



Diffusion and Awareness of Woman Friendly Farm Tools & Equipment among the Farmers

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Farmers toil day and night to provide food for the world's population, while their social and economic situations deteriorate with each passing day. Indian agriculture is heavily reliant on the monsoon season, which results in abundant agricultural output. Because of a successful monsoon, the agriculture sector has thrived throughout the Covid-19 scenario and has gained about 11 million workers in the previous three years, whereas the other sectors have lost more than 21.7 million jobs in the 2020-21 fiscal years alone. The findings of the literature review revealed that farmers face a wide range of issues, including a lack of mechanization, a lack of irrigation, and lack of working capital etc. An empirical study was conducted to understand whether farmers were aware about the technologies developed by the CAIE, Bhopal & other ICAR institutes in Dhoraji of district Rajkot in Gujarat states. A total of 100 farmers were randomly selected based on convenience to assess the diffusion level & awareness level of technologies among the farmers. The study found that the results were shocking and government has to take prompt actions to increase the awareness and diffusion of technology among the farmers of Dhoraji.

Keywords: *Agri-tech; agricultural technology; woman farmer; agriculture; farming; farm-tech; farm technology; women friendly technology; women friendly farm equipment.*

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1. INTRODUCTION

Agriculture sector has outperformed during Covid-19 situation due to good monsoon and added almost 11 million people in past three years while other sector lost the jobs more than 21.7 million in the 2020-21 alone [1]. With the development of digital technology, technology has played an increasingly important role in farming and agricultural operations, and its application has grown in breadth. Agriculture innovation is propelling a revolution in agricultural practices that is decreasing losses while enhancing efficiency and effectiveness. Farmers are reaping the benefits of this. Using digital and analytic technologies to promote continuous improvement in agriculture is a trend that will continue for the foreseeable future. This will result in improved crop yields and help farmers make more money. Any effort to restructure the agriculture industry must take into account ecosystem thinking as well as the digital environment in which it is conducted. Crop selection through crop management to market are all steps in the agriculture value chain that involve public and private partners in agricultural inputs, services, logistics, and other aspects of the agricultural value chain. When building a digital ecosystem for agriculture, considerations such as connection, data management, data integrity, data standards, privacy and security, as well as the ability to drive innovation, must all be taken into consideration.

The Indian government has established a digital agricultural mission for the years 2021-2025, which will include initiatives based on new technologies such as artificial intelligence, blockchain, remote sensing and geographic information systems (GIS), drones and robotics, among other things. Agriculture will continue to be modernized with the use of new technology that will assist farmers in increasing their earnings. With the Ministry of Agriculture, companies such as Cisco, Ninjacart, Jio Platforms, ITC and NCDEX e-Markets have signed a Memorandum of Understanding (MOU) for experimental initiatives (NeML). Crop stress detection, disease diagnostics, and crop monitoring are just a few of the technology options available to the agricultural industry. Hyper spectral imaging will help to boost the worldwide precision farming industry as new technical advances and better application of the approach are made.

It is essential to adopt a fragmented, federated structure that ensures independence for service providers and all other parties while still retaining interoperability as a foundational necessity. Recognizing the importance of digitisation in farming, the Department of Agriculture is developing Digital Agriculture Ecosystems by establishing a federated farmer's database and other services to support it, among other things.

Despite the fact that it employs over half of India's workforce, agriculture industry provides just around 18 percent of the country's gross domestic product. Despite large advances in food grain output, the government faces a number of obstacles in its efforts to raise agricultural production as a percentage of gross domestic products (GDP). Indian agriculture is mostly dependent on natural resources; yet, factors such as climate change and global warming make farming a dangerous proposition. It is necessary to train farmers in the use of current technologies and novel ideas in order to boost their yields and profits. As a consequence of agricultural technology breakthroughs, there have been a number of significant developments in the agricultural and farming areas. Modern and other new technologies are becoming increasingly significant in farming and agriculture, with the introduction of digital technology spreading the reach of these technologies even further. As a result of agricultural innovation, farming techniques are changing, which has the effect of cutting losses and increasing efficiency. Farmers benefit as a result of this development. In agriculture, the use of digital and analytic tools to drive continuous improvement is here to stay, resulting in higher crop yields and more money in the pockets of farmers.

- Fertilizers, insecticides, seed technology, and other aspects of agriculture are all affected by technological advancements. Pest resistance has been made possible via the use of biotechnology and genetic engineering, as well as higher agricultural production. Tilling, harvesting, and manual work have all been made more efficient as a result of mechanization. Irrigation and transportation infrastructure have improved, and waste has been minimized as a consequence of advances in processing technology, with good benefits reported across the board. Robotics, precision agriculture, artificial intelligence, block chain technology, and other cutting-edge technologies are just a few of the topics covered. The following are some of the

ways that technological improvements in agriculture have benefited agriculture:

- Artificial intelligence is used to provide forecasts for the weather and the environment. Agriculture has made significant strides forward as a result of artificial intelligence (AI). Modern artificial intelligence-based technologies facilitate data collection and help in the production of accurate crops and the making of intelligent decisions.
- Agricultural automation has resulted in a rise in output. Combine harvesters are becoming increasingly popular as a means of reducing manual labor and speeding up operations in agriculture. Indian farming is characterized by small landholdings, which necessitates collaboration with others in order to profit from modern technology and techniques.
- Farmers may rely on the Internet of Things to collect data on weather patterns in and around their fields 24 hours a day, seven days a week. This information includes temperature, rainfall, soil moisture, and other parameters. While AI is slowly gaining momentum in countries like India where marginal farming, fragmented landholdings, and other variables act as hurdles, it is making steady progress in other countries as well. However, there is little doubt that artificial intelligence-based

technologies can improve the precision of large-scale farming while also resulting in a significant rise in output.

The world's population is predicted to reach over 9 billion people by 2050, according to projections. The challenge is figuring out how to produce enough food to keep everyone fed. There is a significant impact on the world from food waste in the manufacturing and distribution processes, as well as the problem of decreasing agricultural land. The only way to ensure a more secure food supply in the future is for technology to play a greater role in addressing these issues. Technology may assist governments in conserving foreign exchange, increasing production, and raising the overall standard of living for farming people in developing countries. India has a long way to go before it can be considered a leader in the adoption of modern farming methods aided by technology. Even if progress is being made slowly, pioneering efforts are required to educate farmers about the benefits of technology.

This study helps to understand the status of diffusion & awareness level of women friendly farm technology & equipments among the farmers in Dhoraji of district Rajkot in Gujarat.

The most popular farm technologies commonly used are as below in Table 1.

Table 1. Conventional agricultural technologies and their uses

S No.	Name of the Technology	Most Common Uses
1	Tractor	1. Pulling agricultural machinery like harrow, cultivator, trolley thresher, trolley, etc. 2. It is also used to plough, shaft rotating for thresher, pulley rotating etc.
2	Thresher	Wheat, peas, soybeans, and other small grain and seed crops are separated from their chaff and straw using a thresher. Different threshers are used for different purposes
3	Seed Sowing Machine	Showing Seed. Different seed showing machines are used for different seeds & purposes.
4	Rotary Tiller (Rotavator)	Rotary tillers use a series of blades to plough the land, breaking clods, moistening the soil, and pulverizing it, which aids in soil preparation for growing plants and producing a high yield. It employs a set of blades that spin and break up soil clods while also assisting with weeding between crops.
5	Potato Digger Machine	Potato Diggers are potato-digging machines. They lift by using a share to lift the potatoes off the bed. The soil and crop are moved to a succession of webs, which sieve out the loose soil.
6	Pesticide Sprayer	Sprayers are devices that spray liquids, and they're typically utilised to project water, weed killers, crop performance compounds, pest maintenance chemicals, and manufacturing and production line ingredients.

S No.	Name of the Technology	Most Common Uses
7	Trolley Pump Sprayer	Insecticides, pesticides, fungicides, herbicides, and other pesticides can be sprayed in fields to protect crops against pest assault. Agriculture, horticulture, plantations, gardens, and nurseries all use these sprayers.
8	Cultivator	Cultivator, farm implement or machine designed to stir the soil around a crop as it matures to promote growth and destroy weeds
9	Harrow	The goal of harrowing is to break up clods (lumps of dirt) and give a finer finish, as well as a good tilth or soil structure that is suitable for seed planting. It can also be used to get rid of weeds and cover seed after it has been sown.
10	Combine Harvester	A combine harvester is a grain harvesting machine. The term comes from the fact that it combines three independent harvesting operations—reaping, threshing, and winnowing—into a single procedure.
11	Feeding Straw Chopping Machine	It is mostly used to chop green (dry) maize straw, rice straw, wheat stalks, grass, and other similar materials. It's a forage feed processing machine for agriculture. It is suitable for feeding cattle, sheep, horses, deer, and other livestock.
12	Agricultural Bund Maker (Bund Machine)	Steel box frame, hitch systems, and discs make up 'BUNDMAKER.' The implement's best use is in crop planting and water control. It's also utilised in the earthing up process.
13	Raap-Daati	Cutting the green grass and green straw
14	Chipiya or Stalk Uprooter)	It is used for uprooting operation for the stalks of crops like cotton, red gram, Lantana Camara etc.
15	Sickle / Hasiya	It is the most important instrument in the kitchen for vegetables & fruits peeling & cutting and in the fields for crop harvesting, grass cutting etc.
16	Powarah	It is used during irrigation. It is also used to spread the ballast properly.
17	Kudaari	The main use of kudaari (Kudaal) is Smashing Rocks, Prying up Stones, Paving, Garden, Digging Tree Roots, Loose Soil, and Chopping Wood.
18	Pitch Fork	A pitchfork (also a hay fork) is an agricultural tool with a long handle and two to five tines used to lift and pitch or throw loose material, such as hay, straw, manure, or leaves. The term is also applied colloquially, but inaccurately, to the garden fork.
19	Khurpi / Khurpa / Trowel	A Khurpa is a short-handled cutting instrument with a flat blade that is used for weeding and digging dirt in small gardens or vegetable farms. It is typically used to hoe or earth up weeds on small farms or in ridges or rows of vegetables.
20	Garden forks / Rakes	Garden Forks/Rakes are used as a broom for collecting fallen leaves, grass and hay. It can also be used for soil loosening, leveling, and mild weeding. When it comes to functioning, this equipment can be compared to a harrow used in agriculture. The teeth of hand rakes can be made of wood, iron, steel, tines, or plastic.

Various conventional (Indigenous/Old) Technologies, as shown in Fig. 1, which are still very much used and effective for most of the farmers.

Modern Agricultural & Farm Technologies used by the Indian farmers which are propelled by the tractor as shown in Fig. 2.

Manual and motor driven Technologies used by the Indian farmers which are shown in Fig. 3.

1.1 Research Objective

To understand the diffusion and awareness level of woman friendly farm tools & equipments documented by the CIAE, Bhopal in Dhoraji of district Rajkot in Gujarat.



Fig. 1. Conventional yet most widely used technologies in agriculture



Fig. 2. Tractor driven agriculture technologies



Fig. 3. Manual and motor driven agriculture technologies

2. LITERATURE REVIEW

Farmers' death is an important aspect of any farmer's related study because farmers face a variety of issues, none of which have been completely resolved, and none of which can be resolved in a single sitting. However, problems can be minimized through sound policy and decision-making that does not negatively impact the farmers' interests. Debt, drunkenness, the environment, poor produce prices, stress and family responsibilities, indifference, insufficient irrigation, greater cultivation costs, private money lenders, the use of chemical fertilisers, and crop failure were all cited as reasons for farmer suicides, in that order [2]. Thus, stress caused by financial obligations and family obligations received higher ratings than fertilizers and crop failure. Another research done in the same region in 2006 indicated that debt (87 percent) and a loss in one's economic situation (74 percent) were two of the most important variables contributing to suicide [2,3,4]. Farmer suicides were previously recorded by governments in a variety of quantities, ranging from 5,650 farmer suicides in 2014 to 18,241 farmer suicides in 2004 [5]. To per the Times of India, the farmer suicide rate in India was between 1.4 and 1.8 per 100,000 total population till 2005; however, estimations from 2017 and 2018 indicated an average of more than ten suicides per day, or 5760 suicides per year, in the agricultural sector. States have been

accused of falsifying with statistics on farmer suicides, leading some to believe that the genuine number is far higher. India is an agricultural country, with over 70% of the population reliant on agriculture, either directly or indirectly, for their livelihood. In the year 2017 [6], agriculture accounted for 15.4 percent of India's GDP. In the year 2020 [7], agriculture will account for around 41.49 percent of total labour. In India, farmer suicides account for 11.2% of all suicides [5].

Agriculture activists and academics have identified a variety of reasons for farmer suicides, including anti-farmer legislation, severe debt loads, inadequate government policies, subsidy corruption, crop failure, mental health issues, personal worries, and family difficulties [8,9,10].

3. METHODOLOGY OF THE RESEARCH

3.1 Process Flow of the Study

The process flow of the study is very simple and self-explanatory as shown in Fig. 4.

3.2 Geographical Area of the Study

The study was conducted in Dhoraji of district Rajkot in Gujarat. The Google map location is shown in Fig. 5.

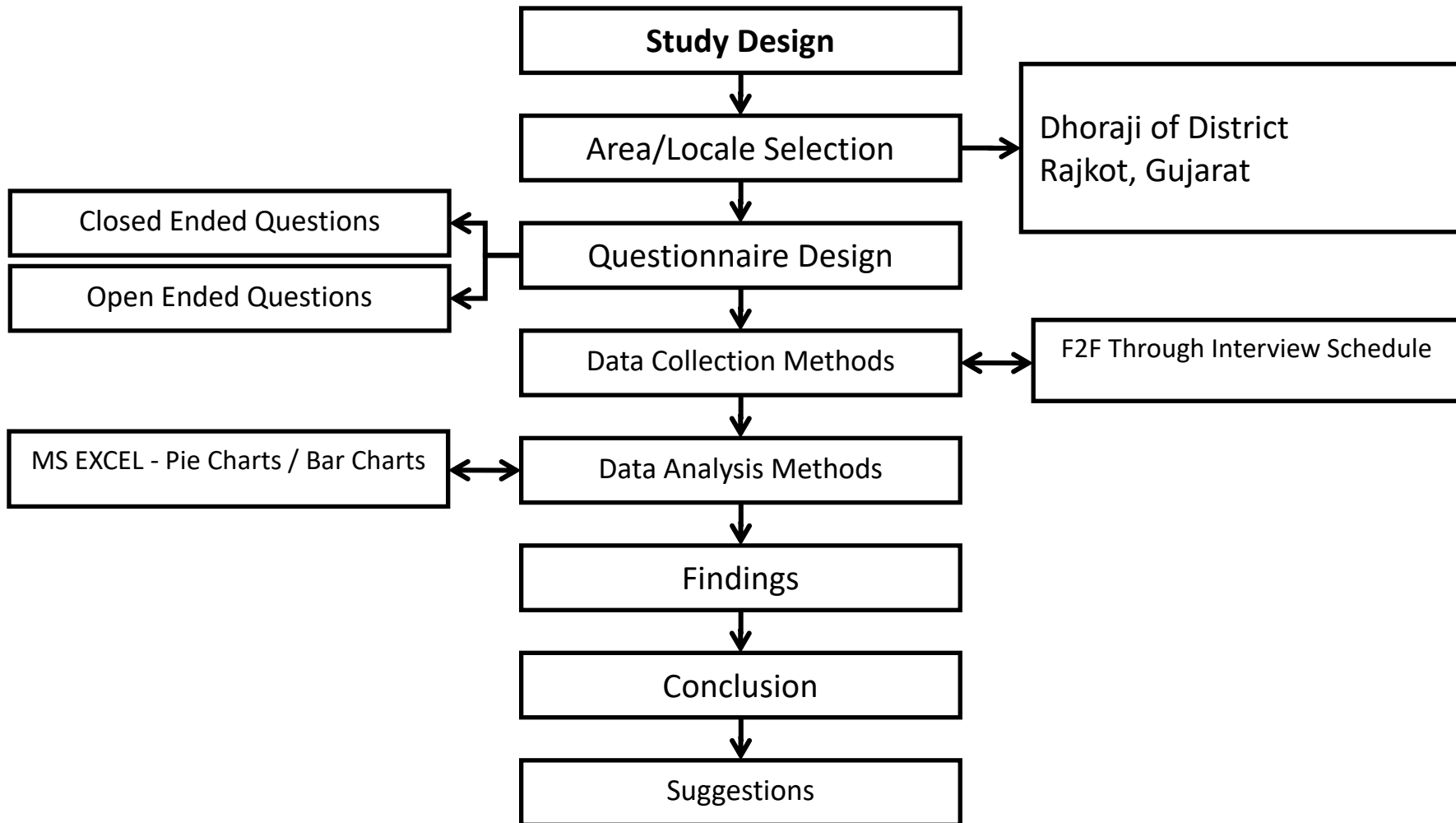


Fig. 4. Research design



Fig. 5. Women Friendly Farm Tools & Equipments Taken from ICAR- Central Institute of Agricultural Engineering (ICAR-CIAE), Nabi Bagh, Bhopal

3.3 Data Collection

The primary data were collected using a well designed questionnaire with two types of questions (Open ended and closed ended questions) through face to face interview schedule basis. This study tried to find the current status of 'diffusion and awareness of woman friendly farm tools & equipments (from CIAE, Bhopal) among the farmers' and for that reason a list was downloaded from this link - <https://aicrp.icar.gov.in/esa/woman-friendly-farm-tools-and-equipment/> [ICAR- Central Institute of Agricultural Engineering (ICAR-CIAE), Nabi Bagh, Bhopal]

The list of woman friendly farm tools & equipments is shown in Fig. 5.

3.4 Data Analysis

The data were collected using the list of Fig. 5 and the analysis is provided as below:

Q.1 How many of the above technologies you know/aware about? Count & Write Nos, if yes

The final results of the above question are shown in the Fig. 6. Most of the given technologies shown are facing lack of awareness as per the graph. Only chipiya (uprooter) is comparatively known by the farmers followed by fertiliser broadcaster. Rest technologies are unknown to the farmers. Government and ICAR have to take a note of this analysis and take initiatives to spread the awareness & benefits of these technologies among the farmers.

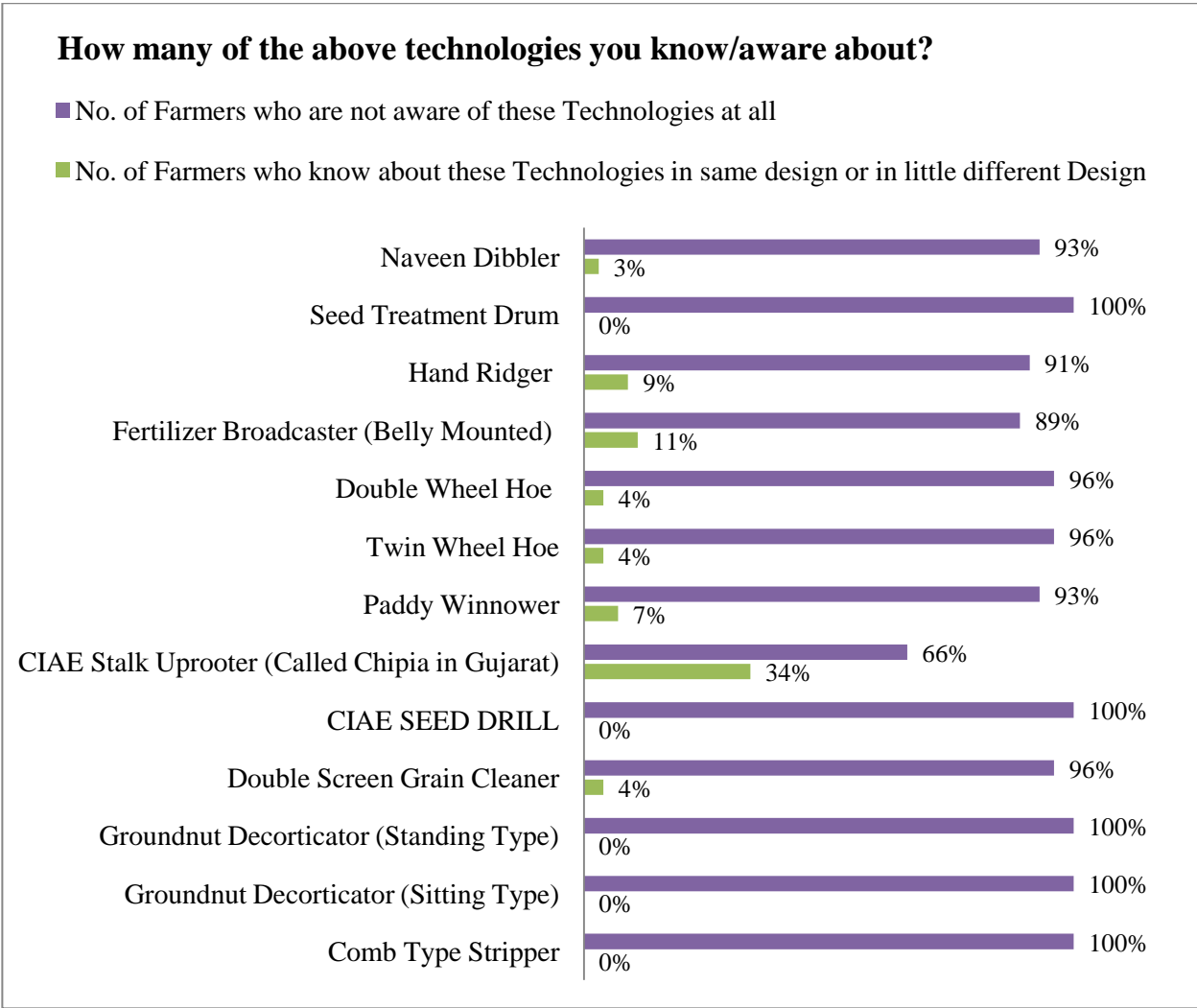


Fig. 6. Graphical representation of the question on “How many of the above technologies you know/aware about?” in the form of Bar Chart

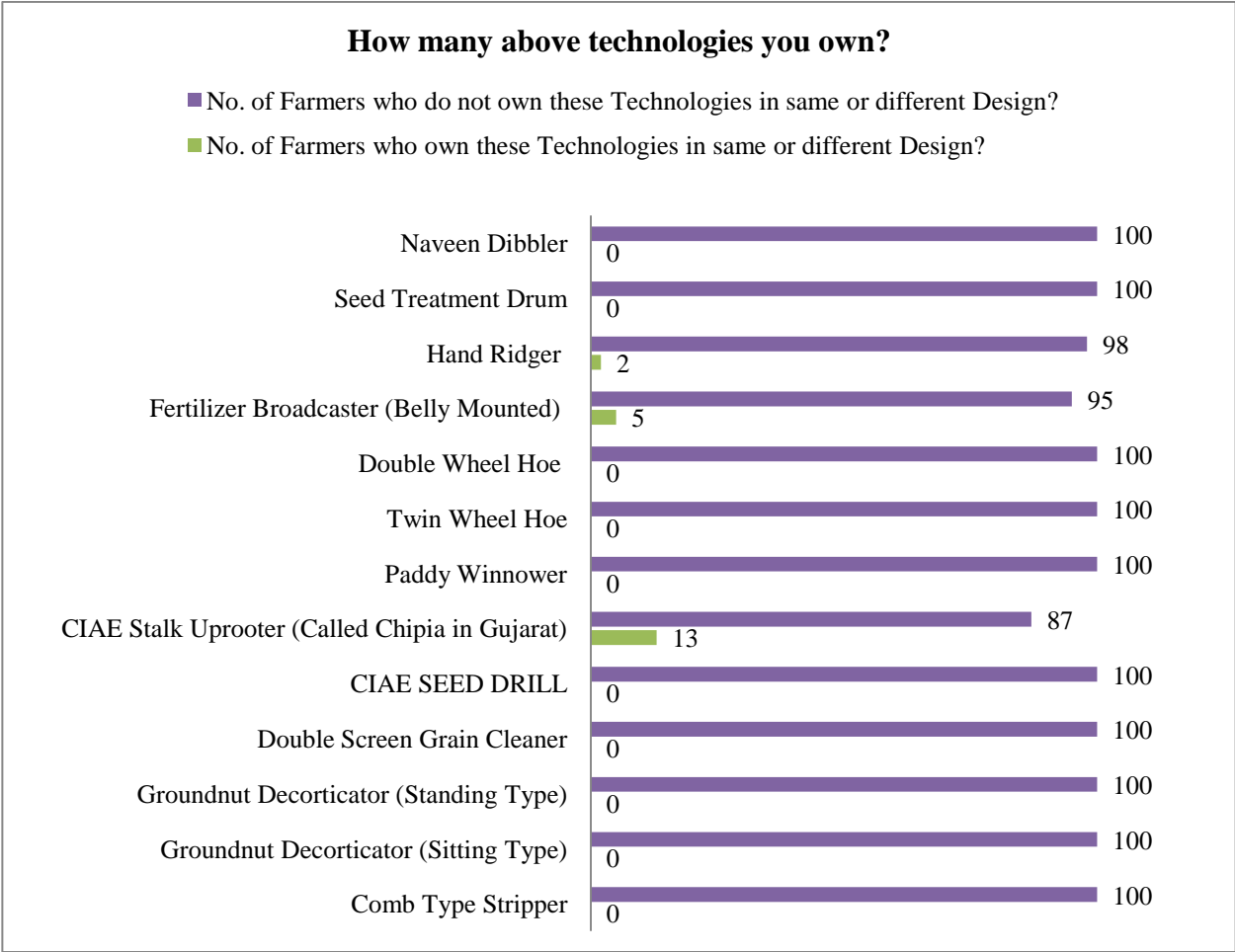


Fig. 7. Graphical representation of the question on “How many above technologies you own?” in the form of Bar Chart

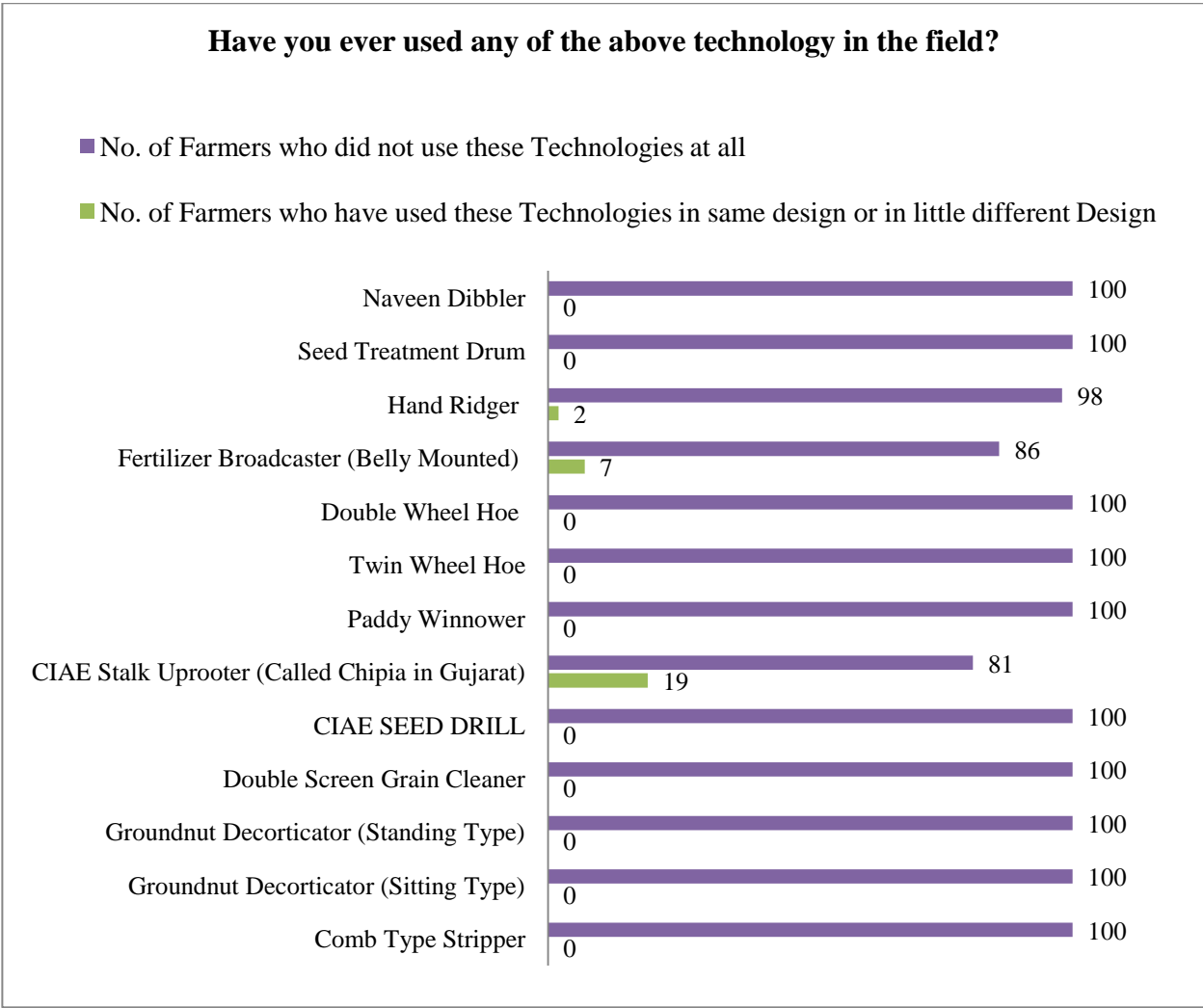


Fig. 8. Graphical representation of the question on “Have you ever used any of the above technology in the field?” in the form of Bar Chart

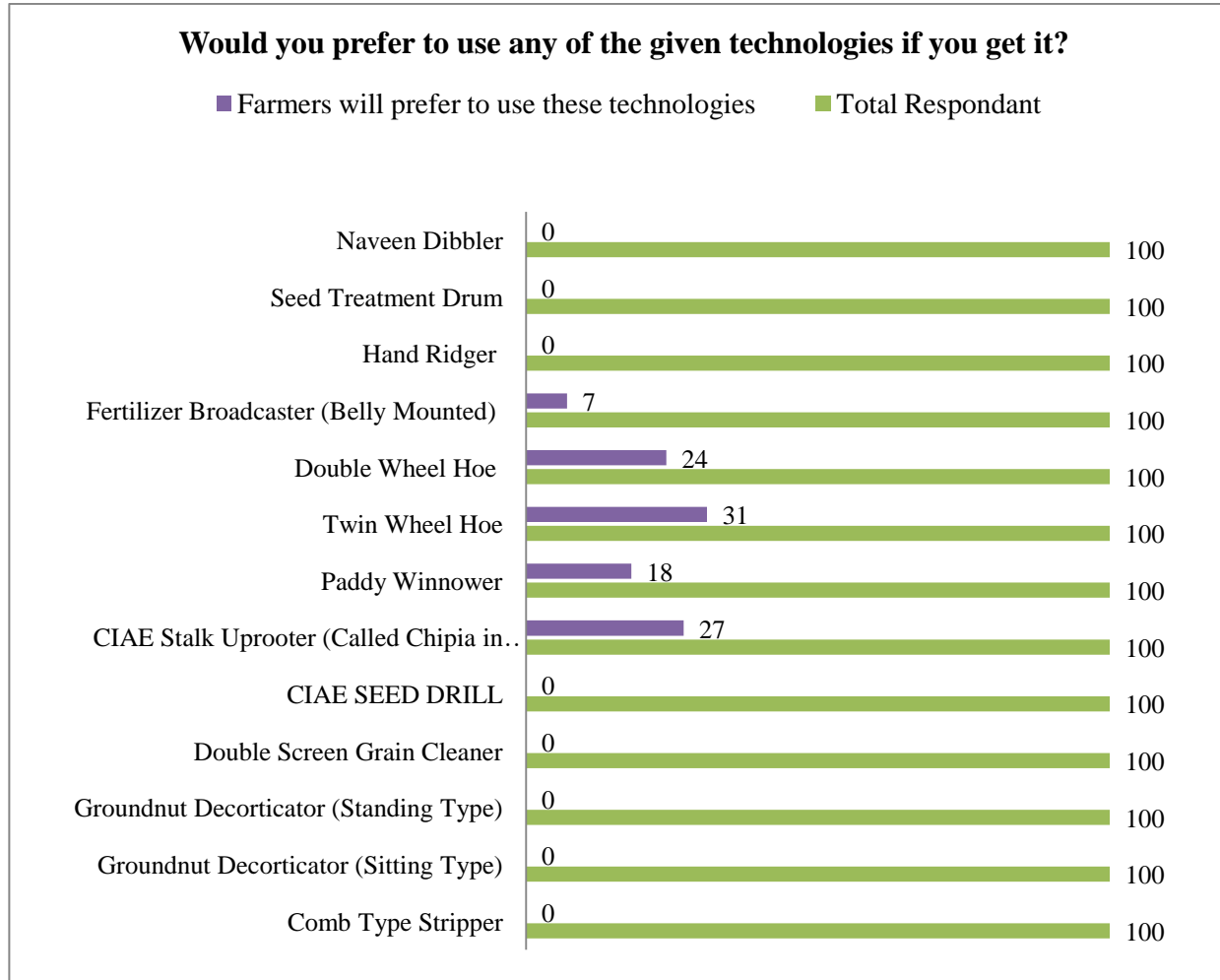


Fig. 9. Graphical representation of the question on “Would you prefer to use any of the given technologies if you get it?” in the form of Bar Chart

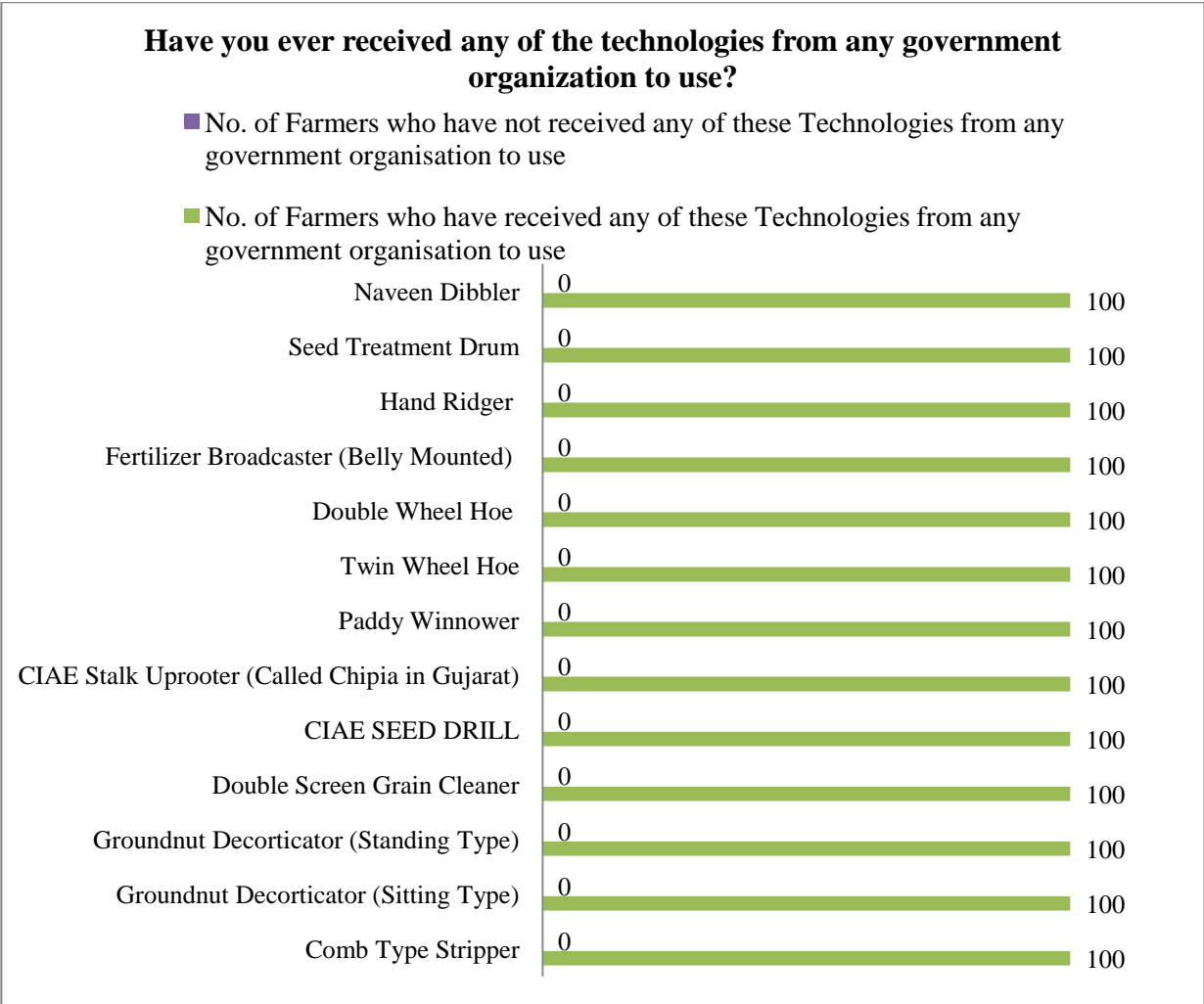


Fig. 10. Graphical representation of the question on “Have you ever received any of the technologies from any government organization to use?” in the form of Bar Chart

Q.2 How many above technologies you own? Write Nos. from 1 to 13, if you own

The final results of the above question are shown in the Fig. 7. Most of the given technologies shown are facing lack of diffusion as per the graph. Only chipiya (uprooter) is comparatively used and known by the farmers followed by fertiliser broadcaster and ridger. Rest technologies are either unknown to the farmers or very less diffusion has happened so far. Government has to take a note of this analysis and take initiatives to penetrate the technology among the farmers to bring efficiency, productivity, and ease of work.

Q.3 Have you ever used any of the above technology in the field? Write Nos. from 1 to 13, if yes

The final results of the above question are shown in the Fig. 8. Most of the given technologies shown are facing lack of awareness and diffusion as per the graph. Only chipiya (uprooter), fertiliser broadcaster, and hand ridger are comparatively used and known by the some farmers however most of the farmers are unknown to these technologies. Rest technologies are either unknown to the farmers or very less diffusion has happened so far. In case of fertiliser broadcaster, few farmers has borrowed & used it. Government has to take a note of this analysis and take initiatives to penetrate the technology among the farmers to bring efficiency, productivity, and ease of work.

Q.4 Would you prefer to use any of the given technologies if you get it? Choose nos. from snaps

The final results of the above question are shown in the Fig. 9. Farmers are willing to use few of the technologies based on the photo shown however if these farmers are educated & actually shown how these technologies work and what the benefits are. The willingness to use these technologies may increase drastically. Farmers have shown interest in twin wheel hoe, fertiliser broadcaster, paddy winnower, and uprooter. Farmers are not aware about either the benefits of the technologies or the technology itself and hence Government and its institutions to spread awareness & distribute some of the technologies free of cost. Institute continuously visit the farmers, train them, tell about the advantages of the given technologies, monitor it by frequent visits at the farmers place to ensure that farmers are used to of these technologies.

Q.5 Have you ever received any of the technologies from any government organization to use? Write Answer in Yes / No

The final results of the above question are shown in the Fig. 10. No farmer has received any kind of technology from government organization to use. This is also one of the reasons that farmers are not aware about most of these technologies.

4. OUTCOME OF THE RESEARCH – FINDINGS, CONCLUSION & LIMITATIONS, AND SUGGESTIONS

4.1 Findings

Farmers are not much aware about women friendly farm equipment and technologies as only 14% farmers are aware including all schemes from state or central government, about government related schemes and their benefits and hence they could not receive benefits whereas PMKSNY has reached a decent no. of farmers (about 73%). Farmer's situation on modern & ultra modern agri-tech is very poor as compared to other developed countries. Non of the farmer (0%) is using ultra-modern techs like IoT, Sensors, Drones etc. including automatic milking machine & equipment for milking however modern techs like tractors & related machineries & equipments including small tractors are little bit (about 16%) used by the farmers in Dhoraji.

Most of the farmers (about 79%) use existing farm technologies on rental basis due to scarcity of funds, return on investment, lack of produce price (MSP), and weather conditions etc. There is a huge gap in technology awareness programs for farmers at root level as 77% of the farmers rely on indigenous/existing/conventional knowledge from their family & friends and 69% farmers decide the quality & quantity of inputs on the basis of this existing knowledge. The trends reveal that the new generation is gradually seeking some other opportunities outside of agriculture due to decreasing per capita land due to growth in population, tough to survive, aspirations, poor government policies for farmers, corruption, lack of produce rate in the market, increasing education level, etc.

In the study, it was found that if agricultural infrastructure for farming as input is supported by the government in terms of modern & ultra-modern techs, schemes like PMKSNY, natural khaad & natural & effective pesticides &

weedicides etc. at grassroots level, it will impact overall agricultural performance (productivity) as there is a positive & high correlation of these variables on agricultural output (produce). Also, Agriculture has positive & strong correlation with farmers Socio-Economic Conditions. Therefore, both the governments (state governments as well as central government) should jointly work together to facilitate the farmers with said infrastructure individually or on shared basis to uplift the current situation of the farmers not only on Dhoraji but across the country.

It is seen that through this research that the technologies which were developed by the government institutions like ICAR-CAIE, Bhopal were not diffused among the farmers in spite of a huge government infrastructure like central & state agricultural institutions, agri-colleges, KVKs, and many other research institutions in every state in India. The study has randomly chosen 13 equipments & machines from the ICAR-CAIE's list of women friendly farm tools & equipments details via <https://aicrp.icar.gov.in/esa/woman-friendly-farm-tools-and-equipment/> and 100 farmers were asked 5 questions by showing a photo (shown in Fig. 5). The results were very disappointing as below:

1. Most of the shown technologies were not known to the farmers. Only chipiya (uprooter) is comparatively known (about 34%) by the farmers followed by fertiliser broadcaster (11%) but the ownership of these technologies is very less chipiya (uprooter) about 13%, fertiliser broadcaster (5%), and hand ridger (2%) respectively. These use was little higher side of these techs like chipiya (uprooter) about 19%, and fertiliser broadcaster (7%) due to sharing of these techs to the neighbours & relatives. Farmers are interested in using many of these technologies such as fertiliser broadcaster, double and twin wheel hoes, paddy winnower, uprooter etc. The interesting point is that none of the farmers has received these any of these technologies for use.

4.2 Conclusion

Farmers work hard day & night to feed humanity however their social & economic situation is degrading day by day. Farmers favoring decisions, good government policies, ensuring MSP to root level & marginal farmers, input materials & infrastructure to be sold at lowest & subsidized rates and to ensure reaches at end

farmers, enhancing irrigation systems, enhancing farmers related social schemes such as PMKSNY, modern & ultra-modern technology awareness programs on war-footing basis, are required to uplift the farmers social & economic situation. Study reveals that farmers and agriculture have supported the Indian economy while every sector & every industry was shut in Covid-19 situation [11,12]. The overall situation of Dhoraji's farmer is not too bad as compared to Bihar, Jharkhand, UP, MP, Maharashtra etc. due to specific crops such as cotton, ground nut, soyabean etc. as farmers have good infrastructure in terms of government mandis (APMC), cotton mills, and edible oil factories which ensures that farmers sell their crops at rational price. Yet, the overall farmer's situation is not good and hence government has to focus on agriculture & agri-farming on war footing basis to bring out farmers from awful situation to good situation.

4.3 Awareness

The study recommends the distribution of low costs yet necessary technologies individually and also the awareness and diffusion & distribution of modern/ultra-modern technologies on in groups with control with NGOs, government institution with proper monitoring & control for farmers use on free or on minimum rental basis. Social schemes to be increased so that farmers get direct monetary benefits just like PMKSNY.

4.4 Limitation of the Study

The study was based on the 13 technology documented by CAIE, Bhopal. The questionnaire was prepared both in English and in Hindi along with colored printout of all the concerned technologies. The analysis was done in English for further presentations. There is always a chance that same technology might be used by the farmers in different forms.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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