Intelligent Farms:
Opportunities, Obstacles and Ideas for Smart Agriculture in India

By
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Agriculture and allied sectors are the primary source of livelihood for nearly 55 per cent of India’s population (Census 2011) but accounted only for approximately 17.8 per cent of the country’s Gross Value Added in 2019-20. The average size of farm holdings in the country are just over one hectare, with small and marginal farmers holding nearly 86 per cent of the total land holding. Small holders find it particularly difficult to invest in expensive technologies and other inputs that would improve efficiency. Additionally, the existence of many intermediaries across the value chain, challenges in access to credit and technology, limited sales channels, and lack of digital infrastructure have inhibited agricultural potential. With agricultural output being utilised as important input for various industries, including retail and e-commerce, the importance of agriculture and improving yields becomes all the more urgent. These distinctive attributes of the agriculture sector in India have made it imperative to look towards policies that improve yield, simplify value chain networks, democratise digital infrastructure, and improve access to credit and insurance.

An important solution lies in the rapid adoption of AgriTech, defined here as technologies and tools that improve yield, efficiency, and profitability by leveraging Internet of Things (IoT), big data, Artificial Intelligence (AI), Machine Learning (ML), drones, and sensors in agricultural processes to track, monitor, automate and analyse. Dubbed broadly as ‘Smart Agriculture’, wherein emerging technologies are utilised to minimise the impact of the ‘unknown’ within agriculture. For instance, weather, soil, and climatic conditions have historically been an important determinant of the agricultural processes in India. Using predictive technologies to detect erratic weather, sensors to map the specific type of climate and soil in an area, and ML algorithms that determine the appropriate crops based on this data, can substantially improve the quality and quantity of yield. The improvements in the domain of agriculture over the recent years, especially during the last century or so, have occurred hugely at the expense of exhaustive and unobstructed use of natural resources. While concern for the same was expressed much earlier, the technological advancements of the current epoch, such as those entailed within smart agriculture possess the true potential to navigate the agricultural domain on a path that is much less intrusive to the natural resources. These technological advancements (like Precision Farming) are largely dependent on an integrated system which is managed by software and driven by sensors at the backend. Furthermore, the continuous, rigorous, and robust monitoring and surveillance capabilities exhibited by drones and sensors largely surpass the once-in-a-while superficial inspections carried out manually. This enhancement is especially relevant to monitoring of farmlands the supervision of produce stored in warehouses.

This opportunity paper delves into the current agriculture scenario in India by discussing the persisting challenges on the demand and supply side of the AgriTech space. Being cognizant of the context within which the sector operates equips us to then think about the future of AgriTech in India. The report concludes by charting out a roadmap for the incorporation of smart agriculture in India, emphasising the need for a multi-stakeholder effort towards achieving this goal. The roles of the government, private entities, and startups are discussed, and the necessity of a synergistic relationship between these players, as well as the farmers themselves. The paper also highlights certain potential solutions to the existing challenges in the sector, to start this important conversation, especially considering the novel challenges that the COVID-19 pandemic brings.
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Defining Smart Agriculture

Smart agriculture is a means of farm management which involves the integration of various technologies in agricultural practices, with the aim of increasing the quality and quantity of agricultural products. These goals resonate with those of the farmer, who also wishes to improve his yield and uses the age-old, tried and tested means to do so. The change that smart agriculture brings is the technology to achieve these goals with enhanced efficiency by reducing uncertainty and excessive human effort. Smart Agriculture thus, brings a transformational methodology which intensifies the penetration of technology into an erstwhile innovation deprived sector.

There are certain dynamic dimensions associated with the domain of smart agriculture which together constitute the entirety of this concept.
Defining Smart Agriculture

'Precision' in the term precision farming refers to the provision of the exact number of inputs needed for the production of a desired quantity and quality of crops. The nature of implements used as inputs in the agricultural processes are highly unique in their availability, cost, and ease of use. The abundance of sunlight, contrasted with the low availability of water and nutrients, indicates the need for careful regulation subject to the specific needs of each crop type.

Precision Farming relies on the data-driven decisions generated with the assistance of various sensors. IoT-enabled sensors placed suitably (alongside the crops for instance, or as the need may be) collect data pertaining to lighting, temperature, soil condition (nutrient levels), humidity, CO2 / O2 levels and pest infections, among others. Various data processing methodologies then follow, to predict and further suggest corrective methods so that these essential parameters can be kept within the desirable range.

Crop Management and Monitoring

IoT-enabled sensors are installed at suitable locations near the crops in order to collect data specific to the crop. These sensors meticulously report data pertaining to temperature, precipitation, leaf water potential and overall crop health. In other words, data associated with the crop in particular is grasped and processed accordingly.

The data thus collected can be used to monitor the growth of the crops and to detect any anomalies to effectively prevent any diseases or infestations that might probably possess the potential to negatively affect the yield.

Agricultural Drones

Drones are essentially one of the most robust agricultural-tech advancements due to their ability to traverse a large area of land in a shorter span of time as compared to the same being carried out manually. They are also able to provide unobstructed photographs of the crops from above, which can be appropriately processed to detect pests and other anomalies that may impact crop health.

Furthermore, apart from surveillance capabilities, drones also possess the ability to perform tasks that would otherwise require human effort, such as planting crops, combatting pests by spraying insecticides, crop monitoring, etc. As a consequence of possessing these abilities, drones have proven to be an integral part of the Smart Agriculture revolution. Moreover, the usage of drones requires minimal network externalities to be put in place. In other words, drones require no other subordinate equipment to rely on and can function as an individual unit.

This is also one of the domains where there is a lot of potential to further enhance the capabilities. While complete automation of drone operations is more or less around the corner, the proficiency of drones in surveillance of agricultural lands can potentially be increased owing to subsequential advancements in the precision of sensors attached. Such sensors include those used to detect pests and to reveal any other anomalies that indicate a deviation from ideality.
Defining Smart Agriculture

Management of crops after they have been produced is an equally important task, since oftentimes, the lack of proper storage conditions and appropriate prevention of pests leads to immense losses of good quality produce. As much as 50 to 60 per cent of cereal grains can be lost in the storage phase simply due to technical inefficiency.

Smart agriculture provides a way around this by predicting the amount of space and the temperature of storage that shall be needed for storage of crops cultivated. It does this on the basis of the number of seeds sowed during a particular season and then calculating a rough estimate of how much yield is expected. Furthermore, cameras that are either individually installed or are a component of robots are able to keep a check on rodents and other pests by raising an alarm whenever unidentified movement is detected.

This aspect is usually not addressed appropriately in traditional agricultural settings in India and is a great incentive for smart agriculture to penetrate India.

Environmental Impact

Various aspects of traditional agricultural methodologies consist of processes that have, over time, caused excessive damage to the environment. As agriculture grows more intense than it has ever been, even relatively smaller positive developments can be scaled up to have a great impact on the overall bigger picture.

Fertilizers and insecticides have long been known to concentrate minerals and nutrients (like nitrogen) in the soil which then get through to various organisms, causing damage and even loss of life. With the advent of smart agriculture, it is possible to deliver the precise quantity of fertilizers and insecticides when required, and to the exact location so as to prevent concentration.

Furthermore, a slightly modified technique called Climate-Smart Agriculture (CSA) boasts of a technologically enhanced method that takes into consideration the varying climatic conditions which would otherwise have had a negative effect on multiple different aspects of agriculture, thereby eventually affecting the yield. CSA relies on methodologies like sustainable intensification and strengthening the resilience of the agricultural ecosystem and making it more robust to challenges induced by climate variability. Mitigating greenhouse gas emissions and avoiding deforestation also comprise of the key features that CSA relies on. CSA can achieve a triple-win situation by increasing productivity, enhancing the resilience of crops to challenges induced by climate change and reducing the emissions per each calorie or per kilo of food produced.

Post-Harvest Crop Monitoring

Management of crops after they have been produced is an equally important task, since oftentimes, the lack of proper storage conditions and appropriate prevention of pests leads to immense losses of good quality produce. As much as 50 to 60 per cent of cereal grains can be lost in the storage phase simply due to technical inefficiency.
India: Present Scenario and Challenges

Historically, Indian agriculture has faced the formidable challenge of producing more food to feed a growing population, but it faces an even more difficult challenge today and for the future — to produce more in a way that is sustainable. The agricultural sector as well as the economy it feeds is characterised by a growing population, increasing demand for agricultural products, an enhanced focus on doubling farmers’ income and intensifying aspirations of becoming an agricultural exporter. What impedes the realisation of these dreams is the production environment being constrained by systemic challenges which lead to diminishing resource efficiency and farm incomes. Fragmented landholdings, lower yield compared to global benchmarks, uncertainties and risks involved in traditional farming (e.g., instinct-based decision making) are some of the challenges faced by the agriculture sector.

Given this context, there is a need to set the agenda for the next level of growth of the agricultural sector, one that is underscored by its focus on precision agriculture and technological transformation. While the benefits of leveraging IoT in agriculture are well known in terms of resource optimisation, increased production and even increased accuracy in crop evaluations, there are significant operational and infrastructural roadblocks to smart agriculture achieving scale in India.

While some of these constraints might have to do with the demand side of the AgriTech industry, that is the end-users of agricultural technology - the farmers, still others pertain to the supply side — the government and private players pioneering AgriTech in India. It is crucial to note that there is a significant overlap between the two.

This paper first looks at certain structural challenges that lay within the field of production before exploring the arena of investments in smart agriculture in India. To begin with, the Indian agriculture industry is unorganised and unstructured, with the presence of multiple levels of intermediaries and middlemen across the agriculture value chain. Thus, the agricultural supply chain remains highly fragmented with small and marginal farmers as the primary providers of grain to the country. The impacts of this can be analysed on multiple levels.
India: Present Scenario and Challenges

In India, one of the biggest challenges in adopting smart agriculture techniques is the small field size. Since the first agriculture census over 45 years ago, the number of farms in India has more than doubled from 71 Mn in 1970-71 to 145 Mn in 2015-16, while the average farm size more than halved from 2.28 hectares (ha) to 1.08h. Between 1970-71 and 2010-11, the number of farms increased by 194 per cent, almost exactly in line with the rural population, which increased by 189 per cent. As Ramesh Chand and others pointed out in a 2011, Economic and Political Weekly research paper, this relationship reflects India’s inheritance pattern, which leads to farms divided between multiple heirs.

The Indian experience shows that small farmers are more productive than large farmers. Ramesh Chand and others show that small farmers use more inputs (such as fertilizers), use their land more intensively (planting more crops) and adopt more technology. Yet, despite this efficiency, farm incomes remain poor. It is the poor returns to farming—despite intensive efforts put in by farmers—that lie at the root of India’s farm crisis. According to the Situation Assessment Survey of Agricultural Household 2013, an average Indian farming household earns just INR 77,124 in a year, translating to INR 6,427 monthly, barely enough to cover the average monthly expenditure of INR 6,223.

According to NSSO (2014), 52 per cent of the agricultural households in rural India were indebted and the average amount of outstanding loan per agricultural household was estimated to be approximately INR 47,000. Furthermore, as per NABARD (2018) data, 44 per cent of the farmers had taken loans in 2015-16. Overall, institutional sources contributed to 60 per cent of outstanding loans in 2012-13 and 72 per cent in 2015-16. Both surveys revealed that the amount of outstanding loan and percentage of indebted farmers increased with farm size owing to better access to institutional credit.

Indebtedness to institutional sources has increased steeply with a corresponding increase in farm size, indicating how important the quantum of land possessed by a farmer is, for getting loans from institutional sources. The outstanding loans from institutional sources like banks carried low interest rates (mostly below 12 per cent per annum), compared to non-institutional sources like money-lenders or input dealers that were available for over 20 per cent interest rate per annum. Though most institutional loans were taken by farmers with below 15 per cent interest per annum, many small and tenant farmers were not able to get loans from institutional sources under unavoidable circumstances. Because farm returns often turned negative, taking recourse to loans at exorbitant interest rates continued to push small and tenant farmers into a debt trap.

Among the major States, Andhra Pradesh had the highest share of indebted agricultural households in the country (92.9 per cent) followed by Telangana (89.1 per cent) and Tamil Nadu (82.5 per cent). States with higher per capita incomes like Kerala and Punjab had higher average loan outstanding per household. The level of indebtedness among the agricultural households belonging to the lowest size class of land possessed (i.e., possessing less than 0.01 hectares of land), which also included the landless agricultural households, has significance in the situation assessment of agricultural households due to their lower level of income, increased dependence on wage/salary employment as the principal source of income, etc.

Economic factors and size of the land holdings are interdependent. Farmers with large land holdings are more willing to invest in and experiment with new technology. On the other hand, it is often not commercially viable for small farms to own new smart agriculture applications individually, since this would not be cost-efficient.

The structure of the farm economy is changing in favour of large farmers who are reaping scale economies through farm mechanisation. Increasing farmers’ cash needs are not met through institutional credit sources. Informal credit sources pull small scale farmers into a high interest-bearing debt trap.
Diverse Soil and Cropping Patterns

Given the extremely diverse soil types and corresponding cropping patterns across India, the farming requirements (quantity of water, exposure to sunlight, type of fertilizer etc.) vary greatly. It is therefore more challenging to develop geographical and crop-based customised AI technologies or products.

Additionally, it is common for farmers to consider their entire fields as single farming units. That approach is, however, far from being effective for the application and management of IoT in agriculture. Precision agriculture, for example, requires farmers to divide their lands into several smaller ‘management zones’. The zones must be divided with respect to the soil sampling requirements (different zones have varying soil qualities) and fertilizer requirements. The number of zones on a field, and their respective sizes, should depend on the overall size of the growing area. There is not enough data for the farmers to refer to regarding the division of such zones, and a lack of awareness of the same adds to their reluctance in adopting smart agriculture techniques.

As an alternative, many farmers continue to follow uniform fertilizer application and/or irrigation methods for the entire farm, leading to suboptimal results. Typically, the production function is not the same for all crops, differs in the various zones of a farm, and also changes over the crop/plant-growth cycle. Unless the farmer is aware of this varying production function, there will always remain the chance of application of inputs in incorrect amounts (spraying too much of nitrogen fertilizer, for example), resulting in crop damages.
Digital Divide

In many remote rural areas across the country, strong, stable internet connectivity is still not available. As on 31 March 2020, broadband penetration in rural India stood at a meagre average of 29.2 per cent, with states like Bihar, Uttar Pradesh, Madhya Pradesh, and West Bengal with even lower rates. Unless the network performances and bandwidth speeds are significantly improved, implementation of digital farming will remain a challenge. Since numerous agro-sensors and gateways depend on cloud services for data transmission and storage, cloud-based computing also needs to become stronger. Another pressing issue is the lack of network connectivity in farmlands that have tall, dense trees and/or hilly terrains, which in turn hampers the reception of GPS signals. Majority of the small-holder farmers have a negative attitude towards adoption of CSA and other related new technologies as opposed to their traditional agriculture methods. They need to be sensitised to this change by emphasising on the need for training programs which empower them with the knowledge of advanced techniques.

High illiteracy rate among farmers is a hindrance in the advent of smart agriculture in India. The lack of education and awareness regarding the technology usage and benefits holds them back from adopting advanced techniques in agriculture practices. Various initiatives taken by public and private sector towards ICT adaptability in agriculture have not generated the desired results in terms of awareness, and adoption of the same. They have, however, proved beneficial in improving productivity, reducing cost, and fetching higher returns. A study on the application of remote sensing and GIS, conducted by Sahoo reveals that, in general, Indian farmers face difficulties in understanding the following technical aspects of precision farming:

- Inadequate understanding of agronomic factors.
- Lack of understanding of geo-statistics necessary for understanding spatial variability of crop and soil adopting mapping software.
- Limited ability to integrate information from diverse sources with varying resolution and intensity.

Lack of Customisation

To ensure effective dissemination of smart agricultural technologies, it is important to consider the adaptability and accessibility of such technology. The technology needs to be analysed from a socio-cultural standpoint. An innovation can be groundbreaking in and of itself, but unless it is localised to meet geographical, socio-cultural and demographic-related needs in India, it won’t be used. This lack of customisation results in their inadequate rate of adoption and dissemination. It is already very difficult for new age technologies to reach farmers due to lack of connectivity, in addition to the fact that farmers lack trust in technology, resulting in a low adoption rate.
Lack of Coordination Between Stakeholders

The agricultural landscape today comprises not just the farmer, the aggregator, the wholesaler, and the retailer, but also includes the meteorological department, ministries and state agricultural universities. While this means that advisories can reach the farmer through multiple channels, it might also mean that, due to low levels of collaboration, different advisories for the same geographic area might reach the farmer at the same time. This could confuse the farmers and prevent them from taking the right decision at the right time. AgriTech startups should harness their true potential in digital farming through collaborations and partnerships with agricultural universities, or through public private partnerships.

Supply-Side Constraints

Unreliable Data Sets

In order to provide accurate predictive analysis, any AI-based model relies on several input data points such as topography, soil, weather, seed types, cropping practices, diseases and pest patterns. The access to this data remains fraught with tension. Often, such data is not available publicly and held by disparate entities. Furthermore, data including farm output, which is collected manually and not by using scientific methodologies, is often unreliable for important decision-making.

Currently, The Ministry of Agriculture and Farmers Welfare (MoA&FW), Government of India, maintains around 80 portals, and state departments and universities operate around 800 portals. The data required to provide farmers with accurate predictions as well as financial services might often be highly fragmented. What is more is that with the advent of smart agriculture, more data might be stored with drones and other monitoring devices or apps, leading to further splintering of data making it difficult to undertake efficient private initiatives as well as policy actions.
Investment Gaps

The share of agriculture in India’s GDP has reached almost 20 per cent for the first time in the last 17 years, making it the sole bright spot in GDP performance during 2020-21, according to the Economic Survey 2020-2021. Investment in any sector is the key to its growth. Given the limited fiscal space, the Indian government has been promoting private investments, however the share of private investments has shrunk as share of gross capital formation has fallen, from 8 per cent in FY12 to 6.5 per cent in FY19, according to the Ministry of Agriculture and Farmers welfare report.

The official data shows that between FY12 and FY17, the period for which comparative data are available, public investment remained static at 0.3-0.4 per cent of GDP (at 2011-12 base, market price). Private investment fell from 2.7 per cent to 1.8 per cent, dragging the overall investment from 3.1 per cent of the GDP to 2.2 per cent (according to the Agricultural Statistics, 2017).

However, India’s AgriTech market has a significant runway for growth given the nascent stage of digital solutions coupled with the large base of our agricultural sector. The country is blessed with large arable land which has 15 agro-climatic zones — almost all types of weather conditions suitable for growing a variety of crops ranging from pulses to cotton. Multiple factors such as the size and significance of the agriculture industry, its contribution to the country’s economy, and the robustness of the digital ecosystem define the AgriTech maturity of a country.

There are more than 500 AgriTech startups in India that are trying to solve multi-dimensional problems prevalent in Indian agriculture including low productivity, sub-optimal efficiency in the supply chain, lack of access to markets, institutional credit, crop insurance, quality inputs and market linkages. Of these, diversified solution providers will be able to maximise impact, acting as a one stop solution to farmers by consolidating startups across different segments. The use of nano-technology for the enhancement of food quality and also safety through efficient use of inputs is near in the future. Along with this, the new technologies in agriculture, private investments especially on research and development, government efforts to rejuvenate the cooperative movement to address the problems of small holdings and small produce etc. are changing the face of agriculture in India.
Future Roadmap:
The Way Forward

As per the Draft Agriculture Export Policy, 2018, the Government of India (GoI) is aiming to increase India’s agricultural export valuation to USD 60 Bn by 2022. Precision agriculture and technology interventions can play a transformative role in improving the export supply chains and thus helping achieve Indian agriculture’s true growth potential.

With the rapid penetration of the internet and smartphones which are 5G-enabled, India is well placed to develop an ecosystem conducive to the adoption of AI and related technologies in agriculture. This must be complemented with strong policy support as well as coordinated response from agri startups, agri value chain players, tech corporations and the Government to boost the last mile reach of existing and future technologies. We expect the AgriTech sector in India, still in its nascent stages, to respond to the roadblocks it faces in conjunction with the government. This is an important stride to take as it would strengthen the functioning of farming practices and help boost exposure to the outside world.

The overall AI in agriculture market is projected to grow from an estimated USD 1 Bn in 2020 to USD 4 Bn by 2026, at a CAGR of 25.5 per cent between 2020 and 2026. The market growth will be led by the increasing implementation of data generation through sensors and aerial images for crops, and government support for the adoption of digital agricultural techniques. Presently, the market size of AgriTech, including AI-based agricultural startups in India is estimated to be USD 204 Mn. Indian AgriTech market potential is estimated at USD 24 Bn whilst the current market penetration is only about 1 per cent, according to EY.

This wave of digitisation tries to address structural challenges, like diverse cropping patterns and climatic conditions by enabling instant access to information for the farmer. Digitisation makes data management easier and shortens the length of communication paths a farmer undergoes to procure loans, identify the health of crops and ascertain the most viable crops for their land. To improve the efficiency of distribution of digital agricultural products as well as their reach, all stakeholders must collaborate with each other. Such a cohesive system will ease access to information for farmers at affordable prices.
Research & Development in Smart Agriculture

A focus on research and development for technological innovations is essential for AgriTech development. Consequently, a major push is required from the government in encouraging research efforts specifically in the field of agriculture. Identifying this gap, several policy initiatives by GoI have promoted investments and startups in India’s agricultural economy. Aspire was launched by the GoI in 2017 with the view to set up a network of technology and incubation centres, and to promote startups for innovation and entrepreneurship in rural and agriculture-based industries. Platforms like Startup India have tremendously increased the ease with which AgriTech startups can access incubators, mentors and investors. The Venture Capital Finance Assistance (VCA) Scheme specialises in assisting farmers and agribusinesses through interest free loans provided by SFAC to qualifying projects to meet shortfall in the capital requirement for implementation of the project.

Contribution of Academia

Strengthening the links between private players and state agricultural universities will create an effective support system. While firms can use this as an opportunity to identify and train future employees, they can also benefit from firsthand access to the expertise of professors and researchers in the world of academia. This collaboration is thus mutually beneficial, as firms rely on university researchers for product innovations and faculty gain prestige through increased external research funds. Such public private linkages would not only provide easy access to information for farmers but would also enable the spread of information at affordable prices to farmers.
Inter-continental Collaboration

Another way to close the innovation chasm that exists in AgriTech is by employing international collaborations to drive technological progress. India and Brazil recently agreed on a Joint Plan of Action promoting information exchange between the two countries. The pacts signed under the plan focused on cooperation in the realms of agricultural technologies and expertise. Brazil has also partnered with China and several African nations to help drive growth in the AgriTech segment, while focusing on developing its own capabilities in agricultural research and models such as green agriculture and marketplace models. This is certainly something that can be replicated by India.

While access to research efforts internationally enables AgriTech firms in India to customise those technologies for the Indian landscape, this cannot be done without access to data on Indian farming. Indian Startups like Stellapps incentivise the youth from villages to gather information and train them to help the farmers in gathering the required data to enable the accurate functioning of the App, using IoT and AI.

Aggregating Data

As mentioned earlier, at present the Ministry of Agriculture and Farmers Welfare (MoA&FW), GoI, maintains around 80 portals, and state departments and universities operate around 800 portals. Since the required data may often be fragmented, it is imperative that these multiple data points or portals are aggregated into a single integrated agriculture platform. To benefit from the true potential of precision agriculture, multiple actors who have hitherto collected and provided information individually need to be brought together to consolidate agricultural data. Data from new and upcoming avenues such as drones, satellites and digital payment should be included in this effort to build an integrated platform for it to truly be an all-encompassing solution for all information on agriculture in India.

Significant steps have been taken to aggregate the data from sources such as digitised land records, photographs of standing crops, evidence of digital payments and receipts, etc. This data can be fed into a credit risk assessment algorithm, which can accurately assess farmers’ produce to provide them easy finance options and ease payouts of insurance settlements, loan recoveries, etc. Steps are being taken world over to integrate data and enable access to all stakeholders—Azerbaijan initiated a 12-month project funded by the European Space Agency, Sentinels for Sustainable Pasture Management (SenSPa), that aims to demonstrate the use of observation data of our planet and develop an inventive application for sustainable pasture management. SenSPa will cater to the needs of governmental and local authorities, public and private stakeholders, and farmers for efficient monitoring and sustainable pasture management. A good step towards leveraging technologies such as ML and AI would be to aggregate data on a unified platform.
Extensive Value Provision to the Farmers

This research will be incomplete if we don't consider the adoption of existing technologies in the first place. Due to both limited financial resources and fragmented landholdings outright purchase of equipment such as drones and even tractors don't seem prudent for a lot of farmers. Responding to this mismatch some startups like EM3 Agriservices and Tringo have already started extending their services in provisioning of renting models in some states of India in either providing facilities to rent these products or share them. However, given the spread of agriculture in India, there is scope for either Public Private Partnerships or government support in several states of India.

Incentives and Financial Support

The penetration of smart technology into the agriculture sector requires huge incentivization as previously mentioned. Government incentivisation like, Bhoomi, launched by the Karnataka State Government, maintains data on the ‘Record of Rights, Tenancy and Crops’ (RTC) which is updated by the Government and helps the farmers in obtaining crop loans, getting electricity connection, procuring subsidies, creating partition deeds, etc. Several private sector startups focusing on fintech in the agricultural sector also provide services that serve to boost financial inclusion. This is currently done using various self-owned payment gateways for farmers to ease the transactions and record cash flow, this leads to a creditworthiness assessment which boosts the productivity of the farmers and increases loyalty to the companies in the long run. This is because the financial data collected by these apps also helps farmers furnish accurate records of produce and harvest sizes often deemed necessary to procure loans from banks. It is a win-win situation both for the farmer as well as for the companies. Such enterprises mentioned above such as payment gateways would help the farmers as well as the country to improve farm activities to a huge extent.

Future Roadmap: The Way Forward
Networking and the Role of Smart Agriculture Companies

Dairy Farming startup, Stellapps, enables dairy farmers to enhance productivity by aggregating services on a common platform. Their technology provided huge opportunities for farmers to link themselves with premium markets, and services both in the financial and tech niche. Their work aspires to generate economies of scale and traceability for the farmers in the long run using IoT.

According to EY, an opportunity of USD 4.1 Bn exists in the financial services segment. Firms need to develop lending solutions which are different from existing urban lending solutions to win in this segment given the lack of financial inclusion and access to accurate data. Precision agriculture and farm management offers a significant market potential of USD 3.4 Bn and has experienced lower investment activity compared to supply chain tech and output market linkages segments. Startups need to offer more inclusive solutions in hardware, software and services which have been illustrated below keeping in mind affordability and landholding patterns.

Indian farmholdings tend to be fragmented, as mentioned previously. Also, leasing of agricultural land is prevalent in India. Thus, it’s very natural to find a farmer working on a particular plot of land in one season and on another plot in the next season. In such a scenario, equipment which can be easily installed and reinstalled and used for multiple locations during its lifetime would definitely be more attractive for the farmer to invest in.

Building Trust in Smart Agriculture Solutions

Another trend in the Indian farming ecosystem is that of a lack of trust in technology. This often results in a low adoption rate. To see a greater penetration of technology like apps and drones we expect a larger focus on socially embedded innovation that factors in the socio-cultural dynamics of a farming community. For example, vernacular language-based call centres for agricultural services; this is already being tested by the Darpan App which is available in 12 Indian languages. Additionally, investments must be made in the education of farmers in order to familiarise them with the use of new instruments. This will not only encourage farmers to use technology in their daily activities but will speed up the process by leaps and bounds as communication will become easier and solutions can be offered from the data which is procured by the farmers’ use of the technology if they choose to do it voluntarily.
The Way Forward

On a broader level it may be possible to see the emergence of end-to-end AgriTech firms or startups. As illustrated above, presently much of the data is being collected in a fragmented manner— a piece of the puzzle is with the monitoring apps, a few pieces with the fintech apps and a huge chunk of it with the banking system or the government. This might make it challenging for the startups to work with in the long run. Diversification might entail leveraging economies of scale by aiming to service a larger part of the agricultural supply chain produce. Players could rely on data collected across all the stages of the supply chain to also offer financial services to farmers.

Alternatively, the vertical integration might also extend to e-commerce with the emergence of ‘farm-to-fork’ models. This trend is already visible in the growth of firms like ‘Fresh to Home’ which provides farmers and fishermen with an app for commodity exchange. The farmers then bid with the firms electronically using the app. It also helps guide fishermen on how to use the latest technology. By dealing directly with the producer, the startup is eliminating as many as half a dozen middlemen to cut costs. It has built its own supply chain network and also uses trains and planes to move inventory. Through its website it delivers vegetables, fish and poultry in most cities in India.

The future of smart agriculture is promising in India as digitisation is here to stay. It has increased accountability using a data centered approach and this is bound to pick up in the pandemic, as most of the world shifted online. Digitisation of most industries was exacerbated by the pandemic. This has transformed the supply chain; most notably remote monitoring is possible now as the data can be used to find the best procurement points with the use of machine learning optimisation. Digitisation has enabled the collection of vast amounts of data from various parts of the country making inputs about quality and quantity of production, and usage over various demographics available. More emphasis should be placed on procuring such technologies and making them digitally accessible to the farmers in the easiest way possible to ensure the best results across the country. This paves a way for future candidates entering the AgriTech sector as well as serves the current players.

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Intelligent Farms:
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