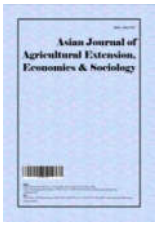

Asian Journal of Agricultural Extension, Economics & Sociology

38(10): 24-32, 2020; Article no.AJAEES.61273
ISSN: 2320-7027

Documentation and Analysis of Digital Start-Ups in Agriculture and Improving Public Extension System from Digital Start-Up Experiences

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Authors' contributions

This work was carried out in collaboration among all authors. Author DAKR did documentation and analysis and conducting focused group discussions. Author SNM, who is a digital extension expert and author MAK helped in designing the study and made some critical suggestions. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2020/v38i1030427
Editor(s):
(1) Dr. Zhao Chen, University of Maryland, USA.
Reviewers:
(1) Kupriyanova Marina, Ryazan State Radio Engineering University (RSREU), Russia.
(2) Ing. Ingrida Košičiarová, Slovak University of Agriculture, Slovakia.
(3) Lakshmi Sujeeun, University of Mauritius, Mauritius.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61273

Original Research Article

Received 17 July 2020
Accepted 22 September 2020
Published 23 October 2020

ABSTRACT

Aim: To document and analyze digital start-ups operating in the field of agriculture and suggesting some strategies to improve public extension system.
Study Design: Descriptive was employed for the study.
Duration of the Study: Study was carried out between last quarter of 2018 and first quarter of 2019.
Methodology: Desk study method was adopted to document the start-ups and focus group discussion was carried out with the experts in the field of agriculture extension.
Results: Fifty two digital start-ups were operating in the agriculture sector and these start-ups were placed into different components across agriculture value chain.
Conclusion: Government agencies are rich sources of data and on the other side start-ups lack data and are fully equipped to serve farmers. So, collaboration between the two could be a game changer in revolutionizing the agriculture extension system.

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Keywords: Start-ups; digital; public extension system.

1. INTRODUCTION

Sensing the upsurge in mobile and internet penetration the agriculture sector is being flooded with the stream of educated youth, fired by the ideas, passion and innovations to launch newer kinds of technology and business models in order to lift the face of agriculture from primitive to hi-tech one [1] [2]. Start-ups are providing missing links in the agriculture value chain and delivering efficient products, technologies and services to the farmers on one hand, and the consumers on the other hand. From ICT applications to farm automation, from weather forecasting to drone use and from inputs retailing and equipment renting to online vegetable marketing, from smart poultry and dairy ventures to smart agriculture, from protected cultivation to innovative food processing and packaging, its proliferation of all innovations and technology driven powerful start-ups set to revolutionize the food and agriculture sector [3].

The Start-up is a temporary organization designed to search for a repeatable and scalable business model." A start-up is called digital when its main assets are linked to technological investments. Its value proposition is based on at least one of the following characteristics:

1. An automated business process through the use of hardware and software.
2. The exploitation of data to generate services.
3. The delivery of services through online mode.
4. Permission of transaction through secured online platforms.

It usually needs one or several rounds of fundraising before generating revenue. Fired by innovative ideas, youth and entrepreneurs are investing in start-ups [4]. Start-ups in agriculture are recent happenings. Start-ups are providing missing links in the agriculture value chain and delivering efficient products, technologies and services to the farmers and consumers. From ICT apps to farm automation and from weather forecasting to drone use and from inputs retailing and equipment renting to online vegetable marketing, and from smart poultry and dairy ventures to smart agriculture and from protected cultivation to innovative food processing and packaging, its proliferation of all innovations and technology driven powerful start-ups set to revolutionize the food and agriculture sector. Keeping this in mind an attempt was made to document the digital start-ups engaged in the field of agriculture and some strategies are suggested to improve agricultural extension system form the experiences of start-ups.

2. METHODOLOGY

The investigation was carried out in 2018-2019 in India and is a desk kind of study. Descriptive research design was adopted for the study and focused group discussions with 30 extension agents were carried out to know how agriculture extension system can be improved with the help of start-ups. All the start-ups (as of 2018-19) engaged in agriculture and which use digital technologies to deliver services are documented. The documented start-ups are then placed into different components (Pre production, production and post production) of agriculture value chain. Some strategies have also been suggested after analyzing various public extension digital initiatives and also the start-ups.

3. RESULTS AND DISCUSSION

A total of 52 agricultural start-ups which uses digital technologies to deliver their services have been identified (As of march 2019). All the 52 start-ups are tabulated below with their major focus area.

3.1 Segmentation and Analysis of Agricultural Digital Start-Ups across Agriculture Value Chain

An attempt was made to put the above start-ups across agriculture value chain, mainly into three components such as pre production, production and post production.

3.1.1 Start-ups engaged in pre-production activities

Majority of the start-ups in the pre production component are engaged in input supply (24 start-ups) followed by weather information (21 start-ups) market information (21start-ups) Market information (19), precision agriculture (21) renting machinery (13) credit linkage (13).

3.1.2 Start-ups engaged in production activities of agriculture value chain

Various start-up operations that fall under the production component of agriculture value chain are included and reflected in the figure below. Majority of the start-ups are providing services such as capturing data of farm (19 start-ups), prediction services (19 start-ups), linking farmers with experts for crop management advisories (12 start-ups), cooperative land preparation (3 start-ups), crop and pest management advisories (18 start-ups), training and skill development for farmers (12 start-ups), individual farmer specific mobile application provision (7 start-ups), and very few start-ups are engaged in providing services like cold storages, transportation, quality seed production, harvest management and contract farming. So, start-ups may focus on providing the services which are crucial and can benefit from the same.

3.1.3 Start-ups engaged in post production – marketing activities

In post production – marketing the start-ups are involved in many operations like linkage of buyers and sellers (13 Start-ups), procuring produce from the farmers (15 start-ups), linking of consumers and farmers (13 start-ups, aggregation (one start-up), better payment options (13 start-ups), traceability (5 start-ups).

All the agricultural digital start-ups have been segmented into different components across agriculture value chain based on the services offered by them. By following the above provided segmentation, it would be easy for start-up aspirants to identify the potential areas to invest in. And would also provide a chance for government agencies in identifying the potential leaders among start-ups for collaboration with the governments to improve the service delivery to the farming community.

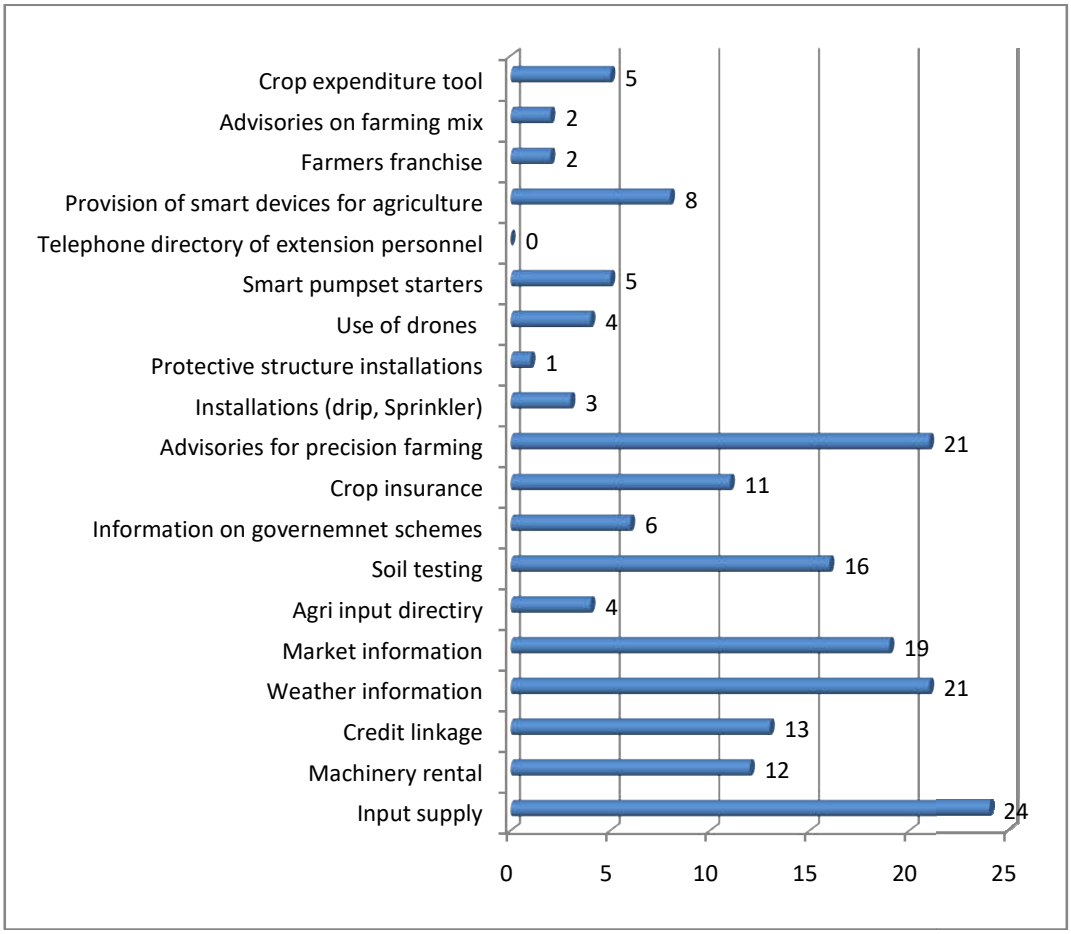

Fig. 1. Start-ups engaged in the pre-production activities of agricultural value chain

Table 1. Digital startups engaged in agriculture (By March, 2019)

S. no.	Start-up	Head Office	Area of operation	Major focus area
1.	Waycool	Chennai, Tamil Nadu	Tamil Nadu, Karnataka	Procurement and supply of the farm produce
2.	Intello labs	Chennai, Tamil Nadu	Tamil Nadu, Karnataka	Data capturing
3.	Gramoco Infratech	Indore, Madhya Pradesh	Madhya Pradesh	Infrastructure creation
4.	Gobasco	New Delhi	Madhya Pradesh	logistics and supply chain management
5.	Krishihub	Bangalore	Karnataka	Input supply and procurement
6.	Bharatrohan	Lucknow, Uttar Pradesh	Uttar Pradesh	Prediction services
7.	Stamp IT	Hyderabad, Telangana	All over India	Mobile application development
8.	Yuktix	Information dissemination and input supply	All over India	remote sensing and prediction
9.	Gramophone	Indore, Madhya Pradesh	Madhya Pradesh.	Information dissemination and input supply
10.	Jivabhumi	Bangalore, Karnataka	Bangalore	Procurement of the produce
11.	Precision Agriculture for Development	Delhi	All over India	Procurement of the produce
12.	Support Farming	Chennai	Tamil Nadu	Financial inclusion, custom hiring of machinery
13.	Ekagaon	New Delhi	Tamil Nadu and Madhya Pradesh	Micro finance, direct procurement of fresh produce from farmers
14.	Our Food	Hyderabad	Telangana, Andhra Pradesh, Maharashtra and Madhya Pradesh	Processing
15.	Kheyti	Hyderabad	Telangana, Andhra Pradesh and Maharashtra	Infrastructure development and input supply
16.	Ekutir	Bhubaneswar	Odisha	Input supply and advisories
17.	KheytiNext	Hyderabad	Telangana, Andhra Pradesh and Haryana	Input supply
18.	Exabit systems	Bangalore	All over India	IOT in agriculture
19.	Connect farmer	Bangalore	Bangalore	E- market place for processed products
20.	Virtual agri services	Hyderabad	Telangana, Madhya Pradesh	Advisories and financial inclusion
21.	Aarav unmanned systems	Bangalore	All over India	Data capturing using drones
22.	Gold Farm	Hyderabad	All over India	Custom hiring of machinery

S. no.	Start-up	Head Office	Area of operation	Major focus area
23	Farms2Fork	Delhi	All over India	Water saving technologies
24	Agribolo	Jaipur	Rajasthan	Input supply, custom hiring and market linkage
25	eFresh	Hyderabad	Andhra Pradesh and Telangana	Input supply and advisories
26	Agrostar	Mumbai	All over India	Input supply
27	Kisan Raja	Bangalore	Karnataka, Andhra Pradesh and Telangana	Water saving technologies
28	Skymet	Delhi	All over India	Weather forecasting
29	EM3 services	Noida, Uttar Pradesh	All over India	Custom hiring of machinery
30	Reuters market light	Mumbai	All over India	Decision support
31	AgroWave	Delhi	NCR-Delhi	Procurement and supply of fresh produce
32	Earthy Tales	Delhi	NCR-Delhi	Procurement and supply of fresh produce
33	Truce	Mumbai	Maharashtra, Gujarat, Uttar Pradesh and Bihar	Procurement and supply of fresh produce
34	FarmAgain	Bangalore	Karnataka, Tamil Nadu and Maharashtra	Precision agriculture and input supply
35	Shanmukha Innovations	Bangalore	Bangalore	Development of contamination devices useful for biosciences
36	Crofarm	Bangalore	Bangalore	Procurement of the produce
37	Aibono	Bangalore	All over India	Precision farming
38	Fasal	Bangalore	All over India	Provision of personalized advisories
39	Onganic Foods	Kolkata	West Bengal	Supply of organic produce procuring directly from the farmers
40	Oxenfarm solutions	Pune	Maharashtra	Pay for use of machinery
41	Farmizen	Bangalore	Bangalore, Hyderabad	Reconnecting with farming experience and supply of organic foods.
42	Harvesting	Bangalore	Bangalore, Hyderabad	farming solutions based on analytics and artificial intelligence.
43	Satsure	Bangalore	All over India	Prediction services
44	Triton Food Works	Delhi	NCR- Delhi	Supply of fresh vegetables and fruits
45	VDrone	Bangalore	All over India	recommendations based on captured data from farm
46.	Ninjacart	Bangalore	All the major cities in India	Connecting farmers and retailers

S. no.	Start-up	Head Office	Area of operation	Major focus area
47	Bighat	Bangalore	All over India	Input supply
48	Raavgo	Chandigarh	Punjab	Machinery rental
49	Flybird	Bangalore	All over India	Smart farming solutions
50	Farmart	Jalandhar	Uttar Pradesh, Uttrakhand and Punjab	Machinery rental
51	Cropin	Bangalore	All over India	Precision agriculture
52	NaPanta	Hyderabad	Andhra Pradesh, Telangana	Input supply and advisories

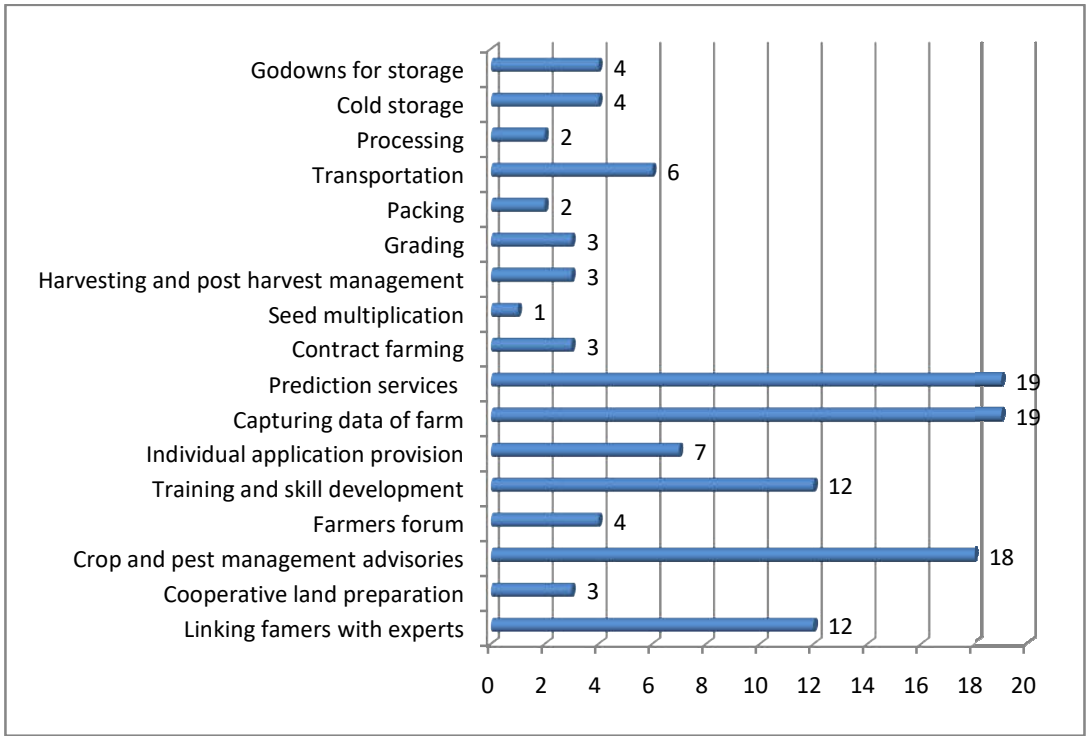

Fig. 2. Start-ups engaged in production activities of agriculture value chain

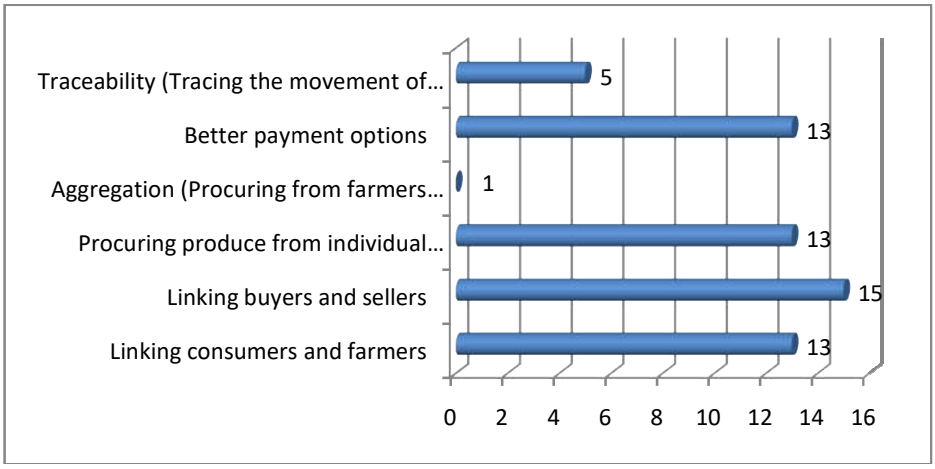

Fig. 3. Start-ups engaged in the post-production and marketing activities of agriculture value chain

3.2 Agricultural Digital Start-Up Experiences in Improving Public Extension System

Public extension in India deals with a large area, large population and diverse cropping pattern. Extension services provided by the government are general in nature and mainly concentrated on supply-driven rather than demand-driven [5]. The Indian public extension system is reeling under severe financial crisis and cannot carry out their operations in an effective manner. In the era of internet, the public extension is still relying on conventional methods to reach out to the farming community [6,7]. Lack of adequate human power is proving detrimental to the functioning of the public extension organizations. Extension systems were impactful in the past when there was an information and technological disequilibrium between farmer and service providers. Over time, as increasing number of farmers become aware of a specific technological thrust, the impact of such extension diminishes, until the opportunity and need for more information-intensive technologies arise. This situation warrants extension systems to focus on disequilibria shift from production technology to market linkages and information access issues.

Sensing the above lacunae in the public extension system and making use of the technological revolutions in the era of internet, many giant companies have floated their start-ups to serve the farming fraternity and reap benefits at the same time. There are many start-ups in the agriculture value chain. The start-ups are making use of internet as a medium to connect to the farmers. They realized, a mere use of digital technologies will not help them in securing the confidence of their client system and are now integrating their digital technologies with their personal staff system. Farm input like seeds, fertilizers and pesticides etc., are being supplied by the start-ups to their remote rural clients when they order them on their mobile application. Majority of the Indian farmers are small and marginal who cannot spend large amounts of money purchasing on farm machinery [8]. Thus renting out the farm machinery could be a better option to save their monetary resources. Though some government agencies are providing the farm equipment on rental basis, their scale of reach is very minimal. So start-ups started providing them to the farmers through their farmer franchises based on aggregation model and also through their own franchises.

Marketing is another area where farmers cannot receive fair price for their produce [9,10]. Start-ups started providing the market information and market intelligence to their client system with the help of the mobile applications. Some start-ups companies are also bringing buyers and sellers together on a single platform where they can negotiate on the price of the product without any involvement of middle men. Majority of the start-ups are also engaged in providing the personalized technical information of the crops to their clients in the form videos and texts. Some start-ups like eFresh, Khethinext have hired separate technical staff to go around the fields of farmers and provide the technical advisories to

the farmers. Some start-ups are also providing the financial assistance to the farmers eliminating all the complexities involved in securing a loan from the public lending institution. In this way there are many other start-ups engaged across the agriculture value chain. Government extension organizations are rich sources of data and collaborating with the start-ups in the sector can help the farming community as well as for the survival of the public extension system.

3.3 Integration Strategies to Improve the Public Extension System

Following strategies are suggested after analyzing the digital start-ups, and various initiatives from public extension system:

3.3.1 Technological up gradation of the extension system

Capacity building of the extension system means the up gradation of technologies and digital tools that are being used to a sophisticated technology cluster, which make the system more efficient and helps in effective output delivery. Initiating schemes with cloud, mobile computing, big data analytics, IOT, block chain technologies etc [11].

3.3.2 Building capacities of the personnel

Most of the personnel in the public extension system are senior personnel and have no updated knowledge to deal with the most advanced digital tools. Capacity building programmes for the extension personnel should be organized to make them familiar with the usage of available digital tools and data handling. Bringing of the best of global experiences to the local extension systems can largely help to update their knowledge. Carrying out Massive open online courses (MOOCs) will help them to learn more about the usage of advanced digital tools and the way of handling data [12].

3.3.3 Collaborations

Private players in the agriculture sector are way forward in adopting the digital technologies in to their operations. The major disadvantage for the private agricultural start-ups is the lack of credible data of the farming community. On the other hand, public extension systems are having which data. The deficiencies on either side can be bridged by working together which is a win – win situation for the both parties.

3.3.4 Developing comprehensive digital platforms

Digital initiatives from the government are not so comprehensive in nature. So far the government has come up with separate digital platform for each major activity in the value chain. When the government comes up with a digital platform for each activity, the platform acquires a disintegrated form. Farmers will not be able to experience the one stop for all facility. Sensing the need of farming community various start-ups in the sector have included this facility on their digital platforms. Thus, the government should think towards developing comprehensive digital platforms which provide services on various fronts not just limit to one or two services.

3.3.5 Digital literacy of farmers and encouragement

Majority of farmers in the country are illiterates or have very minimal education. Though the government and private companies are coming up with various digital platforms, the reach of those platforms is very less compared to the proportion of total farmers. The main root cause of this problem is digital illiteracy of the farmers. Governments should try to bring awareness among the farmers about the use of smart devices and separate programmes may be carried out for the purpose. For example in Chhattisgarh, Under Sanchar Kranti Yojana every woman and college student will be given a smart phone with data connection to promote digital literacy.

4. CONCLUSION

With the growing literacy rates and surge in youth to adopt farming as enterprise, it is high time that private players in the agriculture sector are way forward in adopting the digital technologies in to their operations. The major disadvantage for the private agricultural start-ups is the lack of credible data of the farming community. On the other hand, public extension systems are having rich sources of data. The deficiencies on both sides can be bridged by working together which is a win – win situation for both parties.

DISCLAIMER

Agricultural start-ups which offer at least few digital services in India are included in the study. There may be start-ups which we could we have

missed out during the study due to unavailability of data. And the number of startups included in the study may be not being of representative in nature.

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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12. Torero M. Information and communication technologies: Farmers, markets and the power of connectivity in 2013, a global food policy report. Chapter 6 Pp. 63-74. Washington, D.C; 2014. Information is also obtained from the respective 52 start-up websites.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61273