer Company Limited	Nil	Nil	No
25	Rann Farmer Producer Company Limited	Nil	Nil	No
26	Nagamangala Farmer Producer Company Limited	Samundra Networks	Nil	No
27	Nidagal Farmers Producer Company Limited	Nil	Nil	No
28	Suvarnamukhi Sauharda Sahakari Niyamita	Nil	Nil	No
29	Raita Mitra Farmer Producer Company Limited	Nil	Nil	No
30	KrushikMitra Farmers Producer Company Limited	Nil	Nil	No

30	KrushikMitra Farmers Producer Company Limited	Belagavi	Nil	Nil
31	Chennakeshvaswamy FPCL	Chikkaballapur	Nil	Nil
32	Pragathi	Chamarajnagar	Nil	Nil
33	Hasiru	Chamarajnagar	Nil	Nil
34	Hasanamba	Hassan	Nil	Nil
35	Maravalli	Shimoga	Nil	Nil
36	Attibylu	Shimoga	Nil	Nil
37	Jogadasiri FPCL, Davangere	Shimoga	Nil	Nil
38	Kallukoppa FPCL, Shivamogga	Shimoga	Nil	Nil
39	Harogoppa FPCL, Shivamogga	Shimoga	IFPO	Nil
40	Tumkur Organic Producer Company Limited, Tumkur	Tumkur	Nil	Nil
41	Kalmeshwara Farmers Producer Company Limited,	Dharwad	Tally ERP 9	Nil
42	Putari Farmers Producer Company Limited, Kodagu	Coorg	Tally ERP 9/ IFPO	Nil
43	Sedam Kalanjia Jeevidham FPC, Kalaburagi	Kalaburagi	Nil	Nil
44	Bhoomika Krushi Uthpadakara Sauharda Sahakara Niyamitha	Haveri	Nil	Nil
45	Sri Annapoorneshwari Farmer Producer Company Limited	Chikkamagalur	IFPO	Nil
46	Huthridurga Farmers Producer Company Limited, Tumkur district	Tumkur	Samundra Networks & Tally	Samundra Networks
47	Huliyurdurga Farmers Producer Company Limited, Tumkur district	Tumkur	Samundra Networks & Tally	Samundra Networks
48	Pragathimitra North Kanara FPCL	Uttara Kannada	Tally ERP 9/ IFPO	Nil
49	Channakeshava FPCL	Mandya	Nil	Nil
50	Bhoomata Krushi Belegarara Souharda Sahakari Niyamita	Hassan	Nil	Nil
51	Malli FPCL	Gulbarga	Nil	Nil
52	Ijeri FPCL	Gulbarga	Nil	Nil
53	KSHEMALINGEASHWARA Agro Producer Company Limited	Gulbarga	Nil	Nil
54	Sri Mouneshwara Krushi Uthpanna sahakara Sangha Niyamita	Yadgir	Nil	Nil
55	Kasthurirangappa HSSSPS	Tumkur	Nil	Nil
56	Swawalambhi KrushiUthpadakara Abhivruddhi Samsthe	Tumkur District	Nil	Nil
57	Niranthara FPCL	Chamarajnagar	Nil	Nil
58	Econut FPCL	Mysore	Econut app- customised	Nil
59	Ramapura FPCL	Chamarajnagar	Nil	Nil
60	Gurumatkal PCL	Yadgir	Nil	Nil
61	Bidar Horticulture Farmer Producer Company Limited	Bidar	Tally ERP-9/ Vyapar	Vyapar
62	Shanthi Sagara HFPCL	Davanagere	Tally ERP-9	Nil
63	Vanivilasa HFPCL	Chitradurga	Tally ERP-9	Nil

30	KrushikMitra Farmers Producer Company Limited	Nil	Nil	No
31	Chennakeshvaswamy FPCL	Nil	Nil	No
32	Pragathi	Nil	Nil	No
33	Hasiru	Nil	Nil	No
34	Hasanamba	Nil	Nil	No
35	Maravalli	Nil	Nil	No
36	Attibylu	Nil	Nil	No
37	Jogadasiri FPCL, Davangere	Nil	Nil	No
38	Kallukoppa FPCL, Shivamogga	Nil	Nil	No
39	Harogoppa FPCL, Shivamogga	Nil	Nil	No
40	Tumkur Organic Producer Company Limited, Tumkur	Nil	Nil	No
41	Kalmeshwara Farmers Producer Company Limited,	Nil	Soil testing Lab- Krishitantra	No
42	Putari Farmers Producer Company Limited, Kodagu	Nil	Nil	Yes-100%
43	Sedam Kalanjia Jeevidham FPC, Kalaburagi	Nil	Nil	Yes-100%
44	Bhoomika Krushi Uthpadakara Sauharda Sahakara Niyamitha	Nil	Nil	No
45	Sri Annapoorneshwari Farmer Producer Company Limited	Nil	Nil	No
46	Huthridurga Farmers Producer Company Limited, Tumkur district	Samundra Networks	Nil	No
47	Huliyurdurga Farmers Producer Company Limited, Tumkur district	Samundra Networks	Nil	No
48	Pragathimitra North Kanara FPCL	Nil	Nil	No
49	Channakeshava FPCL	Nil	Nil	No
50	Bhoomata Krushi Belegarara Souharda Sahakari Niyamita	Nil	Nil	No
51	Malli FPCL	Nil	Nil	No
52	Ijeri FPCL	Nil	Nil	No
53	KSHEMALINGEASHWARA Agro Producer Company Limited	Nil	Nil	No
54	Sri Mouneshwara Krushi Uthpanna sahakara Sangha Niyamita	Nil	Nil	No
55	Kasthurirangappa HSSSPS	Nil	Nil	No
56	Swawalambhi KrushiUthpadakara Abhivruddhi Samsthe	Nil	Nil	No
57	Niranthara FPCL	Nil	Nil	No
58	Econut FPCL	Nil	Nil	No
59	Ramapura FPCL	Nil	Nil	No
60	Gurumatkal PCL	Nil	Soil testing - Krishitantra	No
61	Bidar Horticulture Farmer Producer Company Limited	Nil	Nil	No
62	Shanthi Sagara HFPCL	Nil	Nil	No
63	Vanivilasa HFPCL	Nil	Nil	No

64	Kollegala HFPCL	Chamarajnagar	Tally ERP-9	Nil
65	Hemavathi HFPCL	Tumkur	Tally ERP-9	Nil
66	Hebburu HFPCL	Tumkur	Tally ERP-9	Nil
67	Rajaghatta HFPCL	Bengaluru Rural	Tally ERP-9	Nil
68	Anekal HPCL	Bengaluru Urban	Tally ERP-9	Nil
69	Moodalagiri HFPCL	Kolar	Tally ERP-9	Nil
70	Sadaliamma Horticulture Farmers Producer Company Limited	Chikkaballapur	Tally ERP-9	Nil
71	Shri Ramalingeshwara Horticulture Farmers Producer Company Limited	Chitradurga	Tally ERP-9	Nil
72	Bidar Krushika FPCL	Bidar	Tally ERP-9	Nil
73	Navnutan Farmers Producer Company Limited	Belagavi	Tally ERP-9	Nil
74	Hirodeshwara Farmers Producer Company Limited	Kalaburagi	Tally ERP-9	Nil
75	Sahaja Samrudhha OPCL	Bangalore	Tally ERP-9	Nil
76	Sahayoga Suvidha FPCL	Bidar	Nil	Nil
77	Chilume FPCL, Tumkur	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
78	Dharithri FPCL, Haveri	Haveri	Samundra Networks & Tally	Samundra Networks & Tally
79	Rayabagh FPCL, Belagavi	Belagavi	Samundra Networks & Tally	Samundra Networks & Tally
80	Haveri FPCL,Haveri	Haveri	Samundra Networks & Tally	Samundra Networks & Tally
81	Sri Venugopalaswamy HFPCL, Bengaluru Rural	Bengaluru Rural	Tally ERP-9	Nil
82	PragathimitraSauharda Sahakari Niyamita, Uttara Kannada	Uttara Kannada	Tally ERP-9	Nil
83	RaithaSpoorthy FPC, Belagavi	Belagavi	Tally ERP-9	Nil
84	Honnakere Horticulture FPCL, Karnataka	Karnataka	Tally ERP-9	Nil
85	Gramachetana FPO, Bagalkote	Bagalkote	Tally ERP-9	Nil
86	Beleric FPCL, Bagalkote	Bagalkote	Tally ERP-9	Nil
87	Nitturu Farmer Producer Company Limited	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
88	Cspura Farmers Producer Company Limited	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
89	Gubbi Chennabasaveshwara Farmers Producer Company Limited	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
90	Chelur Hagalavadi Farmers Producer Company Limited	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
91	Davangere & Chitradurga Districts Regional Cooperative Organic Farmers Associations Federation Limited	Davangere	Tally ERP-9	Nil
92	Negilamidita Farmers Producer Company Limited	Bagalkote	Nil	Nil
93	Ektha Apparels producer Co	Bangalore	Nil	Nil
94	Amruthur FPCL	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
95	Sujeevana FPCL	Tumkur	Samundra Networks & Tally	Samundra Networks & Tally
96	Madhyakarnataka	Davangere	Nil	Nil

64	Kollegala HFPCL	Nil	Nil	No
65	Hemavathi HFPCL	Nil	Nil	No
66	Hebburu HFPCL	Nil	Nil	No
67	Rajaghatta HFPCL	Nil	Nil	No
68	Anekal HPCL	Nil	Nil	No
69	Moodalagiri HFPCL	Nil	Nil	No
70	Sadaliamma Horticulture Farmers Producer Company Limited	Nil	Nil	No
71	Shri Ramalingeshwara Horticulture Farmers Producer Company Limited	Nil	Nil	No
72	Bidar Krushika FPCL	Nil	Nil	No
73	Navnutan Farmers Producer Company Limited	Nil	Nil	No
74	Hirodeshwara Farmers Producer Company Limited	Nil	Nil	No
75	Sahaja Samrudhha OPCL	Nil	Nil	No
76	Sahayoga Suvidha FPCL	Nil	Nil	No
77	Chilume FPCL, Tumkur	Samundra Networks & Tally	Nil	No
78	Dharithri FPCL, Haveri	Samundra Networks & Tally	Nil	No
79	Rayabagh FPCL, Belagavi	Samundra Networks & Tally	Nil	No
80	Haveri FPCL,Haveri	Samundra Networks & Tally	Nil	Yes-100%
81	Sri Venugopalaswamy HFPCL, Bengaluru Rural	Nil	Nil	No
82	PragathimitraSauharda Sahakari Niyamita, Uttara Kannada	Nil	Nil	No
83	RaithaSpoorthy FPC, Belagavi	Nil	Nil	No
84	Honnakere Horticulture FPCL, Karnataka	Nil	Nil	No
85	Gramachetana FPO, Bagalkote	Nil	Nil	yes-100%
86	Beleric FPCL, Bagalkote	Nil	planning to purchase drone	No
87	Nitturu Farmer Producer Company Limited	Samundra Networks & Tally	Nil	No
88	Cspura Farmers Producer Company Limited	Samundra Networks & Tally	Nil	No
89	Gubbi Chennabasaveshwara Farmers Producer Company Limited	Samundra Networks & Tally	Nil	No
90	Chelur Hagalavadi Farmers Producer Company Limited	Samundra Networks & Tally	Nil	No
91	Davangere & Chitradurga Districts Regional Cooperative Organic Farmers Associations Federation Limited	Nil	Nil	No
92	Negilamidita Farmers Producer Company Limited	Nil	Nil	Yes-100%
93	Ektha Apparels producer Co	Nil	Nil	No
94	Amruthur FPCL	Samundra Networks & Tally	Nil	No
95	Sujeevana FPCL	Samundra Networks & Tally	Nil	No
96	Madhyakarnataka	Nil	Nil	No

97	Amaranarayana (Horti)	Chikkaballapura	Tally ERP-9	Nil
98	Jamkhandi Horti	Bagalakote	Tally ERP-9	Nil
99	Madakari Sauharda Sahakari	Tumkur	Tally ERP-9	Nil
100	Desi Seeds	Mysore	Tally ERP-9/ifpo	Nil
101	Kayaka Yogi HFPCL	Dharwad	Tally ERP-9	Nil
102	Sirigere HFPCL, Chitradurga	Chitradurga	Tally ERP-9	Nil
103	Shivamogga Thungabhadra HFPCL, Shivamogga	Shimoga	Tally ERP-9	Nil
104	Bangalore GreenKraft Producer Company Ltd	Bangalore	Tally ERP-9	Nil
105	Sasyashri Farmers Producer Co. Ltd	Bidar	Nil	Nil

97	Amaranarayana (Horti)	Nil	Nil	No
98	Jamkhandi Horti	Nil	Nil	No
99	Madakari Sauharda Sahakari	Nil	Nil	No
100	Desi Seeds	Nil	Nil	No
101	Kayaka Yogi HFPCL	Nil	Nil	No
102	Sirigere HFPCL, Chitradurga	Nil	Nil	No
103	Shivamogga Thungabhadra HFPCL, Shivamogga	Nil	Nil	No
104	Bangalore GreenKraft Producer Company Ltd	Nil	Nil	Yes-100%
105	Sasyashri Farmers Producer Co. Ltd	Nil	Nil	No

3. Materials and Methods

Secondary published data has been utilized for compilation of the paper. In addition, information from the FPOs has been collected on a sample basis from 100 FPOs to understand the levels of adoption of technology by the FPOs.

4. Result and Discussion

The primary reason for forming of the FPOs has been to encourage them to go for marketing of their produce on their own. The idea is to inculcate the sense of ownership among the farmers for the produce, which is produced by the sweat, and blood of the farmer. However, the value of marketing of the product was not ingrained in the farmers. In Punjab- the grain bowl of the country, there is a famous saying about produce-assi te sut aande hain i.e., we just dump it in the marketing yard. FPOs are a channel vehicle to change this mind-set. As a first step in this direction, eNAM had taken initiative to train the members of FPOs to associate with future trading of commodities.

Karnataka was the first state where Unified Marketing Platform (UMP) was launched in 2014 to facilitate the farmers to start trading through an online platform. An initiative of Rashtriya e-Market Services (ReMS), it is a joint venture between NCDEX e-Markets Limited and the Government of Karnataka. According to a study undertaken by Niti Aayog UMP in Karnataka, it facilitated 38% higher price realization for farmers in 2015-16 over 2013-14.

Subsequently in 2021 50 FPOs promoted by NABARD and the Government of Karnataka were on-boarded to ReMS and these FPOs are accessible to 44000 traders across 162 markets trading in agricultural commodities. Association through integration of technology has expanded the outreach of markets for farmers beyond their designated mandi limits.

E-NAM also undertook study of 3 all women FPOs FPOs from Bihar, Madhya Pradesh and Rajasthan (Aranyak Agri Producer Company (AAPCL) located in Purnea, Bihar, RRPCL, Dewas, MP and Samruddhi Mahila Crop Producer Company Limited, Rajasthan and found that the FPOs benefited by associating with the futures trade via the technology options opened through NCDEX. The encouragement to associate with future trade was facilitated through hand-holding of POPI (Producer Organization Promoting Institutions). It also underlines how women FPOs can benefit from future trading and by associating with trading can enhance their role in the agri-value chain. Creditably RRPPCL is India's first FPO to be enlisted on NCDEX and become a commodity market participant, setting an example for other small farmers to benefit from association with NCDEX.

Digitalisation challenges faced by agri stakeholders:

Agriculture is a key pillar of the Indian economy but continues to be beset with structural drawbacks. Average landholding size has declined from 1.15 hectares in 2010-11 to 1.08 hectares; with around 68 per cent marginal farmers and the value chain of most crops continues to consist of multiple intermediaries. While production and supply chain inefficiencies abound keeping farmers small and marginal, the nation is catching up with global trends of both consumption (organic, healthy, convenience) and calls for sustainability. There is an immediate need for disruption in the sector led by technology, as it has potential to solve problems of scale, reduce information asymmetry and allow for supply chain disintermediation to make farming more profitable, inclusive and equitable.

Around 1,000 start-ups have emerged in agri-tech with over $3 billion Private Equity (PE)/Venture Capital (VC) investment in the last 10 years. This enthusiasm has also captured attention of large players like Olam, which is adopting precision agriculture, digital warehousing and traceability. Agri-tech is emerging across the value chain with players in agri-finance like Samunnati creating networking and information dissemination platform for FPOs, CropIn providing precision farming through yield prediction, weather-input based advisory, AgNext & IntelloLabs providing value chain infrastructure innovation through visual sorting-grading, quality testing and AgriBazaar providing e-platform for output trading.

High tech Assaying Machines installed in eNAM mandis in Haryana and in Rajasthan have helped the farmers to obtain precision driven quality certificates for his/her produce and he is now in a position to share it with any buyer in any part of the country. (Source- e-NAM.gov.in)

However, the agri-tech space has not yet reached full potential with business models of players still under validation. Key challenges include limited funding for early-stage agri-tech firms, lack of structured data and access to it and limited adoption by farmers due to a fragmented customer base.

It is clear from the Table 1 of sample study of 100 FPOs of Karnataka that the first initiation of technology by the FPOs is for accounting operations. Few of the FPOs have adopted marketing software, extension software and soil sampling software as well.

5. Conclusion

Adoption of diversified options of technology by the FPOs has facilitated them to organize their business in a structured manner. Confluence between emerging agricultural technologies riding on the start-up wave in the country has the potential to create an ecosystem which would help the small and marginal farmers take informed decisions. These decisions are particularly required to counter the weather-related vagaries with which the SMFs struggle. It could be in the form of extension advisory on a real time basis through the emerging modes of group communication like WhatsApp and Telegram. For the start-ups in agriculture, FPOs provide a veritable platform to address a large farmer base, a critical mass so to say for traction and acceptance of a technology.

6. Future Scope

Success story of adoption of e-NAM has shown that its broad-banding is required on an urgent basis. It would be helped by better data connectivity, regular awareness programmes on adoption of emerging technologies, creation of a large pool of assaying, sorting-grading and warehouses infrastructure, more so assaying to create value unlock of the commodities. A successful FPO like RRPPCL need to take lead at the block level to create an ecosystem for adoption of technology by experience sharing of their success, communication of success story in a local language by the identifiable change agents which would help in adoption of technology at a much faster pace.

All these kinds of interventions have the potential to transform the agricultural ecosystem and can make it independent and self-sufficient by facilitating them to function as a single cohesive unit through the catalyst of technology enabled interventions. However, the catch is the affordability quotient of technology so that SMFs which constitute more than 75% of the farming community in India get benefited and facilitated in evolution of agriculture as a single, self-sufficient cohesive unit. This entails strong association between the center and the state, farmers and the private player, and creation of a regulatory space that would ensure affordability and availability of the technology to SMFs. When this is done, “Atmanirbhar Krishi” would become the genie for India’s farming community by lighting a brighter future.

To end in the words of Dr. A.P.J. Abdul Kalam, “It was realized that technology is the highest wealth generator in the shortest possible period if it is deployed in the right direction.”

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