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Digitalization in the Agricultural Sector: Case Study of Bihar and Haryana

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ABSTRACT

Agriculture is the largest source of livelihood for 58% of India's population. A self-reliant primary sector is a pre-requisite to promote economic development. However despite this fact and the reality of two-thirds of people in India who lives in poverty (68.8% of the Indian population lives on less than $2 a day: World Bank); few attempts have been implemented to reach the desired level of agricultural growth. Having said so it is pertinent to align the same goals as laid down as a roadmap to attain the Second Sustainable Development Goal (SDG-2) *i.e.* 'Zero Hunger' and 'Higher Agricultural Productivity' by 2030. Stating the brooding fate of a COVID lead silent food crisis that will put the majority of Indian poor at risk, especially the ones in extreme poverty; undivided attention must be provided to the food front; putting food security as a matter of utmost priority. There by a technological upgrade is an asset that holds the potential to turn Indian agricultural scenario and pull up the face of food security in India. The objective of this dissertation is to emphasize the importance of technology as a driving force to move the agricultural sector along a more sustainable path.

Key words: Agriculture, Digitalization, Internet of things (IoT), Internet and communication technologies (ICT), SDG-2.

INTRODUCTION

India is one of the world's fastest growing economies and among the biggest contributors to the global food basket. India's population has nearly doubled since the 1970's and is approximately 1.3 billion which puts extensive pressure on natural resources in order to produce enough food. It shows immense potential in integrating farm technologies with a robust and digital mechanism. Technology has the ability to both positively impact agricultural development and increase farmers' income. While on one hand, India faces the formidable challenge of food shortage and low agricultural productivity, it faces an even bigger challenge; to grow more sustainably and inclusively. Doing so, would allow it to attain the Second Sustainable Development Goal which aims to eliminate hunger and achieve complete food security by 2030, better. It also faces the issue of declining productivity, a rapidly growing demand for food (not just in terms of quantity but also quality), storage facilities, climate change. It has been established that technology adoption modernizes farmers' production practices and leads to uniform annual returns for farmers, reduced risk of crop failure and increased yields (Seth and Ganguly, 2017). Leveraging technology to achieve higher and sustainable agricultural growth is the need of the hour.

According to a study by the United Nations Development Program, it has become even more paramount as a result of the Covid-19 pandemic which presents the possibility of pushing an additional 207 million people into extreme poverty by 2030. While Haryana, became prosperous as a result of the green revolution and is vital for India's food security, states like Bihar and Odisha face an urgent challenge of ensuring food and nutritional security to its huge population. Moreover, according to a study, conducted by the ICMR (Indian Council of Medical Research), Bihar accounts for 48.3% of the country's stunted children under the age of five years, making it the worst state in India with respect to malnutrition. Therefore, it is necessary to understand the reasons behind this dichotomy which exists between the states of Haryana and Bihar and come up with solutions to resolve the same.

However, this is not to say that the Government has not taken up any initiative to bolster the growing agricultural sector. The e-NAM, for example, provides an e-marketing platform at the national level and supports the creation of infrastructure to enable e-marketing. Portals like the farmer's portal, Kisan call center and Kisan portal that enable farmers to make informed decisions for efficient productivity are laudable and a step in the right direction. Apart from this, addressing challenges at the local level and supporting policies and institutions also play an essential role in the success of technology adoption.

Salient features of the states

i. Haryana

Located in Northwest India, it covers 1.34% of India's geographical area.

Agriculture is the primary sector of Haryana and majority of the population is directly or indirectly dependent on agriculture and its allied activities. It is one of the largest contributors of food grains to India's central pool with a share of 15% and 80% of its total geographical area under cultivation. (Sharma, 2019).

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ii. Bihar

Located in the Eastern part of the Indian subcontinent, it covers 2.86% of India's geographical area. About half of Bihar is under cultivation, but population pressure has pushed cultivation to the furthest limits and little remains to be developed. Rice is the dominant crop grown with pulses, wheat and barley being supplementary crops (Dutt *et al*., 2020).

Digital India and rural development

Digital India was launched in 2015 to create digital infrastructure for empowering rural communities and promoting digital literacy. Digital India can serve as an integral tool for development of the agricultural sector in India. Agriculture in India suffers from various handicaps, for example, the agricultural supply chain in India is highly unorganized and complex. It suffers from lack of transparency and coordination between various stakeholders, leading to bigger ratio of agricultural produce being wasted. The pre and post-harvest situation of the crop needs to be traced in order to improve accountability and transparency. An improvement in transparency about the agricultural processes in the supply chain of the produce will prevent wastage and increase consumer trust. The greatest contribution of digital India is enabling farmers to get the best price while reducing transaction costs, this helps the farmers avoid the costs of intermediaries and expand their profit margins. Because of innovation in digital agricultural solutions built using computer visions, farmers can monitor crop and soil health. They can learn the best practices for the entire supply chain. These technologies help the farmers adapt faster to adverse weather conditions especially in flood and drought prone regions. Availability of sensors and drone helps the rural youth fight pests, spray pesticides and monitor crop health among others. Replacing farmer's subsidies, the government can reach the farmers directly for cash transfers. This in turn helps the farmers come out of debt traps and enhance agricultural productivity. When combined with data infrastructure, subsidies can help increase the farmers' profit margins, enabling them to further invest in their farm's to increase production. With the help of social media platforms, participatory videos explain best management practices to farmers. With digital platforms, farmers can overcome poor banking infrastructure and support savings and access credit digitally.

Objectives

The following research aims to:

i. Highlight the importance of digitalization in agriculture to overcome most of the agriculture related problems in India throughout the journey of the crop production.

ii. Study the existing dichotomy between the states of Haryana which is highly food secure and Bihar which is extremely food insecure. To get to the bottom of this, we must first understand the reasons behind these contrasting scenarios.

iii. Study whether technology has played an important role in establishing this divide and if so, at the end, we also expect to find solutions to enable Bihar become a food secure state and accomplish a feat that Haryana has already achieved.

Hypothesis

It has been hypothesized that there is immense regional disparity between the states of Haryana and Bihar in terms of food security and efforts by the government in achieving the second sustainable development goal. Thrust on balanced use of inputs and technology in the agricultural sector has the potential to turn food insecure Bihar into the 'food granary of India.

Literature review

I. Nedumaran, G. and Manida, M. (2020) observed that e-farming administration is advantageous because it is likely to expand profitability, improve quality in items, generate a higher pay, expand productivity and raise profit. The effect of ICT activities on agriculture, for example The Kisan Credit Card must be evaluated and convenient access to horticultural data must be provided while educating the rural population on these practices. To become prosperous, the advances in enrolling power, accessibility, electronic thinking and biotechnology is the need of the hour.

II. Farooq *et al*. (2020) stated that countries around the globe have adopted various IoT technologies and similarly the Indian government has also made use of several IoT policies to boost up their agriculture. Their major focus is to measure the soil conditions, temperature and earth density in order to help farmers control pests and prevent crop diseases. However many open issues and challenges are associated with the implementation of these policies like loss of data, high costs, lack of knowledge of technology, reliability which ought to be addressed and resolved in the near future.

III. Landmann, D.H. (2018) observed that the access and usage of smartphones for agricultural purposes is still very limited among farmers in various developing countries. They provide access to continually updated and reliable information and have the potential to improve income generation and reduce poverty in developing countries. Despite this, adoption and usage rates among farmers in developing economies remains relatively low. The perceived favorability of smartphones for capacity development among farmers should be the special focus of extension programs. Correspondingly, smartphone applications should be designed with user-friendly interfaces for the specific target groups.

IV. Sharma, A. (2014) in her work stated agriculture in Haryana has played a vital role in development and has touched newer heights with the help of science and technology. Agricultural inputs, investment in technology, rise of efficient technologies are major contributors to agricultural growth. Growth of agriculture and allied sectors is a critical factor in determining the performance of the state economy. This needs a larger reserve of crops and product's behavioral studies and newer sources of data for items thinly covered.

V. Dholpuria, V. (2019) observed that India faces various agricultural problems. Data and communication technology will play key job information trade, direct suggestions, advertise combination and access to funds to make horticulture a gainful undertaking. Through development of digital apps, farmers can get information regarding inputs as well as government schemes and weather updates. Farmers can avail credit facilities as well. In order to create such an app, some technical solutions need to be executed. Some of the initiatives of ICRISAT for example, Krishi Vani serves important functions wherein farmers receive voice messages guaranteeing social manageability and budgetary maintainability.

VI. Mustaqim, M. (2016) stated that data driven farming empowers right decision making, enhances profitability and sustainability. It enables traceability, accurate measurement of plots, the satellite system with close resolutions are helpful in identifying weeds and pest diseases and is equally helpful in harvest forecasts. The online market enables farmers to independently choose buyers. It boosts farmers' incomes by reducing operation costs and fetching higher prices for good quality products. The application also supports local languages.

MATERIALS AND MENTHODS

There is an extensive digital divide between the states of Haryana and Bihar. In order to become food secure, Bihar ought to narrow this divide and introduce more programs which enable farmers to reach their maximum potential. Incorporating initiatives launched by the state of Haryana could ensure this possibility.

Primary data was collected through the process of questionnaire which consisted of close-ended questions in the form of Multiple Choice Questions. This particular method was adopted because of the ongoing Covid-19 pandemic and the use of online questionnaire allowed easy collection of data from the respondents.

A sample size of 40-45 was chosen to satisfy the objectives of this research. Respondents belonged to various backgrounds *i.e.* from different states of the country and belonging to varying socio-economic backgrounds.

Respondents were asked their opinion on questions like the reasons for poor state of agriculture in India, the cause behind Haryana's prosperity and Bihar's backwardness and whether digital investment in agriculture has the potential to transform the state of agriculture in the country. The respondents were provided various options to choose from and in case they were unsure about a particular question, they were given the option of 'not sure' and maybe' to choose from.

The responses gathered were depicted in the form of Bar charts and Pie charts.

However, there is a possibility that a few respondents failed to comprehend the questions despite their straightforwardness and guessed their answers, instead. This could be the result of lack of awareness on the subject being researched. However, this does not in any way impact the interpretation of data, because majority of the respondents provided answers after extensive thought and deliberation as described by them in the comment box.

Secondary data was collected from credible and well-cited academic research papers and journal articles written by authors on the same topic.

Central government initiatives

In order to tackle the issues faced by the Indian farmers, the Government has introduced a number of initiatives. Digital India is a platform to provide services to farmers through digitally enabled devices. Following are some of the initiatives:

i. e- Sagu

In order to advice farmers regarding various techniques to increase farm production, expert suggestions are provided to farmers through Internet and Audio visual communication facilities.

ii. Community radio

This initiative of the Government provides information to the farmers using radio station facilities.

iii. Digital green

Information related to farming, nutrition, health is disseminated through short videos using low-cost and durable technology.

iv. Soil health card schemes

Introduced in 2015, this scheme has been introduced in order to assist state governments to issue soil health cards which provide information regarding improvement of soil health and fertility to farmers throughout the nation.

v. e- NAM

This initiative of the Government serves as an E-marketing platform for the entire nation and supports the creation of infrastructure to enable E-marketing. This allows farmers to earn better prices for their products, thus moving towards the goal of "One Nation One Market" (Sharma, 2019).

vi. The Government has put in operation the use of three portals, namely the Farmers portal, Kisan Call Centre and Kisan portal in order to help farmers make an informed decision for efficient farming under diverse climates.

vii. E-governance programs, Soil health card software and web based software provide farmers with crop management recommendations in many states of India.

viii. National governance plan (NeGP-A)

This provides information to farmers through multiple channels, which includes SMS (Short Messaging Service) and kiosks. Information is provided on issues of varying weather seasons, pests, irrigation, crops, good agricultural practices *etc.*

ix. National Bank for Agriculture and Rural Development (NABARD) has also designed agricultural portals for farmers (Singh, 2020).

Initiatives specific to haryana and bihar

The State Government of Haryana has introduced many digital initiatives to enable farmers increase their farm productivity. They are the following:

i. National mission on agriculture extension and technology

The main objective of this program is to provide the latest technological innovations to farmers through training, exposure visits and Kisan melas. In this manner, farmers are kept up-to-date with existing technology and are able to modernize production in a sustainable manner (Sharma, 2019).

ii. Crop cluster development program (CCDP)

This new scheme has been launched with a budget outlay of 510.4 crore. Under this program, in each cluster marketing infrastructure and post-harvest management facilities like pack house, primary processing center, grading-sorting machine, storage facilities, refer vans, input and quality control facility shall be created to have forward and backward linkages for effective marketing of horticulture produce (Sharma, 2019).

iii. Bhavantar Bharpayee Yojna

It has been launched to mitigate risk of low prices for horticulture produces in market and to motivate the farmers for diversification in agriculture. In the first phase, 4 crops *viz.* onion, tomato, potato and cauliflower have been included. To avail the benefit under the scheme, farmers have to register on Bhavantar Bharpayee Yojna portal of HSAMB (Haryana State Agriculture Marketing Board) website (Sharma, 2019).

The state Government of Bihar has introduced the following measures to transform agriculture in the state digitally:

iv. An ICT-based e-extension and information dissemination system project is being run by the Bihar Agricultural University through its media center. Under this program, the university trains and imparts education related to agritech to farmers across the state through the medium of video conferencing and e-learning materials. The lessons and learning are also disseminated via social media platforms such as WhatsApp and YouTube (Ujaley, 2020).

v. The Kisan Gyan Rath developed by the Bihar Agricultural University established at Sabour is an important mobile application used for imparting knowledge to the farmers at their doorstep. The application is equipped with facilities for soil sample analysis, agro-exhibits, extension literature and technical videos (Sinha and Sohane, 2019).

vi. A massive open online course on entrepreneurship development in agriculture was also introduced to encourage the rural youth to come forward as agri-entrepreneurs (Sinha and Sohane, 2019).

vii. The Kisan Call Center offers solutions to farmers with the help of a toll free number. Moreover, the farmers can also send pictures of the problem they are facing through WhatsApp, to receive customized or personalized solutions or advisories (Sinha and Sohane, 2019).

Therefore, despite the introduction and implementation of many schemes by the Government, the farmers in Bihar are coping up with the emerging challenges of drought, flood, large yield gaps, irrigation and lack of infrastructure, markets and information. To resolve this, technologies and strategies are needed to increase production and yield with an increasing challenge of climate change to which Bihar farmers are extremely vulnerable.

Barriers to adoption of digital initiatives

i. Employment impacts

Agriculture remains one of the largest sources of livelihood for majority of the population of the country. However, technology has the potential to reduce labor intensity and increase labor savings on farms. This could result in economic disruption and increase the rate of unemployment, as a result ('Digital Agriculture feeding the future', 2017).

ii. Security issues

If agricultural systems are reliant on technology, there exists a large-scale potential of hacking control systems to damage crop growth, contaminating the water supplies, *etc*. ('Digital Agriculture feeding the future', 2017).

iii. Development costs

The initial cost for the adoption and development of technology may be so high that it could discourage people from its usage. Therefore, it is necessary to first understand and monitor technology to create an effective system in order to ensure its usage in the most backward areas of the country ('Digital Agriculture feeding the future', 2017).

RESULTS AND DISCUSSION

The majority of the respondents belong to Delhi (14.6%) followed by the state of Uttarakhand, Haryana and Bihar. Majority of the respondents (90%) reside in an urban area while the rest 10% hailed from a rural background. The responses collected were depicted in the form of bar graphs and pie charts.

48.8% of the respondents are not fully sure whether Haryana has been able to incorporate digital technologies in Agriculture in the last decade or not, which signifies that there is lack of awareness among them. 39% agree and

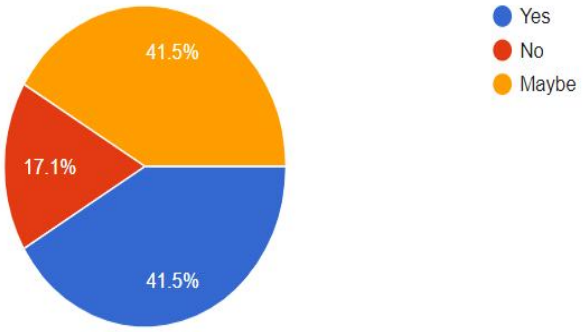

Fig 1: Pie chart represents digital incorporation in Agriculture in Haryana.

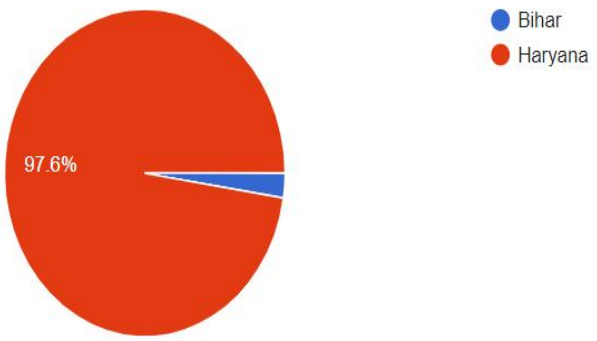

Fig 2: Pie chart represents whether green revolution made Haryana successful and Bihar backward.

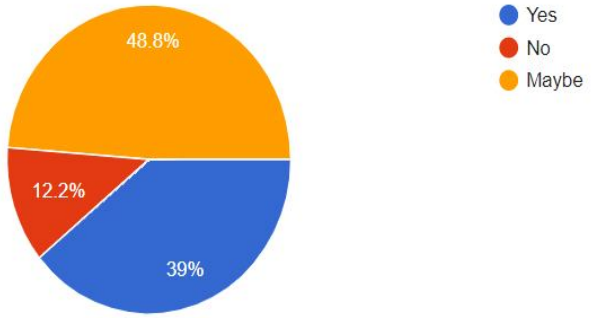

Fig 3: Pie chart represents whether Haryana is agriculturally prosperous upon comparison with Bihar.

12.2% disagree for the fact that Haryana has been able to incorporate technology in the agriculture.

41.5% of the respondents share the opinion that Green Revolution had been successful in creating regional disparity in Indian states on the basis of agricultural productivity and development. Also 41.5% of respondents do not agree to this. Only 17.1% are not sure of regional disparity resulting because of Green Revolution.

97.6% of the people agree that Haryana is agriculturally prosperous than Bihar. Only 2.4% of the respondents are of the opinion that Bihar is relatively less agriculturally prosperous than Haryana.

Majority of the respondents (44.7%) believe that Bihar lacks self-sufficiency in food grains. A small proportion of the people feel it fares well in terms of self-sufficiency.

48.8% of the people believe that lack of agricultural infrastructure is the primary reason for poor state of agriculture in India. The same percentage of respondents *i.e.* 48.8% are of the opinion that lack of awareness and education is also an important factor for the same. Inadequate finance is third factor as opted by respondents followed by social and economic backwardness among farmers at the last.

Majority of respondents are of the opinion that Haryana is highly self-sufficient in food grain production. 31.7% feel that it lacks in self sufficiency of food grains. A small proportion feels that it lacks a lot in self sufficiency of food grains.

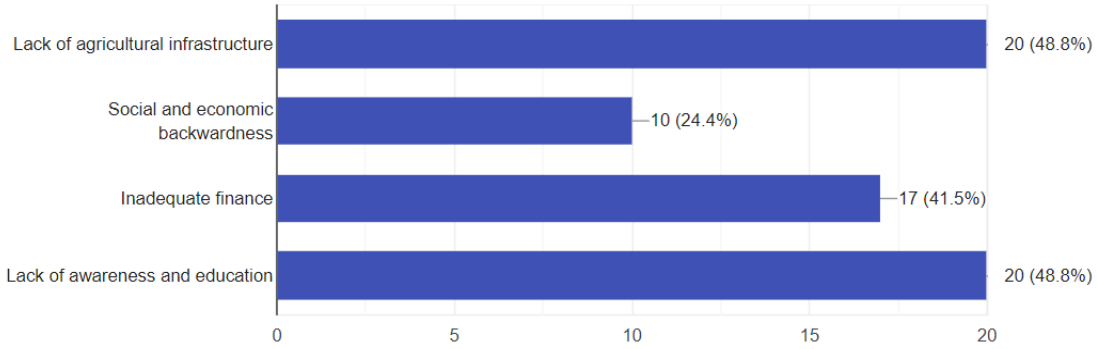

Fig 4: Bar chart represents the rate of self- sufficiency in Bihar.

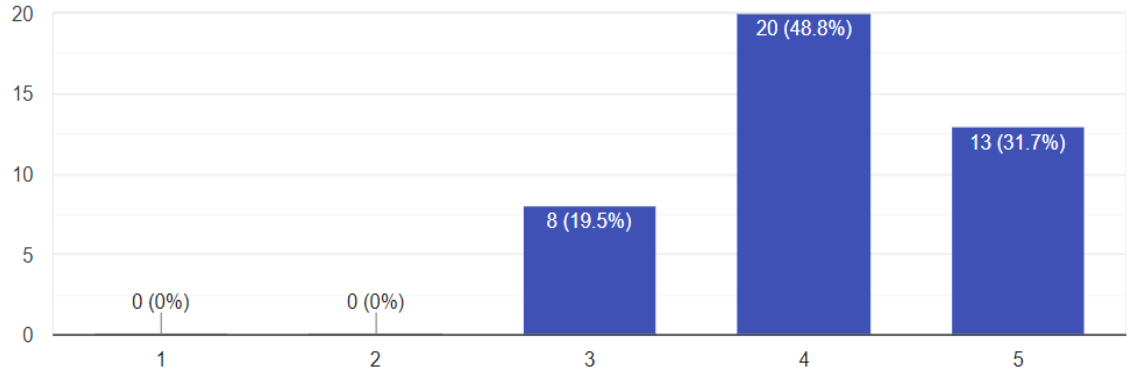

Fig 5: Bar chart represents the reason behind poor state of agriculture in India.

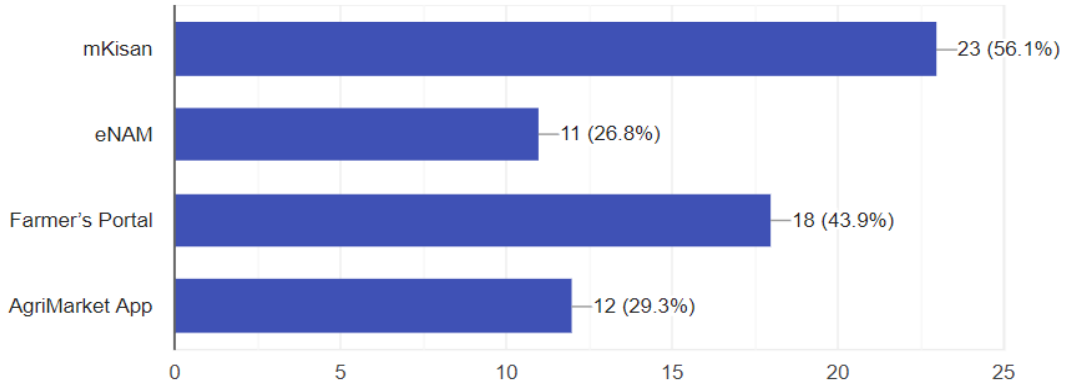

Fig 6: Bar chart represents the rate of self-sufficiency in Bihar.

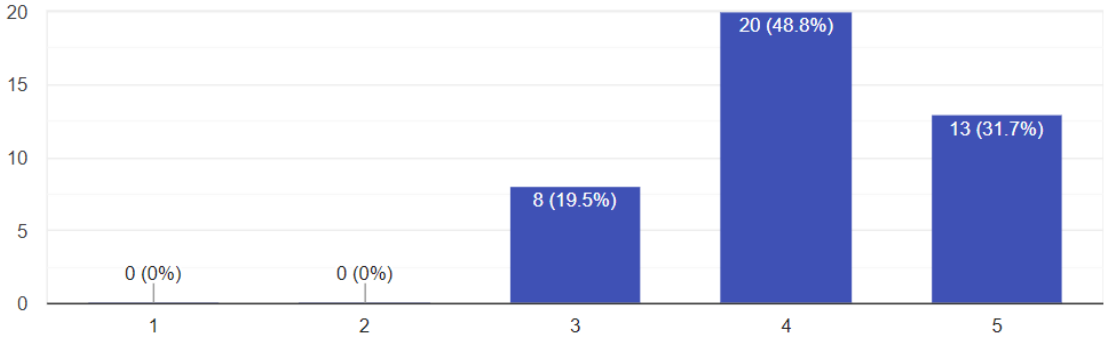

Fig 7: Bar chart represents the awareness of apps and portals among the respondents.

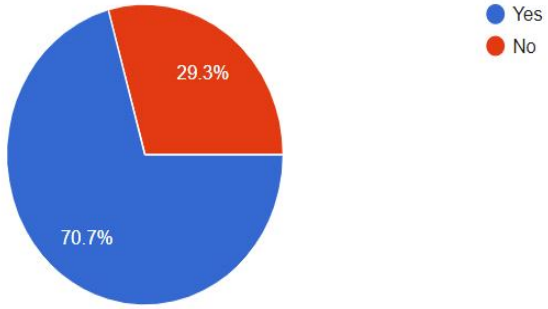

Fig 8: Pie chart represents whether India can achieve SDG-2 by 2030.

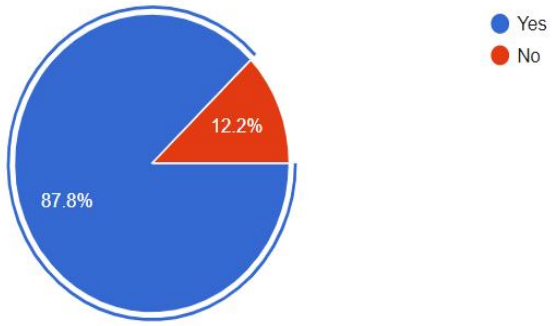

Fig 9: Pie chart represents whether Indian agriculture requires digital investment.

The following bar chart depicts that more than 50% of the respondents are aware of the mKisan portal, whereas Farmer's portal is the second most popular portal (43.9%) followed by AgriMarket App and eNAM which stand at 29.3% and 26.8%, respectively.

70.7% of the respondents are of the perception that India has the potential to achieve the 2nd Sustainable Development Goal ('Zero Hunger') by the year 2030.

87.8% of the respondents believe that Indian state of agriculture requires a heavy dose of digital investment. While 12.2% disagree with this.

Majority of the respondents (58.5%) observed that crop sensors which help prevent leaching and runoff into ground water should be the highest priority of the Government in order to promote crop growth and progress. Followed by High-tech storage facilities at 23%.

85.4% of the respondents are of the belief that digital intervention in agriculture will prove advantageous for the country despite the fact that India is a labor intensive economy.

53.7% of the people believe that technological intervention in agriculture is the only difference in India's and the foreign state of agriculture. While 46.3% of the respondents believe the opposite.

92.7% of the respondents believe that digitalization in agriculture has the potential to make India a food sufficient country and enable it to achieve the second sustainable development goal of zero hunger by 2030. While 7.3% of the respondents believe that is not the case.

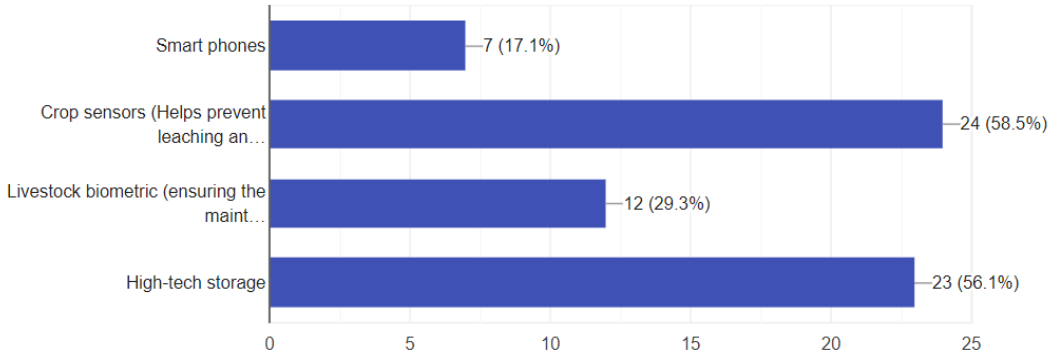

Fig 10: Bar chart represents highest priority of the Government to promote crop growth according to the respondents.

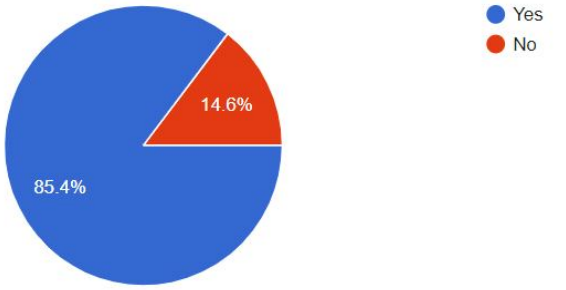

Fig 11: Pie chart represents whether digital intervention will help labor intensive India.

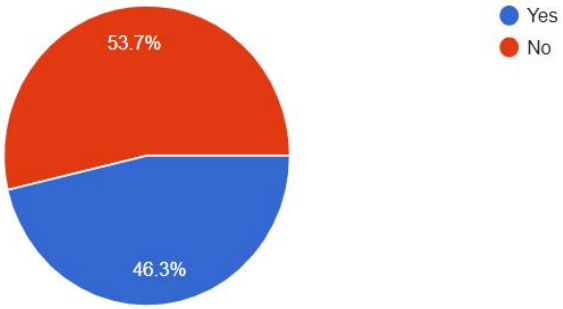

Fig 12: Pie chart represents whether digital intervention is the only difference between Indian and foreign agriculture.

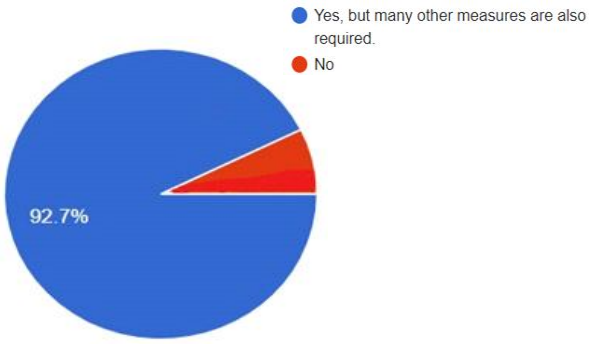

Fig 13: Pie chart represents whether digitalization can make India food sufficient.

CONCLUSION

Indian Agriculture has been plagued by severe problems including inadequate finance, presence of intermediaries in the supply chain of the produce, dependence on climate for agriculture. These are just a few among others. Back in 1960's, initiatives by the state to increase agricultural productivity, like the Green Revolution, on one hand has yielded much better produce by modern methods of farming, while on the other hand has managed to create immense regional disparity among Indian states. The rich states have tried their best to incorporate technology in agriculture to further increase their incomes and have achieved food sufficiency. States like Haryana and Punjab have achieved food sufficiency while states like Jharkhand, Bihar and Odisha *etc*. have been lagging behind in food grains sufficiency. Technology has the potential to transform agriculture by creating, producing, harvesting and establishing storage facilities for farmers and help the Government by enabling them to create better policies for the rural youth. Majority of the people are also of this opinion, as proved in our research. The hypothesis has been proved that technological innovations in the state of Bihar can turn it into the 'food granary of India' and increase its social and economic well-being, which had been the case with Haryana in the last few decades. The primary reason for the existing dichotomy between both the states is the lack of agricultural infrastructure in Bihar and heavy dosage of investment in agriculture by Haryana.

The importance of digitalization in agriculture to overcome most agriculturally related problems has been extensively highlighted throughout the research. The dichotomy existing in the two states was initiated by past developments like green revolution and later by the adoption of modern technologies in Haryana. This helped Haryana achieve food sufficiency and double the farmers' income. Therefore, adoption of modern farming methods could have similar ramifications for Bihar by moving it along a more sustainable path. Though the state has introduced some initiatives in this regard but greater commitment and determination is required to achieve the second sustainable development goal which aims to attain zero hunger by 2030.

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