Jeevika trust
village livelihood in India

AUGUST 2021

Developing Robust and Sustainable Smart Farm Solutions

Agri-tech solutions for small hold farmers in rural India

This document aims to summarise the key reasons for low returns, yields and incomes among small hold farmers in rural India and highlight some of the most promising Smart Farm solutions designed to overcome these issues whilst identifying the barriers which prevent farmers taking up these solutions.

JEEVIKA RESEARCH GROUP

Jeevika Trust

Jeevika Trust has focused on India for the last 40 years, a country where even today almost 40% of children show signs of malnutrition. We operate in remote villages where the existing challenges of poverty remain alongside new ones such as climate change.

Our projects have addressed the provision of clean water and sanitation, health care and income generation by working with those facing discrimination such as women, tribal communities, Dalits and people living with HIV. . We are now developing new approaches using appropriate technologies to help create 'smart farms' and 'smart villages' to end rural poverty and mitigate the impact of climate change.

Jeevika Trust promotes opportunities that bring hope and a sustainable future by working with our local partners towards the goal of making local people proud of Village India'

If you have any questions about this document, please get in touch with Mark Roberts, Director at Jeevika: markt@jeevika.org.uk Document last updated on: 30/06/2021

Contents

If you have any questions about this document, please get in touch with Mark Roberts, Director at Jeevika: markt@jeevika.org.uk Document last updated on: 30/06/2021

Introduction

Our project: 'Smart Farm India!'

Smart Farm India aims to double the incomes of <2Ha farmers and other food producers such as fishing communities and beekeepers in order to reduce hunger and empower small producers.

Jeevika is developing a "Smart Farm Network" to promote knowledge sharing, link solutions and encourage "open innovation" we are also working on the following demonstration projects:

- Implementing an innovative low-cost solar refrigeration unit in rural India aimed at small farmers, fishing communities and other producers to avoid wastage and bring access to higher value markets. Undertaken in partnerships with Brunel University, Institute for Social Sciences, Doug Marriott Associates and Jeevan Rekha Parishad.

- Supporting 'controlled environment' agriculture projects e.g. Khyeti "greenhouse in a box" which reduces scarce inputs such as water and increases yields whilst improving farmers' resilience to climate change.

- Linking farmers with digital (app based) and other remote solutions for advice, market access, weather forecasting and pest control.

- Promoting the development of local farmers producer groups to provide training and technical expertise to share resources and give better access to markets and fair market prices.

1. Reasons for low returns for small hold farmers in India

Nearly 90% of farmers in India are small, the average size of a farm is just 1.15 hectares and 85% of land ownership is less than 2 hectares.[1] Low incomes are a salient feature of these small hold farms, with the average income of farmers owning less than 2 hectares of land being just $70 per month.[2]

Key reasons for the low yields and incomes for these small hold farmers in rural India:

Lack of knowledge:
Poor education levels and high illiteracy means that farmers are often unaware of the latest production techniques or are unable to implement them effectively.[3] Additionally, when farmers lack the appropriate knowledge and training, they risk reducing productivity and potentially damaging their land. For instance, some of the key reasons for low agricultural productivity in Odisha include the lack of appropriate cropping systems, poor use of fertilizer, and deforestation to clear land for agriculture.[4] When these practices occur, it can increase salinity, alkalinity and aridity of the soil, reducing soil fertility and thus damaging the land that farmers hope to cultivate.[5]

Traditional farming practices:
Traditional cultivation methods, such as manual ploughing, two crop patterns and poor irrigation, can lead to low productivity and low yields.[6] Farmers, especially small holders, often fail to invest in modern technologies or machinery, since the investment is often not worthwhile for small farms that can be managed with cheaper traditional tools such as wooden ploughs, sickles and spades. Cattle are often used in Indian agriculture, but they are less productive than tractors and other machinery.

Lack of diversification:
One of the key reasons for the high levels of subsistence farming and low incomes in India is a lack of diversification.[7] Even if poor productivity rates for cereals (a popular crop in India) rose from 2.88 tons/ha to world average levels of 3.67 tons/ha, this would not solve the issue of low incomes, as a supply glut would depress prices.[8] Diversifying into a broader range of crops such as higher value vegetables or fruit would help alleviate this problem. However, diversification can be difficult for various reasons. Firstly, high yield crops in particular use a lot of water, which is often in short supply in India. Secondly, the government implements support prices for many staple crops, which can distort markets and create perverse incentives for farmers to overproduce these crops. Finally, despite the increase in productivity, yields, and incomes that would come from investing in resources such as better seeds, chemical fertilizer, and pesticides, many farmers find it difficult to access them.[9] This is due to high prices, as well as the difficulty involved in procuring these products - often farmers have to get these items from different sources, that are often far away, and they may not have items in stock consistently.

---

1 Hindustan Times, 2021

2 Hindustan Times, 2019

3 Causes of Low Productivity of Agriculture in India, Pooja Mehta

4 Development of Agriculture Sector in Odisha: Post-Liberalization Scenario, Shikta Singh, 2017

5 7 Reasons for Low Productivity in India Agriculture, DK Sinha

6 Causes of Low Productivity of Agriculture in India, Pooja Mehta

7 The World Bank, 2012

8 The India Forum, 2021

9 Development of Agriculture Sector in Odisha: Post-Liberalization Scenario, Shikta Singh, 2017

Poor infrastructure:
Without sufficient rural infrastructure, such as rural road networks, transport facilities, power supply, marketing and storage, farmers cannot easily sell their produce to retailers, and therefore they cannot realise the full value of their harvests.[10] This agri-infrastructure has not developed in line with agricultural production, so supply chains are at the mercy of a poorly organised, fragmented and inefficient sector.[11] Furthermore, poor irrigation is a prevalent problem in the agricultural sector; indeed, almost 30% of farms have no access to irrigation and rely entirely on rainfall.[12] This is a significant problem leading to low yields and volatile production that is heavily reliant on climatic conditions

Poor and fragmented supply chains:
The Indian agricultural sector has many distortions in its supply chain, and small farmers in particular remain marginalised with access to food markets that function poorly or only very locally.[13] Smallholders, limited access to markets increases their vulnerability to economic shocks and hinders opportunities that could arise if trade was easier. They are geographically dispersed and their supply is both small and inconsistent, private traders either do not source from them or require high margins to cover their costs. This lack of connectivity in the supply chain is caused by a lack of storage (specifically cold storage) facilities and inefficient transport systems. This also contributes to high levels of waste; India wastes an estimated 4-16% of its fruit and vegetables.[14]

Climate:
India's rural economy is one of the most vulnerable to climate change, according to the UN Intergovernmental Panel on Climate Change.[15] Given that almost 60% of India's farmers rely mainly on rain for irrigation, failed monsoons can cause severe fluctuations in crop yields, creating shortages which leave farmers with a substantial income shortfall.[16] This makes price support programmes useless, as the crop is often lost and there is a lack of supply. More broadly, farmers face significant climate risks which affect yields and incomes, including droughts, floods, temperature fluctuations, and unseasonal rain.

Lack of access to credit and financial services:
Many of the climate risks outlined above can leave farmers with low incomes due to under- or over-production, which leads to fluctuating prices driven by supply and demand. These issues are compounded by a lack of suitable insurance products.[17] Farmers are often not covered sufficiently, because insurance companies lack information on small farmer contract holders and are forced to charge high premiums to cover default risks. Furthermore, farmers often take out loans to finance investments in more productive technologies or to buy fertilizers and pesticides, but given their lack of credit history and low incomes, they face high interest rates or overly restrictive repayment schedules as banks refuse to lend to them so they are driven to expensive money lenders.[18] This creates a significant debt burden, and can cause stress (especially when climate issues lead to bad harvests) that has often been known to drive farmers to suicide.[19] This is a particular issue in Odisha, where droughts in 2015 led to nearly 200 farmers committing suicide in the last 6 months of the year.

---

10 Development of Agriculture Sector in Odisha: Post-Liberalization Scenario, Shikta Singh, 2017

11 International Food Policy Research Institute, 2018

12 The India Forum, 2021

13 The Food and Agriculture Organisation of the United Nations, 2015

14 The Times of India, 2018

15 BBC, 2018

16 Agricultural Crisis in India: The Root Cause and Consequences, Christopher Albert Dhas, 2009

17 Daily Pioneer, 2016

18 Agricultural Crisis in India: The Root Cause and Consequences, Christopher Albert Dhas, 2009

19 The Wire, 2016

Structural factors:
Small farms are themselves a key reason for low productivity and yields the mean size of a holding is under 2 hectares.[20] This makes investments in productive technologies economically unviable, as the upfront costs are too large to be affordable or proportionate for small hold farmers. This means that mechanised operations, water management and irrigation, and agri-tech solutions are underutilised. Dissatisfaction is also more common among small farmers: 76% of those dissatisfied with farming operate 1 hectare or less, and are subsequently more likely to leave the profession.[21] Some argue that given smallholder disaffection with farming the best route for them would be to give way to larger-scale farming or even corporate agriculture . This ignores the fact that the most dissatisfied are also the more vulnerable, older, less educated, and female, who cannot readily find alternatives to farming as a source of income. However, these issues can be addressed by creating strong producer groups, sharing resources and equipment to benefit from economies of scale and collective bargaining in the market.

Social factors:
Social and cultural factors can affect farmers' decision-making in a variety of ways. For instance, many farmers often dedicate their money and resources to aspects of life other than farming investments, as these cultural aspects might be more important than promoting their economic position. In addition, **there are traditions in India of dividing land holdings between the children of a family**. This led to per capita cultivable land being reduced from 0.43 hectares to 0.23 hectares in the 20th century, leading to greater subdivision and fragmentation of land holdings.[22] Furthermore, issues such gender inequality, language barriers, and the caste system are significant barriers that compound the issues faced by many small, marginal rural farmers. These issues are explored in more detail in section 3.

Conclusion:
Subsistence farming remains common in India with most of India's agricultural produce directly consumed by the producers with what remains providing meagre returns. This is due to a combination of factors, outlined above: most Indian farmers, being poor, use outdated implements and technology, and are not able to afford costly inputs. **They are also unable to access cheap credit to invest which results in low returns and poverty level incomes**, which in turn means low savings and low levels of reinvestments. Thus, a vicious circle perpetuates the situation and stagnation in agriculture prevails

20 The Food and Agriculture Organisation of the United Nations, 2015

21 To farm or not to farm? Indian farmers in transition, Bina Agarwal and Ankush Agrawal, 2016

22 Causes of Low Productivity of Agriculture in India, Pooja Mehta

2. Agri-tech solutions for small hold farmers

There are various NGOs, charities, businesses, and academic institutions working to solve the issues outlined in section 1 by leveraging agricultural technology. At Jeevika, we believe that if we can connect these organisations, they will be able to pool resources, knowledge and expertise, to unleash the full potential of these innovations.

To achieve this, a database of these organisations detailing the scope of their work is being developed. We hope this will be a useful resource to facilitate knowledge sharing, and encourage organisations to collaborate through online meetings and other exchanges. Longer term we propose developing an interactive online map using GIS to identify and link these initiatives.
This is a summary of some of these technologies, which are grouped under three headings: 1) **Agri-tech Solutions**; 2) **Market Access Solutions**; and 3) **Other Solutions**. (link to database when available)

1. Agri-tech Solutions:

Precision agriculture:
As digitisation extends across India, a wide range of agri-tech companies are developing new technologies to help farmers increase yields, often in the form of an app that can be directly accessed by farmers using their phones. Some are simpler such as Plantix which is an image recognition pest and disease monitoring app, whilst others such as The Sowing App developed by the International Research Institute for Semi-Arid Tropics (ICRISAT) integrate a range of variables relating to climate and soil conditions to optimise harvests. Mobile phones and cheap data plans are driving uptake, although lack of access to smartphones by the poorest farmers is a limiting factor.

The agri-tech solutions offered work at varying scales. SatSure, for example, utilises satellite imagery and big data to determine agricultural conditions. Whilst this app can help with decisions such as what to sow or when to irrigate, its broader scale using remote sensing is perhaps most useful for regional or larger scale agriculture . Although most of the companies identified, focus on farming on land, there are also examples of its application in aquaculture, such as the 2020 startup Aquaconnect which uses AI and remote-sensing technologies to assist shrimp and fish farmers to improve efficiency and revenue.

At the other end of the scale, some agri-technologies have direct contact with farms via farm installed sensors or by working directly with the farmers themselves. Fasal, for example, conducts microclimate analysis at a farm level/point scale using on-site sensors allowing for real time analysis of climate, soil and crop conditions. In this case, farmers pay a monthly subscription for active crops. To date, this model has been associated with cash crops, such as grapes and citrus fruits, indicating that the technological investment may only be viable for farmers growing relatively high value produce and is potentially too expensive for many small hold farmers. In contrast, Aibono offers a more cost-effective solution, which still collects microclimate data daily directly from farmers to provide guidance to improve yields,[23] yet allows farmers to pay for the platform from yield profit. This approach attempts to accommodate the difficulties facing marginal farmers in obtaining credit.

Some agri-tech companies have a more direct approach to engaging farmers in new technology. Freshokartz provides analytics to farmers such as soil tests and past crop history, as well as operating physical centres in villages to provide farm advice and deliver resources. Other applications, like the previously mentioned Plantix app, focus on the simplicity of the technology itself to encourage uptake.

23 Aibono conducts farming in the cloud, increases yield on the ground, Vishal Krishna, 2017

Smart Farming Technology delivers an easy to use app that transfers knowledge from experts (e.g. agronomists) to farmers. Farmer engagement in the app development process also aimed to maximise relevance and ease of use. Precision Agriculture for Development is working on a range of successful projects using mobile phones to disseminate advice and support small farmers.

Beyond this, are numerous agri-tech projects operating at a national and local scale to increase yields for farmers. ICRISAT, for example, works both at a government level to promote drought resistant crops, as well as having agricultural projects in a range of Indian States.. There are also new technologies such as Geographical Information systems (Hitachi).

Controlled environment agriculture:
These provide a controlled (usually greenhouse or polytunnel) environment which gives better control over inputs such as water and pest control. This can also substantially increase crop yields and provide greater control over harvesting times as well as the diversity, types and quality of the crops which can be grown on relatively small amounts of land. They have the potential to provide small farmers with intensive high yield solutions. Examples include vertical farming techniques Vertical Future (UK), and AI technologies, that offer more sophisticated solutions, but these are generally unlikely to be accessible to small hold farmers as the costs are relatively high. Kheyti, an organisation providing low cost "greenhouse in a box" solutions, is working to make this type of agriculture accessible to the very smallest producers at reasonable cost.

Water and soil management:
Water shortages and soil degradation, as discussed in section 1, pose an increasing problem for poor farmers. Included in the database are a range of soil and water management solutions primarily using simple technologies such as deepening/widening streams, bunds, storage ponds, well refilling, and afforestation. Some focus on the restoration of water storage post extreme weather events (HiFI project) and others focus on drought-prone areas that were historically successful agricultural areas (BNGGVN). The projects typically take an holistic approach integrating education, community involvement, appropriate technologies and simple resources to develop sustainable agriculture. For example, Manuvikasa have delivered >2000 water tanks to villages, which are low maintenance, integrate local labour and microfinance and focus on the most marginalised farmers (e.g. women, low caste). The Odisha based Centre For Dignity (CFD) creates and restores small scale water resources and micro-irrigation structures by building community-based management institutions and perhaps offers an insight into in-situ project delivery for Jeevika's current pilot project.

2. Market Access Solutions:

Food supply chains:
Whilst it is clear that technologies provide opportunities to increase yields, it is also evident that access to markets and gaining high produce prices are also critical to improving the situation for poor farmers. As a consequence, online agri-marketplaces are being developed to allow producers to access the best crop prices via mobile phones (e.g Gobasco). Other farm-to-business startups aim to eliminate middlemen from the supply chain. In the case of AgriBazaar the farmers receive payment directly into their bank accounts via e-wallet AgriPay. Whilst this increases farm profitability for many farmers, it may be inaccessible to the poorest/women farmers who are unable to open a bank account. Despite this, technology to connect farmers directly to retailers is available via a range of companies in different states including Crofarm, DeHaat, Ninjacart, and Krishihub. These companies deliver fresh fruits and vegetables to retailers after procuring it directly from farmers. Krishihub also focuses on reducing wastage. An alternative approach is more conventional producer groups such as those created by the Centre for Sustainable Agriculture (CSA) which has created 25 producer organizations marketing produce under the brand name 'Sahaja Aharam'.

In addition to simply improving supply chains for farmers, some companies are using technology to integrate precision agriculture with the supply chain. For example Cropin has developed its SmartFarm application, which currently assists over 5 million farmers in farm management and also provides produce traceability from farm to fork. Intello Labs uses image processing for crop inspection and crop product grading to support farmers in gaining the best possible prices, with farmers simply paying a fee based on the number of images processed. A 2020 startup AgNext uses more advanced computer vision, spectroscopy and IoT devices merged with AI-based data sciences for instant analysis of crop quality. These latter two applications are arguably, though, more focused on food quality rather than specifically improving the life of poor farmers.

Building market linkages and strengthening producer groups:
In addition to agri-tech solutions, a number of organisations advise farmers how to obtain better market access and help develop producer groups. The Centre for Sustainable Agriculture (CSA), for example, works with more than 5000 farmers across a range of states organized into 25 producer organizations marketing their produce under the brand name 'Sahaja Aharam'. This strengthens collective resources and knowledge sharing, as well as providing better market access and improved incomes.

3. Other Solutions:

Microfinance:
In evaluating the relevance of agri-tech solutions for poor farmers, it is clear that for technologies to be successfully adopted they must be affordable for farmers. It is therefore vital that farmers have easy access to credit - a particular issue for the poorest marginal farmers. If farms are to be 'Smart Farms', consideration of social and economic constraints must also be integral to the implementation of agri-tech projects. We have therefore included examples in our database of successful microfinance programmes. These include VRUTTI whose flagship model '3Fold' supports over 40,000 smallholder farmers, enabling them to access multiple services (farm financing, market institutions, etc.). The result is greater financial resilience whilst still maintaining farm independence. Although not currently operating in India, M-Kopa is another example of an innovative microfinancing model - a pay-as-you-go (PAYG) solar market. This organisation has enabled 1 million customers in Africa to access solar lighting and other technology. It finances the poorest individuals who are unable to access finance by conventional means and therefore potentially provides a suitable model for poor farmers in India. Finally, Lendwithcare is another example of an organisation that works to make funding available by providing free finance for small, rural farmers in Pakistan, South America and Africa.

Community welfare programmes:
Although not strictly agri-tech solutions, in the process of our research, a number of community welfare programmes have been identified which help support farmers struggling as a result of the challenges they face or focus on social welfare improvements running alongside agricultural based projects. In recognition of the holistic approach required for the successful implementation of SMART Farms, these have been included in our database to maintain awareness of the breadth of tools available to facilitate positive change. Examples include Rajasthan Bal Kalyan Samiti which focuses on education and welfare of tribal families alongside provision of seeds and agricultural training, to improve lives of whole communities. A very different support mechanism is the rural distress helpline set up by CSA in response to the high suicide rate amongst farmers in rural communities.

3. Barriers to uptake for agri-tech solutions in rural India

New technologies for agriculture are being used by less than 1% of the agricultural sector in India. If various agri-tech solutions exist, with the potential to transform the fortunes of small hold farmers by increasing their yields and incomes, then **why are they not proliferating throughout the sector?**

Access to the internet:
A lack of internet services for farming communities limits their access to agricultural technology. Nearly 58% of the working population in India do not have any access to the internet; this includes significant numbers of farmers and agricultural labourers[24]. This is a considerable hindrance to growth, as mobile internet access can increase revenue for small farmers by 50% as it allows farmers to access an unlimited amount of information, from weather reports to increased price transparency so that farmers can obtain better prices for their crops, as they seek to improve their crop yields.[25] A reliable internet connection can also be used to access administrative services (such as public e-learning modules and land records), assess weather conditions (for instance, via Simputer, a portable computer used by fishermen to view weather conditions)[26], and overcome linguistic and literacy barriers (e.g. via the use of devices that convert text to speech in different languages).

Access to credit and resources:
Agricultural credit has a direct response to agricultural growth. It is essential for farmers to have access to affordable credit to sustain a good crop cycle, since they often need to borrow to purchase seeds, fertilisers,machinery and equipment, and a sufficient supply of water and power.[27] In addition, a lack of access to credit can also limit farmers' ability to invest in and adopt smart farming technology, because they lack the financial resources to do so. This can leave them in a low yield, low income poverty trap.

Poor electrical connectivity and power:
Access to energy is another crucial factor to facilitate sustainable development and poverty reduction. It is estimated that out of the 240 million people that do not have access to electricity 90% live in rural areas.[28] Furthermore, the areas that do have electricity suffer from frequent power outages; even in villages where electricity has been provided, the supply remains very unreliable with the government unable to meet the 6 hour connectivity per day target.[29] Indeed, the World Bank highlights that only 7% of people in rural areas did not experience any outages.[30] In the state of Bihar, during peak hours the electricity supply has been very poor, with electricity only being available at 30% capacity during the evening hours of 6pm to 8pm.[31] The unstable connectivity in rural areas adds to the difficulty for the farming community in using digital technology as it would not function without a reliable power source.

Lack of training and education:
A lack of education and training also makes it difficult for farmers to implement agri-tech solutions. The lack of education causes a barrier when using smart devices and apps as this becomes a complex task for farmers, therefore, the success of smart farming is dependent on farmers being educated and improving their digital literacy.

---

24 Krishi Jagran, 2020

25 The Economic Times, 2016

26 ACF Group, 2021

27 Improving access to Agricultural credit: New perspectives, Renita D'souza, 2020

28 ICRISAT, Energy and agriculture for smart villages in India, Tayyab Safdar and Brian Heap, 2016

29 ICRISAT, Energy and agriculture for smart villages in India, Tayyab Safdar and Brian Heap, 2016

30 World Bank, Power For All: Electricity access challenges in India, Sudeshna Ghosh Banerjee, Douglas Barnes, Bipul Singh, Kristy Mayer, and Hussain Samad, 2015

31 MIT, Uncertainty in Grid Expansion and Grid Supply: A Case Study in Bihar, India, Patricia Levi, 2015

Moreover, a lack of knowledge can lead to an improper use of new technologies, which can cause damage to the land which farmers heavily rely on. Consequently, in order to move away from traditional farming methods, farmers must be provided with the training in the new farming practices and technologies, not least to avoid causing lasting damage to the soil.

Finally, although many technologies and resources could be provided to small hold farmers in many instances, it is often the case that farmers are unaware that these possibilities exist. For instance, a study of farmers in Sri Lanka suggested that over 75% of farmers were unaware of e-agricultural concepts. Ho²wever, when farmers are younger, more educated, or have access to smartphones and the internet, their awareness and uptake is likely to be far stronger. This demonstrates that wider reform is necessary - people need to be digitally literate and have a suitable level of education to understand what agricultural technologies are available and how they can benefit from them. It is also valuable to provide people with specific training on these technologies, to ensure that they utilise them effectively and to overcome any apprehension that farmers might feel in leveraging these new agri-tech solutions.[32]

Small hold farms:
In agriculture**, innovation is bottled up** at the top because most land parcels are too small, hurting long term productivity. Nearly 90% of farmers in India are small and marginal, and the average size of a farm is just 1.15 hectares. 85% of land ownership is less than 2 hectares. This can be problematic when trying to introduce many of the technologies described in section 2. For instance, when land holdings are so small, even using a tractor makes no sense. Investing in technological solutions is not economically viable or desirable, as the land can be comfortably cultivated by hand and using traditional methods, given the small size. Furthermore, most technologies rely on irrigated land, and over 50% of land does not have proper irrigation due to their small size. This means that innovations such as high yielding seeds are difficult to use. Therefore, new technologies for agriculture are being used by less than 1% of the agricultural sector in India. This compares to fast technology diffusion in the manufacturing sector, where automation already threatens c. 69% of manufacturing jobs in India.[33]

One solution to this issue of small hold farms is to develop **farmer collectives and producer groups**. Indeed, farmers who are able to pool their lands to increase their effective farm size to at least 100-200 acres have been early beneficiaries of technological progress. For instance, the introduction of genetically modified cotton in 2002 saw India become the second biggest cotton exporter. However, this (along with many other) technologies rely on large farms which offer economies of scale and reduce per unit costs. **Producer groups and collectives** also have various other benefits - as larger producers, they are able to pool and share information on a broader scale, they have greater bargaining power over prices in the market, they are more able to diversify their crops, and they are more likely to be able to access financial resources and credit facilities.[34]

Social factors:
According to Oxfam, Indian women make up 75% of full-time workers on farms. However, they are still undervalued and overlooked by the government, often facing discrimintion and gender inequality. For instance, land ownership by Indian women is at just 12.8%, which is considerably lower than male ownership. This is partly due to cultural practices as well as India's inheritance laws, which prevent women from gaining ownership of the land that they work and live on. This issue is compounded by the fact that a lack of land ownership further diminishes access to credit, as women do not own land that can be used as collateral to access financing opportunities via government programmes, as these programmes require a land title. Indeed, a study in Uttar Pradesh found that only **4% of female farmers**

---

32 Sri Lankan Journal of Technology, Assessment of Current Status on Smart Farming Technologies in Batticaloa District, Sri Lanka, A. Narmilan, G. Niroash, and N. Puvanitha, 2020

33 Hindustan Times, 2021

34 A Low-Cost Information Monitoring System for Smart Farming Applications, Muhammad Saqib, Tarik Adnan Almohamad, and Raja Majid Mehmood, 2020

have access to institutional credit. It also leads to an under-representation in the data about suicides rates for female farmers, as they are not counted due to their lack of land titles.[35]

The inequality between men and women also stems from the traditional particarcial society that exists in India. Women are not afforded the same opportunities and are not viewed as equal to men, and this is apparent from the acquisition of mobile phones and access to the internet, to inheritance and land ownership laws which are still entrenched in Indian society. This gender inequality also manifests itself through a lack of literacy skills, which places women at a further disadvantage as they will be less able to harness the opportunities presented by smart farming techniques as they emerge.

Another important social factor to consider is **language**. Currently, there are between 18 and 22 unique languages commonly spoken in India. Furthermore, a 2019 study suggests that only 9.15% of the Indian population speak fluent English.[36] This may present a barrier for our potential international partners, who may not be aware of the vast majority of languages spoken. Naturally, such a barrier presents several issues both for our partners and for farmers. For instance, farmers who can't read English may find it difficult to follow instructions on using new technologies and organisations that are inexperienced in local languages may unintentionally cause confusion or even offence. This can diminish trust and reduce uptake. Therefore, organisations operating in India should educate themselves not only on the various issues that farmers face, but also on the cultural context in which they are operating. Agri-tech businesses could also use diagram-based instructions to overcome language barriers to ensure their products are accessible to people using various languages. This is particularly feasible for basic computer and smartphone operations.

Finally, large portions of Indian society are still rooted in the caste system, and the legacy of this system can create disadvantages for many small hold farmers. A recent study, using data on farming households to assess their access to modern farming resources, found that farmers from lower castes had less access to government schemes and other agricultural information. This is particularly problematic because in India, 82% of farming households belong to the socially marginalised groups like the Scheduled castes and Scheduled tribes.[37] The study also found that farmers from lower castes are less likely to contact government officials for agricultural advice in comparison to those from an upper caste, they are more likely to be small hold farmers, and more likely to lack education. All these factors reduce their income and create a cycle of increased poverty.[38]

35 The Conversation, 2021

36 Language Intelligence, 2019

37 Research Matters, 2019

38 Research Matters, 2019

Conclusion

The aim of this report has been to identify the main reasons for low returns amongst low-income farmers in India, to summarise some of the emerging agri-tech solutions that can help to address these issues, and shed light on the barriers that prevent rural farmers from adopting new technologies. While this research is by no means comprehensive, we hope that this document will add value by:

- Informing Jeevika's strategic planning and the development of our Smart Farm programme. We also hope that this research will enable us to influence and engage with corporate, public and other stakeholders.
- Helping our partner organisations and others, who are seeking to address these challenges, to better understand the practical issues and concerns faced by smallhold farmers in India.
- Inspiring the development of a Smart Farm Network which will encourage collaboration amongst organisations that are working on accessible, effective agri-tech solutions. We hope this network will promote the sharing of knowledge and the evolution of strong project partnerships.

Clearly, there are many highly innovative, exciting agri-tech solutions, but there are also considerable barriers to these being adopted by farming communities in India, who have extremely limited access to resources. The barriers that farmers face are frequently less to do with the limitations of the technology itself, and more about the socio-economic constraints that prevail. Lack of access to affordable capital, weak producer groups, limited training opportunities and sometimes poor alignment of the technologies with farmers' day-to-day needs. Developing effective solutions is made increasingly difficult by changes in climate, erratic weather patterns and, of course, the uncertainty and challenges that follow. ?

Therefore, there is a need to integrate these technologies within the social, economic and environmental constraints faced by rural farmers. In order to do this it is essential that solutions start with understanding the needs and limitations of small farmers and seek to address these by building close partnerships with local decision making bodies, farmers producer groups, individual farmers, other NGOs, government agencies, universities, training bodies and businesses.

The next steps in this research will be to:

- Gather critical feedback and review of this initial research from our partners and wider network, and understand areas for further research.
- Share this work (alongside developing our research database) with Jeevika's network, to begin a process of connecting organsitions to one another so that they can create synergies and address underlying issues to provide a strong foundation to develop agri-tech solutions.
- Begin to ideate strategies for overcoming some of the barriers outlined in this paper, in a holistic and comprehensive way. For instance, a conference or roundtable to explore in more detail how these barriers can be overcome, undertaking more local research and experimenting with different approaches, may be a valuable next steps to begin facilitating further collaboration.

Finally, the outstanding questions that we need to explore further are:

- What are the long term implications of the COVID-19 pandemic on low income farmers?
- What are the best strategies to overcome the barriers faced by smallholder farmers, especially those increasingly imposed by climate change?
- How can we design systems to encourage partnerships and knowledge sharing which will lead to the implementation of agric-tech solutions that will enable farmers to achieve sustainable and beneficial outcomes?

Further Resources

Further Resources:

- Database of agritech solutions (when available).
- Detailed case study Daspalla Odisha (baseline survey for smart farm demonstration project).
- Reports from Jeevika webinars:
    - What makes a farm Smart? (December 3rd 2020).
    - Smart Farm Challenges and Solutions (24th March 2021).
- Smart Farm Brochure and PPT.
- Jeevika Problem Tree.