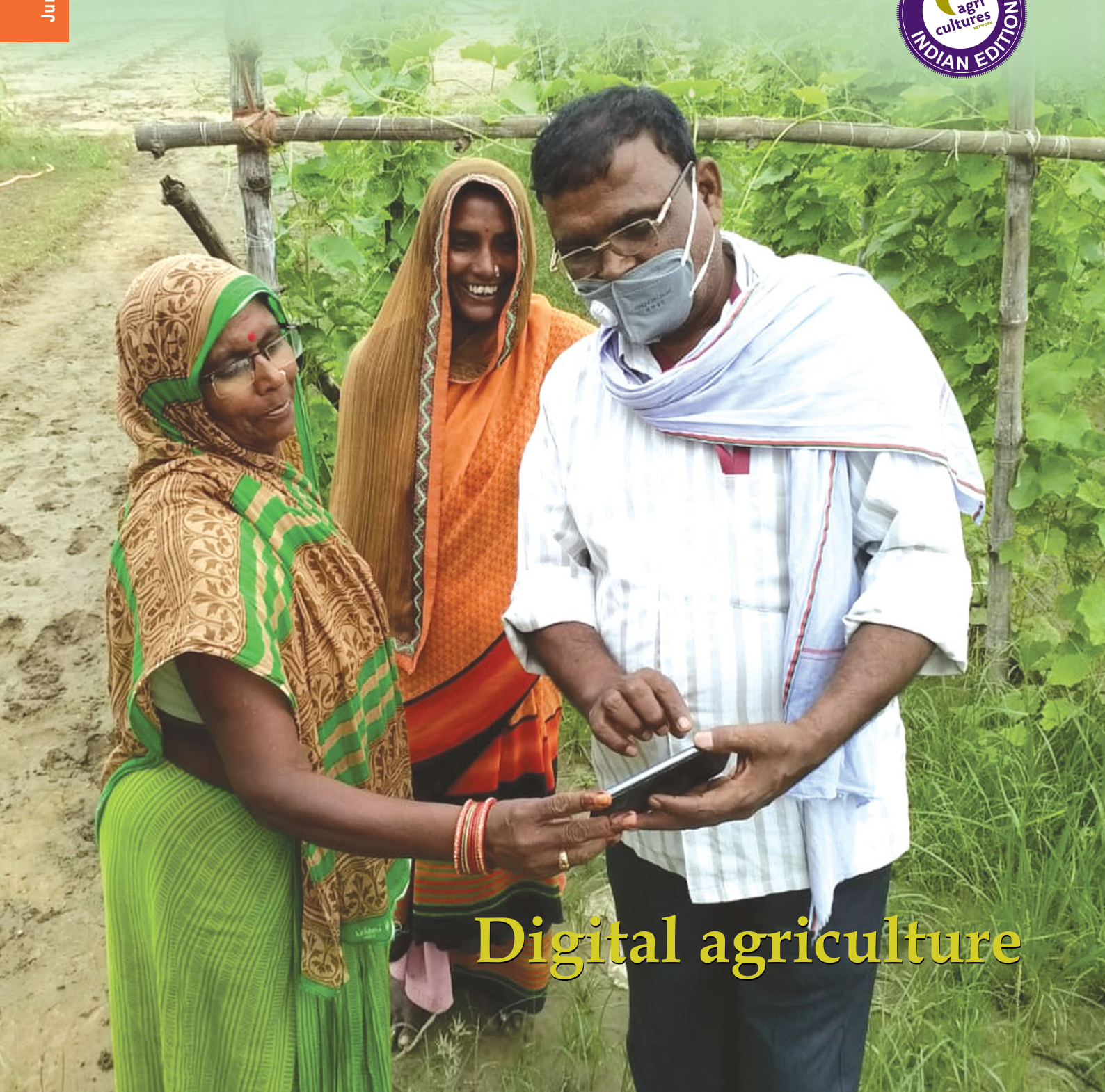
June 2020 volume 22 no.2

20 YEARS
Promoting Agroecology

LEISA INDIA

Magazine on Low External Input Sustainable Agriculture

agri cultures INDIAN EDITION



Digital agriculture

LEISA INDIA

June 2020 Volume 22 no. 2

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COVER PHOTO

Farmers increasingly learn to use the weather app during covid times
(Photo: GEAG)

The AgriCultures Network

LEISA India is a member of the global Agricultures Network. Seven organisations that provide information on small-scale, sustainable agriculture worldwide, and that publish:

Farming Matters (in English)

LEISA revista de agroecología (Latin America)

LEISA India (in English, Kannada, Tamil, Hindi, Telugu, Oriya, Marathi and Punjabi)

AGRIDAPE (West Africa, in French)

Agriculturas Experiências em Agroecologia (Brazil).

www.leisaindia.org

Dear Readers

The World is witnessing an unprecedented situation! Health workers and essential services are going about their life with utmost courage and sense of sacrifice. For farming communities, the journey continues in spite of this new crisis, besides the familiar ones like climate and markets. They are grappling with strained and near stagnant forward backward linkages with intermittent lockdowns.

On the other hand, the crisis has thrown up new modes of interaction, new relationships and processes. The digital technologies are creating new solutions to address social distancing!

We are extremely overwhelmed by the response we received for this issue with contributors spiritedly sharing their experiences giving new hope. We share some of these experience which inspire new ways of moving forward.

We are extremely grateful to MISEREOR who agreed to continue their support to this knowledge sharing initiative.

Hope and pray that we get over the crisis soon. For us in LEISA India team, it is yet another beginning with a stronger resolve after completing two decades!.

Your spirited response and the support with patronage and contribution keeps the movement strong, responsive, responsible and creating new hopes.

The Editors

LEISA is about Low-External-Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the bases of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors, to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge and to influence policy formulation to create a conducive environment for its further development. LEISA is a concept, an approach and a political message.

AMEF is a member of AgriCultures Network, which is involved in co-creation and sharing of knowledge on family farming and agro ecology. The network is locally rooted and globally connected. Besides magazines, the network is involved in multi stake holders' engagement and policy advocacy for promotion of small holder family farming and agroecology. The network consists of members from Brazil, Ethiopia, India, Netherlands, Peru and Senegal. The secretariat of the network is located in IED Afrique, Dakar, Senegal.

MISEREOR founded in 1958 is the German Catholic Bishops' Organisation for Development Cooperation. For over 50 years MISEREOR has been committed to fighting poverty in Africa, Asia and Latin America. MISEREOR's support is available to any human being in need – regardless of their religion, ethnicity or gender. MISEREOR believes in supporting initiatives driven and owned by the poor and the disadvantaged. It prefers to work in partnership with its local partners. Together with the beneficiaries, the partners involved help shape local development processes and implement the projects. This is how MISEREOR, together with its partners, responds to constantly changing challenges. (www.misereor.de; www.misereor.org)

AME Foundation promotes sustainable livelihoods through combining indigenous knowledge and innovative technologies for Low-External-Input natural resource management. Towards this objective, AME Foundation works with small and marginal farmers in the Deccan Plateau region by generating farming alternatives, enriching the knowledge base, training, linking development agencies and sharing experience.

AMEF is working closely with interested groups of farmers in clusters of villages, to enable them to generate and adopt alternative farming practices. These locations with enhanced visibility are utilised as learning situations for practitioners and promoters of eco-farming systems, which includes NGOs and NGO networks. **www.amefound.org**

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Small farms can become efficient when tacit knowledge of farmers is integrated with explicit knowledge from other sources. ICAR's initiative has shown that this could be possible by adopting digital tools.

33 Bringing digital technology to farmers' door steps

B K Singh, Ajay Singh and Archana Srivastava

Today we are more dependent on digital technologies than ever before. This paradigm shift towards digital technologies should not further marginalise the small and marginal farming communities, who ensure our food security. GEAG with the support of DST empowered 1200 small farmers to perform farming with greater precision in emerging weather shocks, using digital technologies.

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Digital agriculture

Increasing population, degrading natural resources and climate change are some of the challenging issues facing agriculture. The consequences are increased uncertainties of farm livelihoods, productivity and incomes; increasing challenges of hunger, malnutrition, food and nutrition insecurity.

Farm production and efficiency has to be enhanced to meet the growing demand for food. Agricultural operations have to be run differently using new technologies leading to more profitable, efficient, safe, and environmentally friendly farms. Digital technology is one such technology which is now gaining momentum in agriculture.

While some of the digital innovations seem to apply to large scale farming, even small holder farming can benefit greatly from digital applications. Digital tools can make smallholder farming more resilient, productive and profitable. There are already good examples illustrating this. This issue includes some of those experiences.

Small farmers and digital initiatives

Small farmers can benefit in a number of ways using digital tools. Digital platforms offer significant advantages to smallholder farmers by providing list of services that help them access support services like farm advisory, inputs, finance and markets. Technology combined with data could be a driving force towards building resilient agricultural communities.

Digital platforms are being used to provide extension services, especially by the mainstream institutions. For example, ICAR CPCRI developed E-kalpa, a comprehensive farmer friendly mobile based android application to help the coconut farming community to access crop advisory (Anitha Kumari P, p.14). Similarly, FARM Mojo is an app built on IoT platform to benefit fish farmers by smart pond management (Partha B Biswas, p.28).

Technology is one aspect. Appropriate content is the key. It requires a thorough understanding of the location and expertise on the subject, as farming is location and crop specific. For instance, mKRISHI® PAWS, a mobile app was developed by ICAR-IISWC Dehradun, by involving a number of stakeholders like farmers, input dealers, extension workers and researchers working in remote and hilly regions (Bankey Bihari et.al., p.22).

Some NGOs are trying out innovative platforms. Krishi Janani's marketplace platform in Tamil Nadu is building an alternative model that emphasizes decentralization and regeneration (Usha Devi Venkatachalam, p.10).

Concerns and supportive measures

Often the skill requirement is underestimated. The paradigm shift towards digital technologies should not further marginalise the small and marginal farming communities. Alongside investment in technology, there is a growing need for investment in building capacities of communities in development of digital skills and knowledge. For example, GEAG trained 36 model farmers on crop advisories, weather advisories, geo-tagging and crop health monitoring, who serve as 'change agents' to scale up the digital interventions in Bihar and Uttar Pradesh (B K Singh, et.al., p.33).

Digital technologies should not be viewed as an absolute solution to challenges in farming. A study conducted in Dehradun found that the adoption rates were found to be higher when supplemented with conventional approaches. (Bankey Bihari et al., p.22).

Establishing a 'digital agriculture ecosystem' requires an enabling environment for innovation by farmers and agripreneurs. Partnerships with public agencies become critical in wider usage and making the initiatives more relevant and meaningful. For example, large-scale pilots on digital applications are being implemented in four districts of Bihar and Madhya Pradesh by CropIn in collaboration with State Rural Livelihood Mission (SRLM) in Bihar and MP (Krishna Kumar, p.5). The role of civil societies in this enabling role is critical as they are better in understanding the needs, the realities, creating empathetic interfaces.

Although agriculture cannot do away with grassroots institutions and human interventions, digital technologies can play an important role in helping the sector overcome specific challenges (Ram Dhulipala, p.18). Especially during the pandemic times with extended lockdown measures, there couldn't be a more opportune time for stakeholders to explore digital alternatives.

Enabling digital transformation in agriculture

Krishna Kumar

Digitalisation in agriculture is not just the future, but the present reality of global agriculture. Digital technologies have been a major potential booster to the world of agriculture. CropIn's digital solutions are helping farmers in skill-building and making them future-ready.

SmartFarm actively engages farmers by sending them advisories about best practices

Photo: CropIn

Information and Communication Technologies or simply known as ICTs are revolutionizing agriculture and contributing towards shaping a better future for farmers by creating a positive impact towards increasing their livelihoods. ICTs help in empowering the rural community by providing better access to technology, natural resources, improved agricultural technologies, effective production strategies, market access and much more through the power of modern technology.

In 2010, when the agrarian crisis was looming large on the rural areas of Karnataka where local farmers were facing a gamut of problems ranging from non-availability of finance, climatic vagaries, soil degradation, pest infestation and diseases, operational inefficiencies, and no predictability of yield, Mr. Krishna Kumar wanted to do his bit to prevent farmers' suicides and avert the agrarian crisis. He left his high rising career at GE and set up CropIn Technology Solutions- an agriculture technology solutions start-up that would address several pain points of millions of farmers across the country.

CropIn started with a vision to maximize per acre value by harnessing technology, works towards the proliferation of digital technology and data analytics that can contribute to bettering the lives of farmers and agriculture service providers in the agriculture ecosystem for the best. CropIn caters not just to one industry vertical but to many segments. The product offered to each segment varies according to the requirement and the geography involved. CropIn's product suite enables data-driven farming by connecting all the stakeholders in the Ag-ecosystem. The unique and innovative products offered by CropIn are purely B2B providing solutions for agribusinesses at different levels of the ecosystem. Our focused segments are Farming and Processing Companies; Aggregators, Exporters, Food Retailers & Traders; Agri Input Companies, which include farm machinery, seed sales, fertilizer, nutrients, pesticides etc.,;Banking and Financial Institutions; Crop Insurance Providers; Development Agencies, NGOs and government bodies; Farmers- addressed through agribusinesses.

> Developing resilience in agriculture to regular weather shocks in the short-term and to climate change in the medium to long-term is one of the biggest challenges facing Indian farmers today.

The ICT's that CropIn Technology Solutions has developed over the past decade has brought in a radical change in the agriculture sector and the results have reflected on the development it has aimed to bring in for the farmers globally.

Success stories

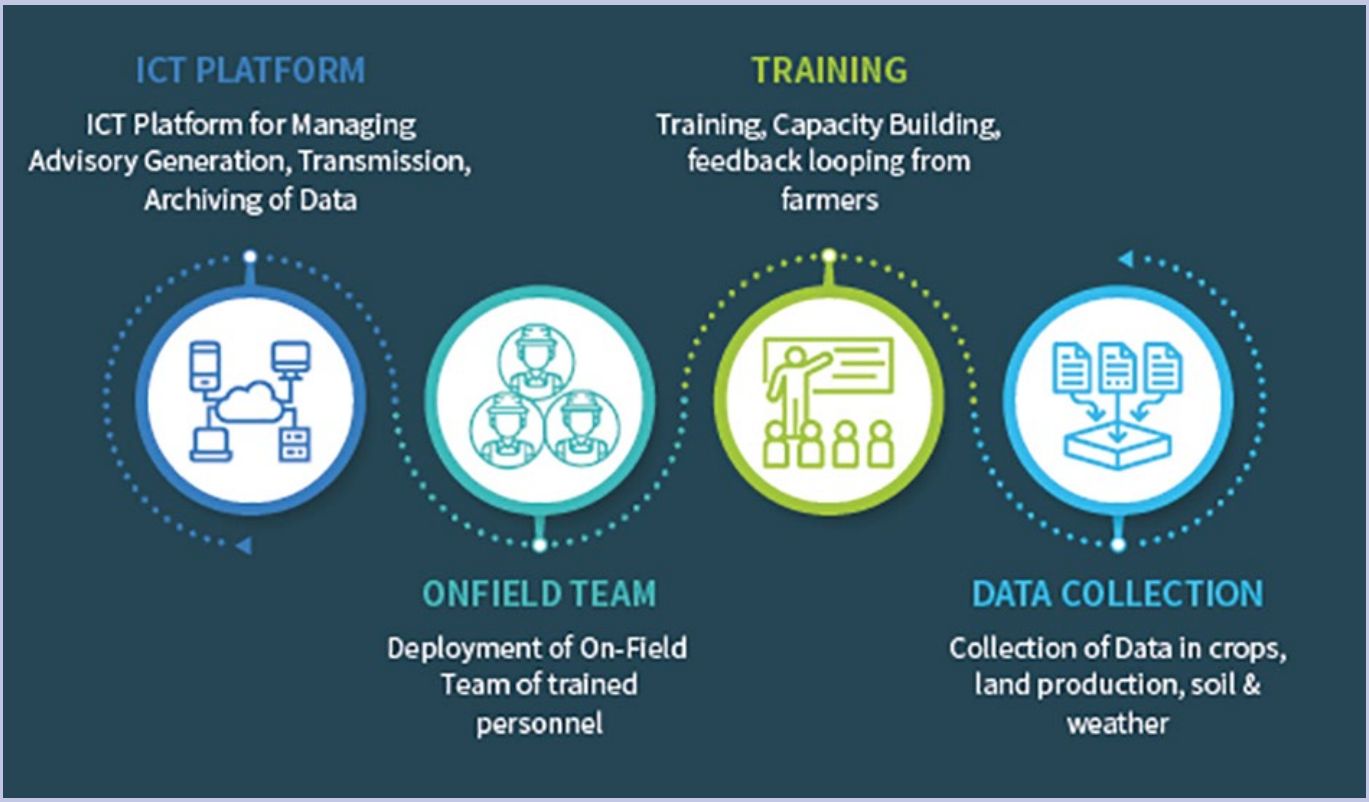
CropIn has been a pioneer in leading the AgTech sector not just as a technological visionary but also as a socio economic impactor through its collaborations with development agencies and organisations.

a) The Tata CInI Project

CropIn partnered with the Collectives for Integrated Livelihood Initiatives (CInI), a philanthropic organization established by Tata Trusts in an endeavour to uplift the lives of Central India's tribal households through their Central India Initiative. In April 2015, CInI launched its ambitious 'Mission 2020: Lakhpati Kisan – Smart Villages' program, with an aim to bring about 101,000 households irreversibly out of poverty with increased quality of life and life choices and to develop 17 blocks as regional drivers for growth across Maharashtra, Gujarat, Jharkhand, and Odisha.

Each of the 101,000 households is envisaged to earn $1590 per annum or more, compared with the baseline average yearly earnings of $530. Currently, the program impacts over 70,000 households, bringing them in the ambit of institutional structures for driving change.

To achieve goals that are inclined more towards capacity building of the farmers, CInI is primarily leveraging CropIn's SmartFarm solution to achieve the same. The field staff engage with the farmer on a day-to-day basis



and collect critical farm data using SmartFarm's easy-to-use modules. This data is stored in CropIn's centralized cloud platform and is readily available to other key stakeholders in the project for effective decision-making.

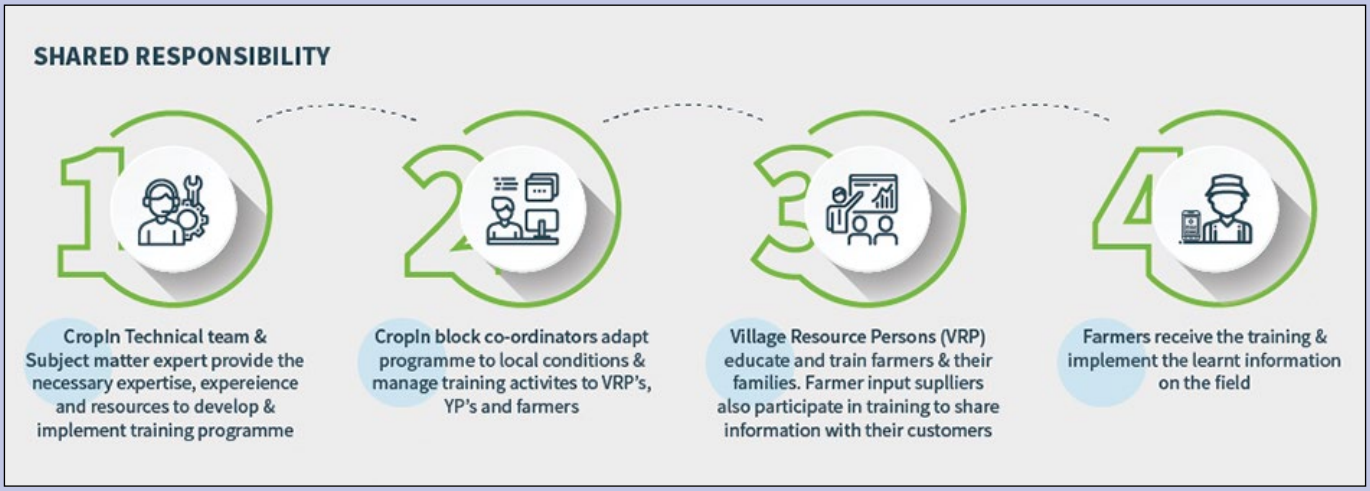
The collaboration with CropIn now enables CInI to leverage SmartFarm to intervene at every stage of the crop lifecycle and improve the livelihoods of over 4,300 farmers across Godabanda and Dhalbhumgarh regions in Jharkhand. CropIn's engagement with CInI digitised 3,400+ plots and built accurate farmer and farm profiles through proper channelisation and digitisation of data.

SmartFarm then actively engages farmers by sending them advisories about the best practices, such as the appropriate usage of chemical inputs to help them optimise their production. The application also helps monitor the field staff who engage with the farmer on a day-to-day basis, and collect critical farm data using SmartFarm's easy-to-use modules. This data is stored in CropIn's centralised cloud platform and is readily available to key stakeholders actively involved in the project for effective and timely decision-making. Lastly, SmartFarm helps analyse productivity and estimate yield, thereby allowing CInI to measure the impact of the interventions and improve outcomes going forward.

CropIn believes in technology combined with data to be a driving force towards building resilient agricultural communities and a key factor in improving nutrition, economic growth, sustainability and productivity globally. Good agricultural practises are extremely essential in achieving this goal and CropIn was successful in helping farmers adopt these practices and be future-ready for climatic unpredictability in the Jeevika Project.

b) Jeevika - The SLACC Project

The Sustainable Livelihoods and Adaptation to Climate Change (SLACC) Project for India is in association with the Government of India's National Rural Livelihoods Project (NRLP) and is supported by the World Bank. This public-private partnership project brought CropIn on-board as the preferred partner for bringing technology for climate resilience to the doorsteps of Indian farmers. The project aims to empower farmers to adopt climate-resilient practices and adapt to climatic changes and unpredictability.



Developing resilience in agriculture to regular weather shocks in the short-term and to climate change in the medium to long-term is one of the biggest challenges facing Indian farmers today. Large-scale pilots are being implemented in four districts of Bihar and Madhya Pradesh to test the effectiveness of digital apps to generate climate-resilient solutions for farming needs. This was made possible through a public-private partnership between the State Rural Livelihood Mission (SRLM) in Bihar and MP with CropIn Technology. CropIn has developed digital applications to advise farmers on ways to achieve optimal harvests, depending on weather conditions, soil and other indicators.

In order to effectively track and monitor farmer progress, there needs to be a foolproof mechanism that alerts and informs stakeholders at every level of the agro-ecosystem. CropIn's SmartFarm is a state-of-the-art farm management solution, the solution enables farmers to capture several parameters through every stage of production and monitor them systematically to increase productivity at every stage of production.

CropIn Technology has developed a climate-smart advisory module that develops season-wise crop configurations for all the major crops and provides a weather-based advisory to SLACC farmers in the local Hindi language on predictive and curative measures promoting sustainable agriculture practices. Tracking farming activities has never been easier, with better end-to-end visibility and an easy to use mobile application, farm extension workers can maintain better efficiency, transparency and alert stakeholders in the case of pest infestation or disease.

Web and mobile-based advisory dashboards have been developed to enable the Village Resource Professionals to get important insights around sowing, soil health, seed treatment, fertilizer application, and seven-day weather forecasts derived from the best available weather observation systems and forecast models. This data is then downscaled at the farm plot level to help smallholder farmers make effective decisions for their crops. The module also considers technical inputs in real-time from agriculture experts in state research institutions and farm alerts from village resource professionals to develop these practical agro-advisories.

After leveraging the technology provided by CropIn, a village resource professional was able to raise a number of alerts in Bihar and received advisories on sowing, soil health, seed treatment, and weather forecasts that benefited farmers. Over time, he developed skills to interpret technical advisories, train farmers to apply information on their fields, and interact with CropIn professionals, which earned him the status of a master trainer.

Challenges

Promoting digital solutions has its share of challenges too. The first is adaptability, specifically in India, because a majority of Agri enterprises who have already been working with conventional practices view any drastic change towards digitization with scepticism. Also, the

Box 1: CropIn digital solutions

SmartFarm: An award-winning farm management solution which enables complete digitization of farms, empowers data-driven decision-making, provides complete visibility of people, processes and field performance, along with the capability to trace and predict the output. It ensures management of a standard package of practices, adherence to compliance and certification, pest and crop health management.

SmartRisk: An agri-business intelligence solution that leverages agri-alternate data and provides risk mitigation and forecasting for effective credit risk assessment and loan recovery assistance. Proprietary machine learning algorithms built on satellite and weather data is used to give insights at plot and region level.

mWarehouse: A comprehensive solution for packhouse, processing and export companies that enables farm-to-fork traceability and compliance, quality control and flexible inventory management.

SmartSales: A comprehensive CRM and input channel management solution, that helps predict and improve sales and ensures end-to-end performance management of the sales team.

AcreSquare: A unique farmer application that helps companies interact directly with their farmers, share content, educate them and provide consultation, thus enabling companies to extend the power of technology to their farmers and cultivate farmer loyalty.

common misconception that the use of the application is only to track them and evaluate their performance only adds to the challenge and distracts them from the bigger picture.

The second is mobility and literacy. Though mobile communication and broadband connectivity are at its best yet, there are limitations in its penetration of broadband in rural areas, and there is much to improve with regards to rural literacy. Technology keeps on changing and we as a company need to be on the top of it. To stay updated with the latest advancement in technology is a time-sensitive and cost-intensive process.

These challenges subsequently affect Agtech companies' reach of expansion in working directly with the farmers. CropIn has been proactively addressing the above issues, which has enabled us to tackle the barriers better than ever before.

Impact

Farmers are now more tech-friendly and digitalisation of agriculture has broadened their perspective. After witnessing the exponential increase in yield and efficiency on their farms, they understand the advantages of bringing in a technological intervention into their farmland and have reaped the benefits of doing the same. CropIn has so far impacted the lives of 2.1 million farmers and digitized over 6.1 million acres of farmland across 52+ countries. CropIn's solutions can identify over 9,400+ crop varieties while working on more than 388 crops.

CropIn's solutions act as knowledge repositories for the farmers to have ready-made actionable insights on their farmland and to address unforeseen vagaries due to climate and pest attacks. This helps in skill-building and makes the farmer future-ready. The field agents also educate farmers on how to utilise the power of technology on their farmlands through manual training.

Digitalisation in agriculture is not just the future, but the present reality of global agriculture. Digital technologies have been a major potential booster to the world of agriculture. The impact of digitalisation in farming has brought in wonders and scaled up benchmarks for farmers in terms of food production and positively impacted their livelihoods. Digital agriculture means smarter, data-driven decision making, richer yields, high quality produce through a reliable, accurate and a sustainable system that harnesses modern technology towards crafting a better tomorrow.

◆

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Turning technology into a tool for regenerative agroecology

Usha Devi Venkatachalam

Conventional digital market platforms are extractive in nature. Krishi Janani's marketplace platform in Tamil Nadu is building an alternative model that emphasizes decentralization and regeneration. Janani Grow mobile app assists small farmers in converting to regenerative practices and finding high-value organic markets for their produce.

Krishi Janani is a five-year-old for-profit agri tech social enterprise based in Karaipalayam village in Tiruppur district in Tamil Nadu. Our mission is to create a regenerative ecosystem that nourishes farmers, consumers, companies, and the planet.

In the initial years, we were in pilot or prototyping mode. Our goal was to learn as much as we can from the field, build trust within farming communities, and fine-tune the value that technology can offer to farmers. During prototyping phase, we focused on connecting with farmers in two districts, learning about their farming practices, and aggregating them into buying groups according to their needs. Based on our findings, Krishi Janani would buy inputs in bulk and share the resulting savings with farmers in our network. The experiments were a mix of many failures, some successes, and lots of learning. During this time, we were also prototyping a technology framework that facilitates regenerative agroecology to solve agrarian crisis.

The learning during these years helped us identify the approach for the next stage of our journey - a tech-enabled growth across the entire state of Tamil Nadu. The star of this phase is Janani, a marketplace for profitable and regenerative agroecology. It is a technology platform that enables small farmers in Tamil Nadu practice transformative agriculture while also helping manufacturers find curated organic crops and products. On one side, Janani Grow mobile app assists small farmers in converting to regenerative practices and finding high-value organic markets for their produce. On the other side, Janani Market portal facilitates retailers, specialty manufacturers, and startups find traceable,

certified, and verified organic produce sourced from hundreds of small growers through Janani Market portal.

As any startup, we are slowly building a cutting-edge technology stack to serve farmers and fulfill our goals, one software component at a time. There are multiple databases in the back-end that contains information about the many stakeholders in the food value chain - farmers, organic retailers, companies, FPOs, etc. The next is the communication layer. External services that provide bulk or transactional text messaging as well as push messaging services for mobile apps are part of that stack. In the front-end are a Tamil language mobile app for farmers (currently a minimum viable product has been released on Android & iOS) and an English web portal for manufacturers and retailers (currently work in progress).

With all of the above, the most important lesson that we have learnt is this – building a technology platform is the easy part. Technology is just an all-purpose tool and enabler. It can serve an aspirational social good or exacerbate existing social ills, and do both equally well. What is hard is being thoughtful of the social, cultural, and economic tensions that turn technology into a tool of service or a weapon of destruction. I am sharing some of our thinking as we waded through various approaches before settling on a plan. It may be of use to others who are exploring similar paths or planning launch a tech-based social enterprise.

Screen shot of the App

Technology PLUS everything else

A prerequisite for thoughtful design of a technology platform is the consideration of everything else around technology. In our case, we designed a few foundational questions to consider the many non-technical factors. This exercise is especially critical in agriculture where millions of farm households will bear the brunt of wrong choices or misaligned incentive structures. These questions:

- **Ownership and Structure:** Who owns the technology and all its artefacts, especially the data and relationships? What social structure is the technology building up or reinforcing? Does the community have any say in ownership or structure?
- **Risk and Reward:** Who bears platform risks? Who gets the reward? Are risks and rewards judiciously spread out and shared?
- **Financial and Value flow:** Which direction is financial and value flow heading toward? Is it building strength and visibility of everyone in the value chain?
- **Unintended consequences and learning loops:** Creators have an intended impact in mind when they build a tech platform. In the rush to meet the intended impact, what are the other unintended consequences that we may be missing? How can we course correct and make changes based on feedback and learning? What structure do we place now to make learning loops a constant part of future plans and actions?

Exploring these questions showed us two different paths that we can potentially take. Technology as an enabler of extractive business models. Or, technology as a tool for regenerative agroecology.

Technology as an enabler of extraction

Janani is a marketplace whose success will rely on building network effects by benefiting all participants. There are many "successful" market place models, where success is defined in economic terms – growth, profits, company valuation. Amazon, Facebook, and Uber provide a few shining examples that shed a bright light on that path.

Extraction is the most appropriate term for this business model. The technology stack has been built, tweaked, rebuilt, and re-tweaked over many years. Components of the tech stack have even been released as open source software for others to use. React Native, the hybrid framework that we used to build the early version of Janani mobile app, is an open source application released and supported by Facebook. However, when we look at the "PLUS everything else," it is not a model that we want to emulate.

These are aggregation platforms and marketplaces where technology abstracts out the service providers. In the name of serving their customers, whether it is providing lower costs (Amazon) or convenience (Uber), or ease of connectivity (Facebook), these platforms separate the service providers from their users and ensures that our relationship is with the platform rather than with any individual. In this model, all **risks rest at the bottom while all rewards float to the top.** Numerous service providers vie for a winner-take-all competition for lower and lower stakes. Witness the number of Uber drivers who could not make the EMI payments on their cars. Or, sellers who realize that they have been providing a stream of data to Amazon, which used that to create a competing product. **Rewards, finances & value, ownership, and structure – all flow up and out of local communities**, to the shareholders and ultimately the executive-owners of the platform itself.

As the pitfalls in these business models become visible, these platforms are either willfully ignoring the issues or proving to be incapable of turning the tide. Witness the case of Facebook's struggle with fake news. The platform played a starring role in the decimation of the news industry by changing its algorithm to earn advertising dollars. One unintended consequence – the platform is now overrun with mala fide actors who are causing political and social chaos all over the world by planting motivated fake stories. After initially mopping up the advertising revenue, Facebook is now struggling to address this issue.

While this marketplace model may seem successful from a technical and financial perspective, this is not a sustainable model in the long-term. Extractive models, in any sector, are a relic of industrialization and its attendant centralization. They are causing damages that cannot be fixed by tweaking the system. For Janani's platform, we needed to rethink the entire model, from the ground up.

Technology as a tool for regenerative agroecology

Agriculture in Tamil Nadu already has an extraction problem. We dig deeper and deeper bore wells in search of water. We try to squeeze yield out of tired soil. The ecosystem seems to be falling apart. Climate change is increasing the frequency and intensity of weather disasters. In this situation, regenerative agroecology provides a low-cost, low-tech, long-term solution to many crises that farming communities are facing.

If regenerative agroecology is the alternate to extractive agribusiness model, what is the technology alternative? Can technology forget its extractive roots and turn into a tool for facilitating regenerative agroecology? Even better, is there a way to build a technology platform and marketplace that has regeneration in its very essence? This is the question that the Janani Marketplace is working hard at finding answers for. It is important to note that we don't have all the answers yet. In addition, some of these answers are yet to be field tested, a process that may reveal other holes in our imagination. With all these caveats, how is the Janani Marketplace addressing the foundational questions above?

- **Ownership and Structure:** Janani's marketplace is designed to allow farmers and farmer groups to own their data and relationships. While the former (data) gets some attention lately, the latter (relationships) is the critical factor that connects the producer to the consumer. Janani's platform is envisioned as a network of networks, where success depends on the aggregation and success of all other networks. This is a technologically challenging model to bring to life, especially since some of the basic capabilities of the platform – data & file storage, communication, payment processing, etc., – will be shared. Community ownership that is inclusive and sensitive to farm size and existing hierarchies can go a long way in expanding both owner and user base.
- **Risk and Reward:** Farmers are already dealing with a volatile, high-risk situation in agriculture. They do not have the bandwidth to take on the additional risk of building a platform. One of the critical areas of

work is to find value-aligned impact investors who are willing to explore various transparent models of sharing risks and rewards.

- **Financial and Value flow:** Building a technology platform that actively spreads financial and value flow across the entire value chain is one of the most exciting challenges. After mapping value flows of specific processes, Janani is working on finding alternative solutions. One example is the adoption of PGS India as the preferred method of organic certification since that will ensure knowledge created and consumed locally among farmers during the peer-review process. The platform will enable farmers to enter data and knowledge resources in one place which can then be shared with the certification body, buyers, and other farmers.

- **Unintended consequences and learning loops:** Janani Marketplace adopts agile methodology for technology development. It allows for short bursts of software development and release, with each future iteration learning from the previous release and improving upon it. This allows for feedback and learning loops to be part of the software development process. A similar approach is envisioned for field operations and activities. With multiple learning loops in action at any given time, the technology platform will learn from field operations and vice versa.

Our food systems are still functioning in archaic industrialization mindsets. Everything is centralized in this extraction-based business model. Food grows in one region. Travels many miles to be processed. And, then travels even more miles to be consumed. Covid-19 and the related disruptions have highlighted how fragile and breakable these systems are.

An alternative model that emphasizes decentralization and regeneration is the critical and urgent need of the current time. Janani's marketplace platform is building one such solution. Society needs many more regenerative solutions and answers to rebuild various parts of the food system.

◆

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Call for Articles

Small farmers and safe vegetable cultivation

Vegetables can make a significant difference to smallholder livelihoods. With minimum investment vegetable cultivation provides access to healthy and nutritious food under subsistence conditions. It also has the potential to provide an initial step towards establishing an income base for poorer households. Vegetable production provides economic, social and nutritional benefits and importantly can provide gender advantages.

Safe production of vegetables without using chemicals is gaining momentum worldwide. This is owing to increasing health awareness and concern on adverse effects of indiscriminate use of chemical fertilizers and pesticides on food quality, soil health, human health and environment. Safe and non chemical vegetables can be produced by small farmers too. This could be at the household level as kitchen gardens or homestead gardens or could be at a commercial level resulting in certified organic produce. Whichever way it is produced, vegetable farming contributes significantly to livelihood diversification and sustainability.

Of late we see a lot of educated youth getting into vegetable production. Besides being a significant part of periurban agriculture, vegetable cultivation has moved to urban areas and onto the rooftops. In the September 2020 issue of LEISA India we would like to share experiences of safe vegetable production. How are farmers growing vegetables with less resources? What organic inputs goes in the production process? How are farmers managing and marketing the produce before they perish? What value addition is being possible at farm gate or by external agencies? What are the price advantages across different markets for differently value added produce? Are there any organised institutions that help farmers in vegetable production and marketing? What is the role of women? What issues do vegetable farmers face, and how are they being addressed? What has been farmers experience in marketing vegetables during the pandemic situation?

Please send your articles to leisaindia@yahoo.co.in before 5th September 2020.

Going digital

Integrating experiential innovations in coconut farming

Anithakumari P

Small farms can become efficient when tacit knowledge of farmers is integrated with explicit knowledge from other sources. ICAR's initiative has shown that this could be possible by adopting digital tools.

More than 10 million farm families depend on coconut and coconut based farming systems for livelihood as well as nutrition of the family. Coconut is cultivated largely on small and marginal land holdings, where the contribution of family labour is predominant. Farmers adopt practices like resource recycling thereby reducing the cost of cultivation.

Homestead gardens are customized, localized and evolved, based on experiential learning of generation of farmers. Small systems are still open to learning from their own communities as well as from external sources. Information and the advisories needed for coconut cultivation are varied and are not available from a single source of the present extension systems.

Reporting right from the field

Photo: Author

Photo: Author

Field problem reporting window- click and touch for instant reporting

Technology development, dissemination and decision to adopt them in the field is not a linear simple process. It requires feedback, technology assemblage, refinement and integration with knowledge and skills of farming communities. Digital technology provides an interactive platform and the tele density of major coconut growing

Screen shot of e kalpa

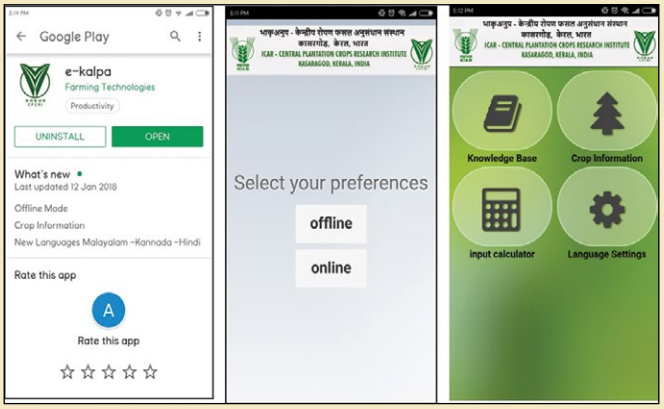

Photo: Author

states such as Tamil Nadu (115.62%), Kerala (124.17%), Karnataka (109.57%) and Andhra Pradesh (97.21%) reveal that there is a huge scope to use mobiles as a means of information sharing.

Development of farmer friendly mobile app-E Kalpa

Digital mode of communication has the strength of providing rapid advisories by providing customized and authentic information to small and marginal coconut farmers; provide right information directly at the right time, at an affordable cost. To help the coconut farming community to access crop advisory digitally, ICAR CPCRI developed E-kalpa, a comprehensive farmer friendly mobile based android application for coconut, arecanut and cocoa.

The development of the app has been a long process. Before developing the app, for three years the need and receptivity of the farming community was assessed. A study was conducted among 750 sample coconut farmers in Alappuzha district. The study revealed that 92 percent of the farmers possessed mobile phones and majority of them were having android operating system. But none of them were using mobile apps for knowledge access and were not aware too.

During 2016 a pilot version was uploaded in English language with only 30 percent of the technology snippets being in Malayalam language. From a telephone survey of the users, it was learned that farmers highly prefer technology snippets in their own local language. A multi disciplinary team of scientists and extension officials collated, edited, refined and uploaded the multi lingual technology snippets in the App.

Most of the coconut growers are marginal land holders. In coconut based homestead systems, farmers need a cafeteria of information on inter crops, mixed crops, life stock, poultry, fisheries etc., as a sustainable ecological unit to meet the economic and dietary requirements of the families. Based on the feedback and demand of the users for crop information on inter/mixed crops in the systems components such as 'Crop Information on 79 crops' and 'Input Calculator for coconut', were added subsequently. A study by ICAR CPCRI during 2017 showed that farmers highly preferred interpersonal localized sources followed by multi-colour images

supported with text format in local language. The process of modification, correction and addition is a continuous exercise for maintaining the quality, usage and authenticity of the technology snippets.

E kalpa was launched in online mode only. However, to reduce the internet dependency in rural areas and to lessen the cost, the contents were made available in offline mode also, which was well accepted. The app can be freely downloaded from google play store (https://goo.gl/b3GTk0).

Features of E-kalpa

E-Kalpa has the following features.

a) Technology snippets / knowledge base on coconut, arecanut and cocoa

The technology snippets are formulated by a team of scientists. The contents are furnished in simple language as text with appropriate images. A total of 271 technology snippets on coconut, arecanut and cocoa on varieties, production technologies, plant protection technologies, cropping systems, harvest and post-harvest technologies including machineries and processing have been developed. The contents are available in multi-language mode – Hindi, English, Malayalam, Kannada and Bengali.

The content is scrutinized for errors, if any, by a multi - disciplinary team of experts. Periodical refinement of the technology snippets based on users feedback is being adhered to systematically.

b) Input calculator for coconut

Input use for coconut plantation varies depending upon the size of the farm and the age of the palms. In the input calculator, a farmer has to enter the number of coconut palms in his garden, according to the age and with a click, the detail report of quantity of inputs (for eg., organic manure, dolomite / lime, chemical fertilizers, cowpea for basal management) for each of the palms and the total requirement will be displayed. Points to remember for fertilizer application is also provided.

Mrs. Usha Gopalakrishnan, Kottinatu house, Kayamkulam remarked that "This is a very useful and simple feature which I found to be very convenient for any coconut farmer for correctly estimating the input requirement."

c) Crop information

Coconut is mostly cultivated as the base crop of homestead system integrating various other crops qualifying it as a unit of agro forestry. Hence a small scale farmer would need information regularly and continuously on these varied crops. E-kalpa provides basic information and critical knowledge on cropping seasons, seed rates, spacing and recommendations on nutrient management of 79 crops in this component. This feature is very much useful not only for farmers but also for field level workers and extension officials.

d) Farm issue management through real time problem reporting

This is an interactive feature of 'e kalpa' for reporting field problems and accessing solutions from scientists and is available in online mode. Farmers can report the field issues or problems as and when they notice it in their field. This can be sent in the form of messages, images, audio or video. Diagnosis and solutions are provided directly by the scientist or multi-disciplinary team of scientists of ICAR CPCRI. The issue reported is automatically tagged with the mobile number and the GPS, which enables tracking of the field problems.

Besides e kalpa, other digitally available information sources on coconut by ICAR CPCRI are ICAR CPCRI You Tube channel which provides multi language content on coconut technologies and advisory services through WhatsApp and Facebook.

Outreach, usage and response

The usage of the mobile App was very slow in the initial period with 1000 to 1600 during the first two years, and picked up slowly and almost 30 percent improvement in the lockdown period compared to the previous corresponding period. Odanadu Farmer Producer Company Ltd., the FPO which is being supported by NABARD and ICAR CPCRI, conducted a rapid telephone survey among its shareholders on digital readiness. They found it to be almost absent among them, particularly old and women SHG farmers. Subsequently the FPO organised skill based training

on the use of mobile phones for accessing FaceBook, WhatsApp, mobile applications, browsing internet, YouTube and other knowledge sources on farming and networking effectively. The lesson plan is family based so that mutual learning makes it acceptable and adoptable. For enabling wider use of the app, the FPO has been promoting the app in all its shareholders meetings, training programmes and farmers meetings. Presently 5000 downloads are recorded with continuous use based on the knowledge demand of the farmer or extension officials.

A study was conducted among 100 users in 2018 on the desired attributes and found that 93.20 percent of the users perceived knowledge/technology snippets in local language as the most accepted feature followed with offline access (84.4%), direct interaction with scientists/ experts (73 %), Real time advisories for field problems (71.3%) and quick updating of information (64.90%). The study indicated that there should be concerted efforts to bridge the digital gap in skills on effective use of ICT tools among farmers. The gender perspectives needs in depth analysis to maintain equity and inclusiveness.

The real time field issue reporting was very interesting in terms of the variety of problems pertaining not only to coconut, arecanut or cocoa but on other crops in the cropping systems also. Around 80 to 85 percent of the field issues reported consisted of problems with multiple causes (eg. Yellowing of leaves), difficult to identify by the farmer (eg. Red palm weevil coupled with leaf rot disease) and hard to decipher or diagnosed (eg. Micro nutrient deficiencies or soil problems).

The app not only helped farmers in accessing information, the interactive feature/process empowered farmers and extensions officials in transferring knowledge with confidence. Mr. Jagesh Kumar, K T Sadanam, a young coconut farmer from Pathiyoor panchayath, Kerala remarked that *"farming is time critical and knowledge intensive. e-kalpa is a right tool which made information available in multiple languages, besides having very handy features like crop information on the inter/mixed crops in coconut gardens, input calculator for coconut which is flexible for individual farmer needs, and technology snippets in local language with appropriate and simple text and photos"*.

The scope of digital farming in evolving smart farms is very vast. Small farms also need to be smart and this is possible by integrating digital tools. Integration and assemblage of tacit knowledge of the farmers with the explicit knowledge from digital and other formal sources is the way forward for being practically smart in the scenarios of climate change and market challenges. Recent experience showed that digital knowledge resources are of practical value and within the reach of farmers or customers, even in the remote areas, especially during the times of pandemic.

However, it is not devoid of challenges. Poor internet connectivity was perceived to be the greatest limitation by many users. Other major challenges include the amount of time required for direct interaction and meeting deadlines for quick responses since multiple expert consultation was required for solutions. Also coordination of operations in multi language mode was found to be very challenging. Some innovative solutions for bridging the gap include 'Common digital facility centres with Wi Fi spots at local points' and 'Community digital master farmers' training programmes'. Digital based information applications could support and serve the multiple stake holders in coconut farming placing the farmers in the front line.

The interactive app empowered farmers and extensions officials in gaining and transferring knowledge with confidence.

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Leveraging digital tools

For adaptive food systems in India during the COVID-19 lockdown

Ram Dhulipala

Despite many exemptions from lockdown, the agricultural sector in India has experienced major disruptions due to the COVID-19 crisis. Agriculture in India employs about 55% of the population and contributes roughly 17% of the gross domestic product (GDP). Therefore, functioning agricultural supply chains are necessary for the food and nutritional security of India.

Furthermore, agriculture is a key engine that, alongside health and education, has the power to propel India and other developing countries toward reaching a number of the lofty Sustainable Development Goals (SDGs) by 2030. The question then is, how can India and the governments, in particular, intervene in agricultural value chains to help cope with the shocks caused by the coronavirus pandemic?

Agricultural extension via mobile phones

The agricultural sector relies on a cadre of people who play key roles in technology transfer. These specialists are often referred to as field extension workers or agriculture extension officers, and, in most Indian states, they are employed by the Department of Agriculture. Recently, a number of development agencies have also been appointing extension officers to cover areas that, until now, have not been reached by the government extension system.

Stringent physical distancing measures could adversely impact the functioning agriculture extension systems; extension workers might find it challenging to move across villages and gather farmers for trainings or other capacity building activities. However, in the immediate future, agricultural extension work can be done via mobile phones. Recent data on mobile phone penetration and network coverage is encouraging. While e-Extension has been happening in India for some time, the efforts have been exploratory in nature and never positioned as the sole method for transferring information and conducting trainings.

In the current situation, phones and mobile networks might be the only means through which farmers can access meaningful advisory.

New models for contracting labor, accessing machinery, and soliciting services

Food supply chains from farm to fork are complex webs that involve producers, consumers, agriculture and fishery inputs, processors, transporters, and more. In a country like India, where over 80% of farmers are smallholders (owning less than two acres of land), both the input supply chains that cater to farmers' input needs (seed, fertilizer, agro-chemicals) and the output supply chains that link farmers' produce to consumer demands are highly intermediary intensive.

Because food supply chains have traditionally been constrained for capital, there has been little automation or mechanization at various nodes along food value chains. Consequently, most activities are manual and labour intensive, and, therefore, dependent on local labour markets.

With the breakdown of informal labour markets, it is not uncommon to hear of instances where farmers are unable to harvest their produce due to labour shortages. Both large-scale returns of migrant agricultural workers to their native villages and the restrictions placed on local workers are reasons for labour disruptions.

Over the past few years, Uber-style models of providing machinery as a service have emerged in a few pockets of the country. These startups were using digital platforms to aggregate demand and mobilize machinery in order to cost-effectively cater to the needs of farmers. There are also some encouraging machine-service model cases using drones to perform tasks like pesticide spraying.

These models have not yet out-performed the economic logic and convenience of local labour from the perspective of the smallholder farmer, but, as informal labour markets shrink, farmers might be more inclined to explore the Uber-style model of mechanization.

Further, governments and the development sector could explore the use of digital platforms to enable labour market functioning. For example, a digital platform

Kamla Devi listens to messages of weather and best climate friendly crop practices on her mobile phone while working in the cowshed at her home in Anjanthalli.

Photo: Prashanth Vishwanathan / CCAFS

Photo: © 2011 CIAT / Neil Palmer

Women at a rice packing center in Sangrur, SE Punjab, India

could connect farmers and labour, minimizing the physical contact and crowding and, therefore, reducing the spread of the virus in informal labour markets.

An unintended positive outcome of digitizing aspects of the agricultural sector could be the formalization of informal economies, thereby providing governments with better data and the means to roll out targeted social interventions to protect farm labour.

Using digital platforms to decentralize markets and reduce contact

Labour issues are not only impacting the production side of agriculture but logistics and marketing activities as well. Nowhere is this more evident than at the critical nodes in the food supply chains like the spot markets or *mandis*.

Because Indian spot markets typically convene large crowds, especially during harvest times, governments are designing ad hoc measures to curb large gathering of farmers, traders, and shoppers. For instance, *mandis* in Punjab and Haryana are issuing tokens that indicate a specific time for the farmers to bring produce to market. There is also a cap on the quantity of produce they can sell. Farmers, however, are struggling to find workers to help load, transport, and unload produce at the *mandi,* therefore disrupting the efficiency of the spot markets. When aggregated and considered in the longer term, these seemingly minor challenges could become serious threats to food security.

Dr. Ramesh Chand, a prominent Indian agricultural economist and a policy maker, advised the government to relax the Agricultural Produce Market Committee (APMC) Act, which could legalize the sale of agri-produce at the farm gate. The stated objective of this recommendation was to minimize food supply chain disruptions in light of the subdued spot market functioning and reduce crowding at *mandis*.

If the APMC Act was altered in the wake of the coronavirus pandemic, digital platforms could be an effective means to facilitate decentralized marketing and sale of agri-produce from the farm gate. For example, digital platforms could be designed to facilitate contract-farming arrangements and remotely monitor and control for quality. Activities like aggregation, packaging, transportation, and delivery could be scheduled in a way that minimizes contact in order to protect workers. These digital platforms could open digital sale opportunities for farmers who typically depend on spot markets to sell.

The shift to digital quality assessment, grading, assaying, and trust in procurement present bigger challenges. Quality assaying and grading of agri-produce is largely subjective, and although governments have been investing in assaying labs at *mandis* to gradually reduce human subjectivity, most traders prefer to physically inspect their produce. If markets were decentralized to the farm gate, there would also need to be a mechanism in place to remotely grade commodities and reduce the need for physical inspection. Until a solution is found, blended digital platform models facilitate these activities at the farm gate.

Another emerging model of interest is farmers striking direct transactions with urban communities. A number of urban AgTech startups have leveraged this model, enabling farmers growing fresh produce within urban halos to find demand in city centers. In one instance, a group of 100 farmers in Siddipet, Telangana used WhatsApp, a digital messaging platform, to reach potential consumers in Hyderabad. The group of farmers was anchored by a key member who disseminated the message widely, compiled the orders, and ensured their deliveries. An in-depth look into how such a loose alliance of farmers leveraged simple tools to address supply and demand issues would be worthwhile. This could be an opportunity to templatize such initiatives through simple standard operating procedures so that other struggling farmers could be empowered by the same mechanisms.

Further, the crisis also gives government an opportunity to deploy warehouse-based sales through eNAM, a pan-India electronic trading portal. The concept of rural godowns, large warehouses within APMC premises, have been part of many government policies and plans of the National Bank for Agriculture and Rural Development. However, rural godowns have yet to gain momentum.

Digitally-enabled godowns would also have enhanced governments' ability to procure goods at Minimum Support Price (MSP) and allowed for the transfer of funds directly into farmers' bank accounts.

Digitizing input supply chains

The input supply chains which provide farmers access to seeds, fertilizers, chemicals, etc. could also see a mini digital revolution due to the consequences of COVID-19. Similar to the farm-to-fork supply chains, input supply chains are highly intermediary intensive. There is a strong informal seed sector through which farmers access seeds. Though the sub-sectors of the agri-input value chains were exempt from lockdown measures, restrictions on labor and transportation could pose challenges. The e-Commerce platforms that offer farm inputs could potentially reduce the impact of these disruptions, and the data made available by digitsing the market would be an added benefit.

Additionally, a whole host of other services and e-Extension could be provided to farmers utilizing e-Commerce platforms. These platforms could also be integrated with financial institutions to enable institutional credit access for smallholder farmers.

To conclude, digital tools and technologies pose viable methods for addressing some of the disruptions currently experienced by the agricultural sector. A number of the recommendations are largely applicable to other developing regions where agriculture is also characterized by a large number of smallholder farmers. Although agriculture cannot do away with grassroots institutions and human interventions, digital technologies can play an important role in helping the sector overcome specific challenges posed by the pandemic. And, faced with the possibility of extended lockdown measures, there couldn't be a more opportune time for stakeholders to explore digital agricultural solutions.

Note: This is an edited version of the original published on CGIAR Platform for Big Data

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Digital Platform *for promoting improved technologies*

Bankey Bihari, Rajesh Bishnoi, Lakhan Singh and Suresh Kumar

Mobile phone, owing to its affordability, accessibility and widespread network is emerging as a preferred digital tool for information dissemination for smallholder farmers. However, the adoption rates are found to be higher when supplemented with non-digital approaches.

Extension services provided by the government institutions is crucial in linking farmers with the developing science and technology. Serving as farm advisory, they also educate farmers about good agricultural and crop management practices, and help farmers in coping with changing climatic conditions. But the exiting extension machinery is neither sufficient nor accessible, especially to those living in remote and hilly regions. Also, this system mostly deals with production enhancement, while ignoring marketing aspect.

Digital agriculture can directly support farmer's access to timely and relevant information, as well as empower the farming community through creation and sharing of knowledge. In the past, television and radio were the main electronic broadcast technologies used to reach rural communities; however, in the past two decades, Internet and mobile-based channels have emerged. ICTs now include computer-based applications and such communication tools as social media, digital information repositories (online or offline), and digital photography and video, as well as mobile phones.

Mobile phone, owing to its affordability, accessibility, minimum skill requirement, widespread network etc., has emerged as an important digital tool for smallholder farmers. There are a number of initiatives using mobiles to communicate information directly to farmers; these include IKSL (IFFCO Kisan Sanchar Ltd. in collaboration with Airtel), Mandi on Mobile (BSNL and

A mix of digital and non- digital approach is needed for technology dissemination and better adoption.

Transect walk during data collection

Focussed group discussion with app users

Uttar Pradesh Marketing Board), Reuters Market Light, and Nokia Life Tools and mKRISHI®.

Information need assessment

To address the information needs of farmers, relevant content is a key component of ICT projects. The extent to which content is customized and localized to a farmer's condition influences its relevance. Keeping this in mind, to develop a platform to be useful to farmers, first a baseline survey was done to understand the information needs of the farmers.

The baseline survey was conducted during 2016-17 in 21 villages of three blocks of Dehradun district namely; Vikasnagar, Kalsi and Raipur. Information on major crops of the different villages were obtained. It was found that maize, mandua, pigeon pea, rice, lobia etc., in Kharif; wheat, barley, gram, lentil, musturd, toria etc., in Rabi season, were the dominant crops. Regarding horticultural crops, fruits like mango, guava, jackfruit, litchi, lemon and vegetables like tomato, ginger, colocasia, chilli, peas, turmeric etc., were grown by the farmers in the area under rainfed situation. Major sources of irrigation were guhl, river etc., in the project area.

The survey highlighted that farmers have limited access to extension services from the line departments. Their source of information has been newspaper, television and radio.

The survey also revealed that 85 per cent of the farmers were using mobiles. Their mobile type was android and IVR. Majority of the farmers were using IVR type of mobile sets.

With regard to information needs, it was found that almost all the farmers of the project area were interested about crop related information (cereal and pulses) and crop protection. More than 83% were keen to know about natural resource management. Around 3/4ths of them expressed their demand for information on horticultural crops, followed by soil health related technologies. More than 50 per cent of the farmers were having a need for information on the market, animal husbandry and different agricultural development schemes. Need for weather related information was also expressed during the interactions.

Screen shot of mKrishi PAWS app

Table 1: Service Matrix – Different type of users

Sl. No.	Stakeholder/User	Medium	Available services for Pilot project
1	Agro Expert	Web Console	**Web console services:** 1) Farmer Registration (Personal info., Land info., Crop Info., Soil Info.,) 2) Soil & Water Management measured (Add, delete, modify FAQs for digital database and mobile app farmers) 3) Photo Gallery – (For mobile app farmers) 4) Advisory: (Will allow to answer the Queries from Mobile app farmers in local language text SMSs) 5) Text And Voice Alerts 6) Reports
2	Mobile App Farmers	Android Mobile App, Java App – (Internet)	**Mobile app features:** 1) Raise Queries through recording from mobile app, also can share photographs with Queries. 2) Weather information. 3) Soil health Card (For Limited no. of farmers after soil testing) 4) FAQs and photo gallery. 5) Feedback.
3	Non Mobile App Farmers	Normal Mobile phones (without internet)	**Normal phone users:** 1) Will receive periodic text SMS related to Soil and Water Conservation (Crop Specific). 2) Will receive periodic voice alerts related to Soil and Water Conservation (Crop Specific).

mKRISHI® PAWS

Subsequent to the baseline survey, ICT network on Personalized Advisory on Water and Soil (PAWS) was developed at ICAR-IISWC, Dehradun, including different stakeholders like farmers, input dealers, extension workers and researchers especially working in remote and hilly regions. This was developed to primarily share knowledge on soil and water conservation. mKRISHI® PAWS was developed with technical support of Tata Consultancy Services Limited for disseminating agriculture and soil and water conservation related messages/best practices among farmers of north western Himalayan region. Services provided and the medium used by different stakeholders is indicated in Table 1.

Content Development

Content has been developed based on the present agroecosystem. Standard messages were developed, refined and sent by the institute project team. Three to four messages per week are sent based on the season and crop growing stages. Totally, 136 specific messages related to different agricultural aspects were sent to the registered farmers and other stakeholders including extension workers, input dealers and development functionaries.

Content has been categorized into different components/ themes. 44 messages related to plant protection were developed and sent to the farmers through mobile followed by crop production technologies (35 messages) and soil and water conservation aspects (21 messages).

Use and outreach

The service provided through app is based on personal information of the farmers, location of the villages, crops grown, soil conditions and economic status of the farmers. Farmers have to register on the app through his/ her mobile number.

Only android users can download and access the app after registration. IVR users can only receive the messages and alerts. They received periodic text SMS and periodic voice alerts related to soil and water conservation (crop specific).

Farmers can raise questions, send the pictures of crops affected, audio messages through mKRISHI®PAWS mobile App and the questions are answered by experts through web console services. Also voice and text alerts are shared with all the farmers. The platform also provides farmers access to photo gallery, weather information, soil health cards. Farmers can send their feedback and get responses.

The app is bilingual and is available in Hindi and English. Users can download the mKRISHI PAWS app from the link: https://www.tcsmkrishi.com/app/mpaws/. Presently more than 400 farmers in the hilly region have downloaded this app.

Feedback and impact

Messages were analyzed on the following parameters viz, need based content, appropriateness, practicability, understandability, length and quality of the messages. Technical terms sent and their clarity to the farmers was also analyzed by interacting with 240 farmers. Majority (80.41%) of the farmers expressed that the messages sent was need based. Around 85% of the farmers expressed that the messages were appropriate to their needs. Majority (77.50%) of the farmers expressed that the messages were practical and were applicable to their farm requirements. Majority of the farmers expressed that it was easy to understand the content received on their mobiles, the quality of messages was good with simple use of technical terms.

Impact of mKRISHI® PAWS service was analyzed in terms of technology application in farmers fields. For doing this, farmers in two blocks with different access to information were compared. Farmers in Kalsi Block in Dehradun were sent only text messages, whereas farmers in Raipur block were supplemented with other methods of capacity building, besides being sent text messages.

In the first set of villages in Kalsi Block, Dehradun, where only text messages were sent to the respondents, the highest rate of adoption was found to be crop protection measures. Around 45% of the farmers practised the information received as messages. Around 25% of the farmers could use soil nutrition information followed by 20 per cent farmers who followed the agronomical package of practices received through text message. NRM technologies in soil and water conservation were the least practiced in the field. Only 10% farmers could adopt the NRM practices shared through the app.

In the second set of villages of Raipur Block, Dehradun, along with text messages, exposure visits, meetings, group discussions and trainings on soil and water conservation and other components were organized for enriching their knowledge. The results were encouraging. More than 91% of the farmers adopted crop protection technologies, 83% used weather information, 66% used soil nutrition information, and 45% adopted latest agronomical practices on their field.

The study clearly shows that while digital tools help in wider outreach and ease of access, yet it is more helpful to the educated and resource rich farmers. Resource poor and comparatively less educated farmers, along with information also need inputs, technical guidance, motivation, persuasion, trainings and other support on a regular basis for adoption of agriculture and rural innovations. Also, technologies and practices are highly location and site specific which cannot be explained through messages only. Hence, messages alone do not help in adoption of practices. A mix of digital and non- digital approach for technology dissemination and adoption is the need.

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IIT Kharagpur launches Online Course on Application of Digital Technologies in Agriculture

IIT Kharagpur has announced the launch of an online course called "Application of Digital Technologies in Agriculture" to train researchers to use smart technologies in India's agricultural practices. The course aims to train learners on the use of modern technologies such as artificial intelligence, drones, machine vision techniques, computer aided design, and sensors in agriculture.

The online course has been sponsored by NAHEP-CAAST, Indian Council of Agricultural Research, New Delhi. The short-term course will be conducted by the Department of Agricultural and Food Engineering at the Indian Institute of Technology, Kharagpur.

"It is crucial to empower the human resources with digital technologies in the field of agricultural science and technology, particularly in less-explored domains. The penetration of such knowledge will drive further R&D and create a culture to understand and expedite the adoption of advanced technologies in agricultural practices," said Professor Rajendra Machavaram, joint Principal Investigator of NAHEP-CAAST-IIT Kharagpur.

The NAHEP centre, according to IIT Kharagpur, is integrated by three interdisciplinary research divisions such as Agribots, Agri-Drones and Agri-AGV's based on four portfolios namely:

- Climate-based Digital Knowledge Support Centre,
- Seed/Seedling Processing and Nursery Automation Centre,
- Smart Portable Machinery Centre,
- Food Processing Automation Centre. It envisages the enhancement of quality and relevance of agricultural higher education to the agricultural university students.

The current course will pilot with the postgraduate and doctoral students, faculty members, and scientists from the Vasantarao Marathwada Krishi Vidyapeeth, Maharashtra, said a statement from IIT Kharagpur.

Source: https://www.dqindia.com/iit-kharagpur-launches-online-course-application-digital-technologies-agriculture/

ICAR-NRRI developed Mobile app "riceXpert"

The ICAR-NRRI 'ricexpert' App provides information to farmers in real time on insect pests, nutrients, weeds, nematodes and disease-related problems, rice varieties for different ecologies, farm implements for different field and post harvest operations. It is a web-based application systems which facilitates flow of information from the farmer to the farm scientist and get their instant solution. Farmers can use this App as a diagnostic tool in their rice fields and make customize queries for quick solution of their problems by sending text, photo and recorded voice and solution received through SMS.

The App is developed for Android platform and can be downloaded from Google Play Store or from www.nrri.in or from www.crri.nic.in web portal. This APP is very useful tool for the researchers, students and village level workers working on rice crop.

At present, around 5000 users have downloaded the app and being used by them. Around 145 queries from the users have been received from the users and being addressed by panel of experts of NRRI and the solution are being sent to them through SMS.

Source: https://icar-nrri.in/icar-nrri-developed-mobile-app-ricexpert/

Impact of COVID-19 on the Digital Agriculture Industry 2020-2021

Post COVID-19, the global digital agriculture market size is estimated to grow from USD 5.6 billion in 2020 and is projected to reach USD 6.2 billion by 2021, recording a CAGR of 9.9%.

The increasing demand for agricultural food products, shift in consumer preferences to higher standards of food safety and quality, and unavailability of laborers during COVID-19 are some of the driving factors for the market. However, the immediate standardization process and technological awareness among farmers are some of the restraints in the market. Some of the major players in the global digital agriculture market are DTN (US), Farmers Edge (Canada), Taranis (Israel), Eurofins (Luxembourg), and AgriWebb (Australia).

The field mapping segment is projected to grow at the highest CAGR between 20w20 and 2021.

Field mapping accounted for the fastest-growing smart management system market in 2021, by value, in the digital agriculture market, as it is the most preferred and adopted way of digital agriculture nowadays. It allows the farmers and growers to monitor the whole farm area through satellite imaging and regulate the processes accordingly. The COVID-19 situation is expected to increase the adoption of the field mapping system, because it allows the farmers to regulate the farm processes remotely without taking unnecessary field trips. The current guidelines of social distancing and prohibition for not getting out from home demand the adoption of such systems, which can help farmers to undertake agricultural activities smoothly.

Asia-Pacific is projected to be the fastest-growing in the digital agriculture market during the forecast period.

The market for digital agriculture, by region, has been segmented into Asia Pacific, Europe, the US, and RoW. The Asia Pacific region segment is to be the fastest-growing market through 2021, by value, in the digital agriculture market. Asia Pacific accounts for the most populated countries such as China and India with increasing demand for agricultural products. These countries are also the most two of the most affected countries during COVID-19. The government policies supporting the digitization of farm processes and the need for efficient usage of natural resources, along with decreasing availability of migrant laborers, are expected to increase the adoption of digital agriculture techniques.

Research Coverage

This report covers the COVID-19 impact on the digital agriculture market based on customer analysis, growth opportunities, short- and mid-term strategies, smart farming system type, end use application, and geography. A detailed analysis of key industry players has been done to provide insights into their business, COVID-19 impact and services, and key strategies associated with the digital agriculture market.

Source: https://finance.yahoo.com/news/impact-covid-19-digital-agriculture-213000593.html

Digital solutions for Aquaculture

Partha P Biswas

Remote monitoring system of fish culture pond

FarmMOJO is a digital solution to problems in aquaculture. It is a simple mobile application that provides advices on water quality, feed usage and the overall health indicators of the ponds based on the farm level information.

Aquaculture has grown at an impressive rate over the past decades. Poised to reach over US$208.9 billion by the year 2025, aquaculture will bring in healthy gains adding significant momentum to global growth. This culture is expected to provide close to two-thirds of global food fish consumption by 2030, according to the UN Food and Agriculture Organization (FAO).

To solve various challenges in aquaculture, Digital transformation is now imperative. This change requires the joint efforts of farms, government agencies, institutions, researchers, and suppliers to work together to make sure that the right technologies are being developed for farmers. Digital transformation in aquaculture is not just a change related to using technology but it is a change related to the business culture. For example, the *eFishery* aims to solve the problems by providing an internet-based tech. to monitor and control feeding even at the "level" of satiety in fishes.

The power of digital solutions

In the aquaculture industry communicating with each other, sending and uploading critical data to a central command station, providing the operator a complete view of the entire facility are now absolutely necessary. IoT platform device makes a smart pond management system. IoT intelligent system is designed for using sensors for water temperature, pH, dissolved oxygen, and water level etc. of pond water. There are solar and non-solar sensors. The system helps 24-hour smart monitoring and effortless fish and shrimp farming. Status of the pond culture can be monitored on cellphones or computers at all time so farmers have time to rest and reduce labour cost. Further the system provides human-

machine interface display, remote control, Cloud and Big Data repository. Daily recording and management may be transformed into graphical display so that farmers can clearly understand daily changes.

Intelligent control system can be used for aerator, feeder, water temperature meter, salinity meter, pH meter, dissolved oxygen meter, water level meter, EC meter, NH4-N meter, nitrate meter, water pump, generator connection etc. When the intelligent control system detects anomalies in the aquaculture pond, it gives signals. The aerator automatically turns the power on or off by a microcontroller depending on dissolved oxygen saturation.

Fish and shrimp feeders can be programmed to change the feeding time and feed usage. Local network system consists of router, modem and battery 12 V which work for sending and receiving data packets either from sensors to cloud server or from cloud server to smart aerator using MQTT (Message Queuing Telemetry Transport) protocol.

Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and also accessing the data. It is not like our hard drive or local network storage. Eruvaka Technologies Pvt. Ltd, Vijaywada, Andhra Pradesh has Cloud based aquaculture pond management solutions for real time monitoring of ponds with intelligent control of aerators, feeders etc. It has voice alert system for in case of low DO levels.

Industry innovators believe that in future Big Data using Hadoop platform would become an important component for industry growth and even influence production yields. Bigdata can deal enormous data sets that would be impossible for any single human to handle demanding the help of automated systems. The data may be of customer transaction records, production databases, web traffic logs, automation, satellites, sensors and IoT.

Some important digital platforms include ***iQuatic,*** is a digital platform that analyzes data about shrimp size, water quality, feeding patterns, and health and weather conditions to help farmers make decisions and optimize their practices. ***Aquanetix, AquaManager, Aquatracker, Smart Water Planet*** are platforms that offer integrated solutions for aquaculture management, integrating smart IT and fish farming innovations. ***Cageeye*** for monitoring of fish behaviour and optimization of food cycles. ***Aquavista*** is an IoT platform that provides a comprehensive overview of the company's aquaculture production operations.

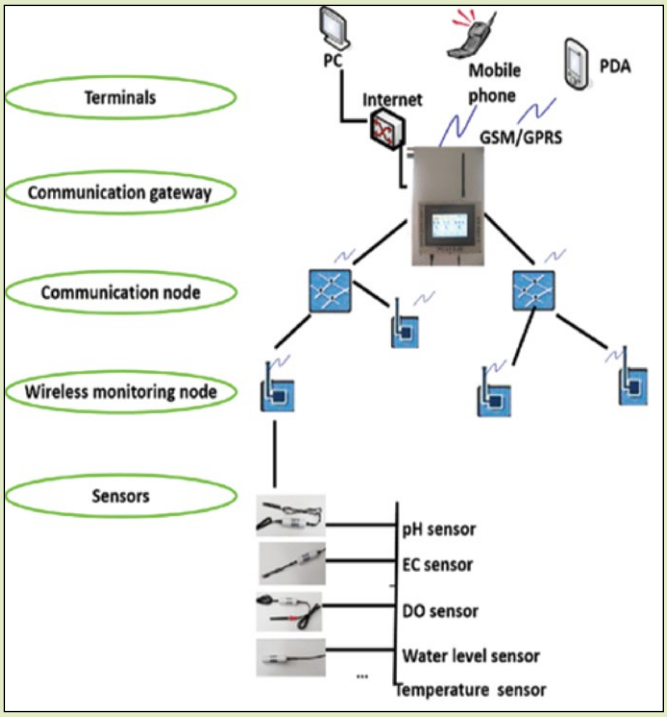
FarmMOJO, an AI power platform

FarmMOJO, floated in March,2018, is a digital solution to problems in Indian shrimp and fish farmers. The mobile app interface advises farmers on water quality, feed usage and the overall health indicators of the ponds. It is a simple mobile application that provides advices based on the farm level information that farmers input into the app.

FarmMOJO uses big data and Artificial Intelligence (AI) enabled farm advisor tool. It monitors the real-time production data gathered from the farms through the mobile application interface. The application also utilizes the data captured by IoT or smart farm management tool. Based on the pond level production data, it's prediction model uses the algorithm (a process or set of rules to be followed in calculations or other problem-solving operations) to provide context sensitive suggestions and alerts to improve the water quality parameters, feed consumption pattern and health management. SIP accelerator provides a great platform to expand it's service offerings in Indonesia and South East Asian shrimp producing countries.

The app uses technology to analyse feed and growth patterns in relation to fish health. It alerts the farmers about parameters, which are not in optimal levels. It ensures constant monitoring of water quality, feed intake, disease outbreak indicators and biomass conversion

FarmMOJO ensures constant monitoring of water quality, feed intake, disease outbreak indicators and biomass conversion which indicates the efficiency of farm feeding strategy.



Design and implementation of a distributed IoT system for the monitoring of water quality in aquaculture

which indicates the efficiency of farm feeding strategy. FarmMOJO observes poor Feed Conversion Ratio(FCR), it recommends actions and relevant products the farmer can use to normalise the pond environment. The company claims that this approach has helped shrimp farmers improve disease prediction rates and accuracy, boost production efficiency, produce higher quality shrimps, increase profits and reduce dependency on external sources for daily operations. It reduces the dependency on technicians in daily culture operations and reduces operational costs.

Use of application is based on a subscription model for the farmers which is to be paid monthly. A basic plan in FarmMOJO costs Rs 500 per pond for the farmers. Apart from helping the farmers in shrimp farming, the company is also working out on multiple secondary revenue sources such as hatcheries, food processors, feed companies and healthcare products producers. The company also plans to offer credit and insurance products for those working in the aquaculture industry in the future.

FarmMOJO company is conducting training and workshop sessions at frequent intervals to train the new generation of farmers about the benefits of technology adoption. Rajamanohar Somasundaram, the man behind this venture says, "Now, 1350 plus farms have been made smart farms with the FarmMOJO implementation." The feedback from farmers using this app is very encouraging as their productivity has risen, reporting about reduction in wastage of feed.

However, there are limitations which impede in the wider spread of digital solutions. The common reasons attributed are illiteracy and lack of awareness. Promoting technology awareness among farmers is a big issue as most farmers prefer orthodox farming system as their forefathers did. Reaching out to farmers by an smart phone is a difficult proposition as they believe it as a misinvestment. Also, it is tough to overcome cultural and language barriers.

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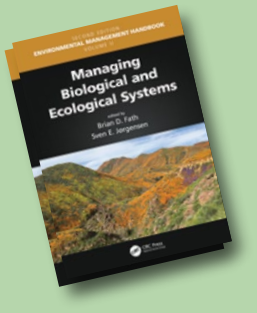
NEW BOOKS



Managing Biological and Ecological Systems

Brian D. Fath and Sven Erik Jorgensen, *July 2020, CRC Press,* 427 p., ISBN 9781138342644

Bringing together a wealth of knowledge, *Environmental Management Handbook, Second Edition,* gives a comprehensive overview of environmental problems, their sources, their assessment, and their solutions. This six-volume set is a reimagining of the award-winning *Encyclopedia of Environmental Management,* published in 2013, and features insights from more than 400 contributors, all experts in their field.

In this second volume, *Managing Biological and Ecological Systems*, the reader is introduced to the general concepts and processes of the biosphere and all its systems. This volume explains how these systems function and provides strategies on how to best manage them. It serves as an excellent resource for finding basic knowledge on the biosphere and ecological systems and includes important problems and solutions that environmental managers face today. This book practically demonstrates the key processes, methods, and models used in studying environmental management.

Home Gardens for Improved Food Security and Livelihoods

D. Hashini Galhena Dissanayake **and** Karimbhai M. Maredia, 2020, *Routledge*, 222 p., ISBN 9781138202139

Home Gardens for Improved Food Security and Livelihoods demonstrates how home gardens hold particular significance for resource-poor and marginalized communities in developing countries, and how they offer a versatile strategy toward building local and more resilient food systems.

With food and nutritional security being a major global challenge, there is an urgent need to find innovative ways to increase food production and diversify food sources while increasing income-generating opportunities for communities faced with hunger and poverty. This book shows that when implemented properly, home gardens can become just such an innovative solution, as well as an integral part of sustainable food security programs. It provides a conceptual overview of social, economic, environmental and nutritional issues related to home gardening in diverse contexts, including gender issues and biodiversity conservation, and presents case studies from Africa, Asia and Latin America highlighting home gardening experiences and initiatives. The volume concludes with a synthesis of key lessons learned and ways forward for further enhancing home gardens for sustainable food security and development.

Food Insecurity: A Matter of Justice, Sovereignty, and Survival

Tamar Mayer and Molly D. Anderson, *July 2020, Routledge,* 236 p. Hardback £96.00, ISBN 9781138358850

Despite global efforts to end hunger, it persists and has even increased in some regions. This book provides interdisciplinary and historical perspectives on the manifestations of food insecurity, with case studies illustrating how people coped with violations of their rights during the war-time deprivation in France; the neoliberal incursions on food supply in Turkey, Greece, and Nicaragua; as well as the consequences of radioactive contamination of farmland in Japan. This edited collection adopts an analytical approach to understanding food insecurity by examining how the historical and political situations in different countries have resulted in an unfolding dialectic of food insecurity and resistance, with the most marginalized people – immigrants, those in refugee camps, poor peasants, and so forth – consistently suffering the worst effects, yet still maintaining agency to fight back.

The book tackles food insecurity on a local as well as a global scale and will thus be useful for a broad range of audiences, including students, scholars, and the general public interested in studying food crises, globalization, and current global issues.

Indigenous People and Mobile Technologies

Laurel Evelyn Dyson, Stephen Grant, Max Hendriks, 2018, *Routledge,* 326 p., Paperback-£31.99, ISBN 9780815386537

In the rich tradition of mobile communication studies and new media, this volume examines how mobile technologies are being embraced by Indigenous people all over the world. As mobile phones have revolutionised society both in developed and developing countries, so Indigenous people are using mobile devices to bring their communities into the twenty-first century.

The explosion of mobile devices and applications in Indigenous communities addresses issues of isolation and building an environment for the learning and sharing of knowledge, providing support for cultural and language revitalisation, and offering the means for social and economic renewal. This book explores how mobile technologies are overcoming disadvantage and the tyrannies of distance, allowing benefits to flow directly to Indigenous people and bringing wide-ranging changes to their lives.

Mobile Media in the Asia-Pacific
Gender and The Art of Being Mobile

Larissa Hjorth, 2011, *Routledge*, 320 p., Paperback-£30.39, ISBN 9780415690119

This century has been marked by the rapid and divergent uptake of mobile telephony throughout the world. The mobile phone has become a poignant symbol for postmodernity and the attendant modes of global mobility and immobility. Most notably, the icon of the mobile phone is most palpable in the Asia-Pacific in which a diversity of innovation and consumer practices – reflecting gender and locality – can be found. Through the lens of gendered mobile media, *Mobile Media in the Asia Pacific* provides insight into this phenomenon by focusing on case studies in Japan, South Korea, China and Australia.

Utilising ethnographic research conducted in the Asia-Pacific over a six-year period, this book investigates the relationship between gender, technology and various forms of mobility and immobility in the region. This book outlines the emerging modes of gender performativity that makes the Asia-Pacific region so distinct to other regions globally.

Mobile Media in the Asia Pacific is a fascinating read for students and scholars interested in new media and gender in the Asia-Pacific region.

Emerging agricultural technologies: Consumer perceptions around emerging Agtech

AgriFutures Australia, *2018*, Publication No. 18/048, Project No. PRJ-011141, ISBN 978-1-76053-013-6

Emerging technologies have already proven be a key driver in the future sustainability and profitability of Australian agriculture. With the sector likely to continue to increase its reliance on new technologies over the short to medium term, it is important to understand what the likely implications from consumers will be, and whether there is a role for industry and others to proactively engage with consumers in this space. Specifically, the report contributes to better understanding the substantial impact that consumer perceptions can have on the adoption of agricultural technology throughout the value and supply chain, especially as it relates to the top ten transformative technologies in agriculture.

This report has been produced under AgriFutures Australia's National Rural Issues Program. It is an addition to AgriFutures' diverse range of over 2000 research publications and it forms part of our National Challenges and Opportunities arena, which aims to identify and nurture research and innovation opportunities that are synergistic across rural sectors.

Bringing digital technology to farmers' door steps

B K Singh, Ajay Singh and Archana Srivastava

Today we are more dependent on digital technologies than ever before. This paradigm shift towards digital technologies should not further marginalise the small and marginal farming communities, who ensure our food security. GEAG with the support of DST empowered 1200 small farmers to perform farming with greater precision in emerging weather shocks, using digital technologies.

Developing resilience amidst weather shocks is one of the biggest challenges in agriculture in achieving the goal of *Atmanirbhar Bharat*. With widespread flooding and waterlogging, millions of small and marginal farmers in eastern Uttar Pradesh and northern Bihar have become farmless and homeless. Thanks to climate change, flooding nature and trends, heavy rainfall episodes, intermittent dry spell, drought followed by flood, pest attack and emerging crop diseases have become conspicuous in the region. A large segment of farming community has been pushed to live on the mercy of subsidies, relief and compensation.

While understanding the climate uncertainties and its impact on agriculture, it is important to reach out to a large number of affected people with farm advisory and practical solutions. However, under flooded conditions,

Farmer accessing weather data on his mobile

reaching out to farmers using conventional means becomes challenging. Therefore, under such conditions, digital technology becomes a preferred means of communication.

Today, most of the farmers in the intervention villages have mobile phones, and thus are equipped to receive agricultural advice through simple text or voice messages, even without access to the Internet. Therefore, accessing weather and climate information through digital smartphone technology would be beneficial to the farmers enabling them to take appropriate decisions even during a stressful situation. This will certainly be crucial to reduce the related risks, enhance opportunities, improve the efficient use of limited resources, minimise cost and increase crop and livestock production and productivity.

The initiative

In 2018, the Gorakhpur Environmental Action Group (GEAG) in collaboration with Department of Science and Technology, Govt. of India initiated a programme to empower 10,000 small and marginal farmers in Gorakhpur and West Champaran regions to adopt climate-resilient technologies. The technologies for climate resilience include flood resilient farming technology, small landholding farm mechanization, developing efficient irrigation system, enhance nutrition of the soil by adopting bio-fertiliser and extend digital technology in farming practices.

GEAG established two Automatic Weather Stations (AWS). One at Mohnag, Gorakhpur and another one at Jamunia, West Champaran coupled with five rain gauge stations at Pachgawan, Dharmpur, Jindapur, Loharpurwa in Gorakhpur and Baikunthwa in West Champaran. The data collection through AWS and rain gauges and formulation of weather forecast is done through three processes, viz. (i) Data processing, (ii) Quality control, (iii) Objective analysis.

The local IMD office helps GEAG to comprehend the microclimatology of the region, leveraging relevant meteorological data. Initially, at macro-level weather forecast information and forecast models generated by IMD, are collected. Using mathematical modelling methods, these macro-level data is downscaled at the block level and further corroborated with micro-level data collected from AWS and rain gauges located at different places of the intervention areas. Before finalising the weather advisory, the subject expert at GEAG, also considers the prevailing synoptic situation around the location of interest to improve the effectiveness of the forecast.

"I work in my farm every day to examine the crop growth and occurrences of pest attacks or crop losses due to erratic weather. I ask my queries via my smartphone to GEAG's professional, which they advise within a few minutes", says Durgesh Kannaujia, a young model farmer in Bhuidharpur village in the Jangle kaudia block of Gorakhpur district in Uttar Pradesh.

GEAG initiated weather and agro advisory dissemination services to the small and marginal farmers at their doorsteps, using the advantages of digital smartphone technology available in the rural areas. In collaboration with local IMD office and Narendra Deo Agriculture university, Ayodhya, U.P, GEAG has been conducting detailed observations of meteorological information, quantification of remote sensing data (radar and satellites), deriving indices and providing operational services to the farmers for making strategic decisions in agricultural operations at different stages of crop growth.

Content and dissemination

For agro advisory, GEAG's in-house professional has developed a climate-smart advisory module, which depicts season-wise crop configurations for all the major crops. The module also considers technical inputs in real-time from agriculture experts in state research institutions. Further, value addition in the crop advisories is also done with an emphasis on promoting low external input agriculture, mainly based on ecological principles. Collating both sets of information, GEAG sends a weather-based agro advisory to farmers in the local Hindi language including predictive and curative measures promoting sustainable agriculture practices.

Through digital smartphone-based initiative, farmers are informed about the forecast of weather conditions such as the probability of rainfall (light to heavy), temperature (maximum temperature, minimum temperature, and diurnal temperature variation), maximum and minimum relative humidity, cloud situation and wind direction/ speed for the forthcoming 5 days. Within the same weather forecast message, in general, farmers are also informed about the appropriate time of sowing of crops

during Kharif, Rabi and Zayad season, scheduling of irrigation, application of fertiliser and pesticides in the field, harvesting as per the prediction of rainfall, and vaccination of pet animals. Farmers are also alerted, in advance, to prepone or postpone the timing of sowing of major crops, its varieties/ breeds/ plants, based on rainfall occurrence. Along with this, information on possible diseases at different stages of plant growth and their remedial measures for the season-specific crops/ vegetables and health care for domestic animals is also provided.

Altogether six such advisories at the interval of 5 days are being disseminated regularly, directly to the farmers and to the DST field staff's mobiles in a month through our web-based platform as small text messages. For reaching out to more number of farmers, the DST field staff write these advisories on a display board placed outside every agro service centre so that farmers visiting the centre are also kept informed.

The initiative informs, in advance, the farmers to undertake various farming activities and most often guide to take an immediate decision at farm level based on the predicted weather conditions and practical agro advisory in the intervention areas. Apart from this, the initiative also helps farmers to reduce crop losses, reduce input costs in agriculture, and ultimately improve the resilience of their livelihood system.

On an average, two to three calls per day or cumulatively 10-12 farmers' calls or missed calls are received between the periods of two advisories (within 5 days after the advisory sent). Sometimes farmers also send problem queries through text or photos by their mobile on the farmer's WhatsApp group created by GEAG. They always remain keen to know some additional information on weather /extreme weather warning and advisory on crops/animals husbandry. GEAG's professionals respond promptly on every farmer's query. GEAG also takes feedback regularly from farmers on the advisory to know the adoption levels, relevance and consequences of adopting new technologies.

Impact

So far, 1200 small and marginal farmers of 18 villages of Gorakhpur and West Champaran have been linked directly with this digital service and tracked across the Kharif and Rabi seasons for the major crops. The 36 model farmers of both the states are systematically trained by GEAG on crop advisories, weather advisories, geo-tagging and crop health monitoring. These model farmers are serving as 'change agents' to scale up the digital interventions in Bihar and Uttar Pradesh.

Farmers found the forecast on weather parameters to be 90-95 per cent accurate. As per the feedback of farmers in both the states, the digital service has been very useful in enhancing preparedness, increasing adaptive capacity, enabling transplanting of Kharif crops at the appropriate time, irrigation management, application of fertiliser and pesticides in the field. Most importantly, crop harvesting is happening at the appropriate time.

Farmers also felt that owing to accuracy of rainfall information, it saved on the cost of unnecessary irrigation, helped in timely paddy and vegetable transplantation. Analysis of farm data of 45 farmers indicated 18-20 per cent reduction in irrigation cost, use of insecticides and fertiliser in the farm activities. The service was found to be very effective and helpful to the small and marginal farmers in day-to-day decision making, which cumulatively has large financial implications on farmer's income.

Advisory for effective decision making

"Weather information helps us in effective decision-making in farm planning activities" says Ramniwas, a 48-year-old model farmer of Rakhukhor village in Gorakhpur.

Gorakhpur in the last two years, has been receiving low rainfall. This made farmers to grow peanuts in Kharif season. Farmers in the region followed the same practice during this year too. Almost 50% of farmers in the village planted peanut crop in Kharif, but this year, the situation changed. The entire Gorakhpur area received 936 mm of rainfall within two months (June- July 2020). The heavy rainfall episodes and waterlogging in the field damaged peanut plants.

Ramanivas through the weather advisory was informed that good rainfall was expected during last week of April and 1st week of May. Being an innovative farmer, he took the information seriously and preponed the sowing of peanuts to first week of May. He sowed peanut in his 0.20 decimal land. He invested Rs. 2300 and earned an income of Rs. 4300 by selling peanuts. He also reduced the input cost by 30 per cent (proper scheduling of irrigation, use of fertiliser) by following the crop advisories during the summer season of 2020.

Automatic Weather Station collecting and processing weather data

Looking ahead

Within a span of two years, the initiative has attracted the farmer's interest because they see a positive difference in their farms and built capacity to make informed decisions. However, it was not easy to scale this initiative among thousands of people within a short period. Initially, it was a challenging task for the organisation to develop the faith of people over the information and the initiative. Other challenges included poor internet connectivity, frequent change of sim cards which makes tracking difficult and lack of regular feedback from farmers. However, with long experience of working with the community in the agricultural sector and support of local IMD office and Agricultural University, GEAG has been successful in implementing the initiative in the highly risk-prone areas.

Agriculture sector has huge scope to use digital technologies. Today, farmers in the region, especially young farmers use smartphone for getting knowledge on many farm activities like adopting locally suited seeds and the making of bio fertiliser, protecting crops from diseases and pests, possible market and price rate through different social media platform like YouTube, WhatsApp group, etc. The programme impact indicates that those farmers who are empowered with weather information and agro advisories are performing well in agriculture. Their crop yield, income and resilience against weather shocks have increased. Therefore, there is an urgent need and a lot of scope for further innovation in integrating digital technologies in farming activities through strong partnerships between governments, businesses, and farmers, as well as the regulatory environment to ensure that digital technology remains affordable and accessible to the farmers.

Acknowledgements

We are grateful to the SEED Division, Department of Science and Technology, Govt. of India, for supporting technology development for the small and marginal farmers in climate stress areas of eastern U.P and Northern Bihar. We also express our gratitude to Mr Kailash Pandey, Climatologist at GEAG for executing the weather and agro advisory service using digital technologies to our farmers.

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