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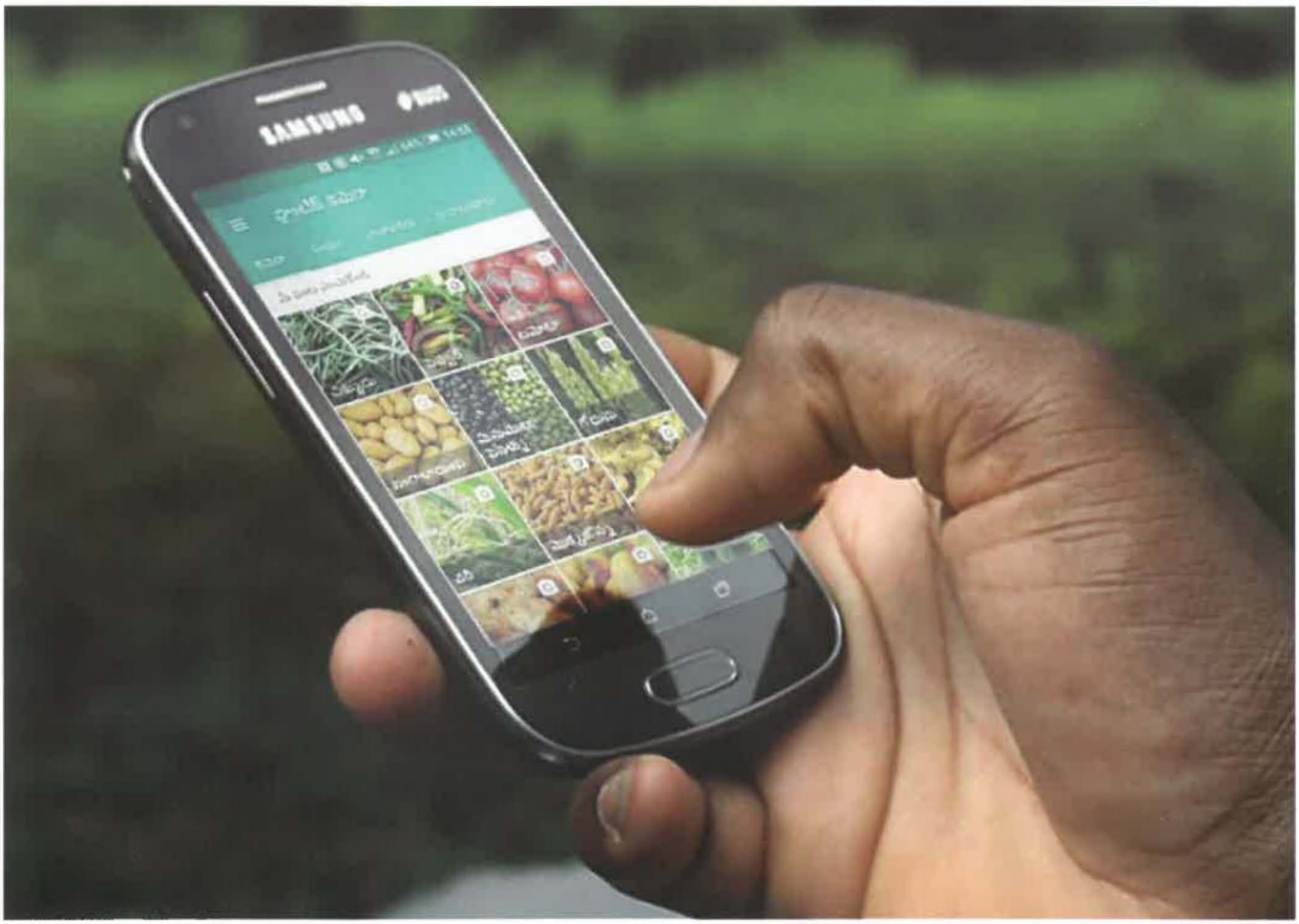
Digital Agriculture, Digital India



Digital Agriculture for Sustainable Development

Given that 68% of India's populations live in rural areas and agriculture is the main source of livelihood for 58% of the population, one must consider the role of Digital Agriculture within Digital India.

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Introduction

We are at a very crucial time in history where the world is faced with a number of challenges like growing population, environmental degradation, global warming, urbanization, malnutrition, rapidly evolving consumer preferences. The global food production needs to increase 50% by 2030 and needs to double by 2050 to meet the global food demand. If global population reaches 9.1 billion by 2050, the FAO says that world food production will need to rise by 70%, and food production in the developing world will need to double.

The Prime Minister of India, Mr Narendra Modi, launched Digital India on 1 July 2015 to create digital infrastructure for empowering rural communities, thus enabling digital delivery of services and promotion of digital literacy. Another important call given by Prime Minister Modi is the call to double farmers' income by 2022. Digital Infrastructure and technologies will have to play a key role if the vision to double farmers' income has to be achieved while balancing the ecological and resource challenges of agriculture.

Digital Agriculture

The key components to support the implementation of Digital Agriculture are Spatial (and Temporal) Data Infrastructure (SDI) and low-cost smart phones and tablets to support bi-directional flow of data and information to rural consumers. SDI has been the key driver to support modern farming in the USA, Australia and Europe as well as the emerging economies of China and Brazil. Agriculture is a data-intense enterprise when one considers soil variability, moisture and nutrient levels, rainfall variability, timing of key operations like planting and harvesting, and market price volatility. Advanced agriculture industries help farmers manage these production and market risks through the application of spatial/temporal data bases that are cloud enabled and integrated through Application Programming Interfaces (APIs). This creates a rich and dynamic data ecosystem that enables advanced analytics to inform farmers of the best economic options to maximize profitability and minimize risk – the two critical variables farmers in India want to manage.

Smart phones are the key interventions as they are equipped with GPS to track where photos of field infestations or hail damage have taken place for technical support or insurance claims. Mobile phones also enable farmers to integrate into structured markets based on approved grades and standards that can be verified using calibrated photos and settlements made through mobile money.

Digital Agriculture is already the nerve center for modern food systems that enables democratization of information and distillation of big data analytics to provide timely and targeted insight for farmers, input suppliers, aggregators, processors and consumers. These insights are now delivered to the location of a decision (e.g. farmer's field on a smart phone) on how to optimize profitability, increase value chain efficiency and support consumer awareness on food and its impact on their nutrition, rural economy and environmental footprint of agriculture. For this to be realized, requirements gathering from each of the key stakeholders are critical. Failure to do this has led to many failed attempts at developing decision support systems, apps, databases, websites, digital sensors and mobile devices that do not serve the needs of farm families. The most successful cases of digital technology development have been a blend of visionary thinking and consumer input (e.g. iPhone, Google, etc).

Digital technology will be key in realizing the Second Green Revolution to increasing agriculture productivity by delivering tailored recommendations to farmers based on their priorities. These recommendations will be drawn from advanced big data analytics related to down-scaled daily observed weather – now a 9 km x 9 km grid but soon to be under 1 km x 1 km – at effectively field level that feed into agricultural system models to estimate yields, harvest date, livestock performance and potential pest and disease outbreaks.

Remote Sensing

Remote sensing is another big data resource to support the development of derived weather products (radar), improved hydrology and watershed management, soil health, crop coverage and crop health estimates, among other application. The Indian Space Research Organization has strong remote sensing capabilities within its constellation of satellites with different resolutions, wavelengths and cadence to support agriculture; however, it is important to also draw on the rapidly increasing capabilities

of the private sector providers of satellite imagery to increase the coverage, frequency and resolution of imagery for specific interventions such as crop loss assessments that have narrow windows for image acquisition.

Satellite imagery is now complimented by Unmanned Aerial Vehicles (UAVs) that can capture multispectral images to assess crop health, damage and yield far more accurately than satellites. However, policies are urgently needed to unlock the responsible use of UAVs by public and private sector providers to support precision agriculture in India. The UAV sector is rapidly maturing and India stands to benefit tremendously from this technology to support smallholder farmers and their migration to India's own version of precision agriculture. Immediate applications of UAV imagery include crop loss assessments, and they can be twinned with mobile validation and fertilizer recommendations based on canopy and soil reflectance, calibrated by ISRO, ICAR and international research organizations like ICRISAT.

Efficient Value Chain

The greatest impact of Digital Agriculture will be realized through democratization of market pricing and compressing transaction costs so farmers capture a higher portion of their produce's marketable value. Agricultural value chains are complex with several actors along the chain but information asymmetry between the farmer and aggregator or intermediaries results in farmers having to sell into saturated, weak markets that are not based on transparent grades and standards.

Powerful business models have emerged from Africa, Brazil and China that use Big Data Analytics and mobile phones to increase value chain efficiency and equitable integration of smallholder farmers. This will translate into access to appropriate inputs (e.g. digital soil maps to recommend micronutrient blends for fertilizer) and credit (e.g. banks will now know their rural customers to manage lending risk). Commercial service providers are offering targeted recommendations to farmers in developed markets to improve productivity through to market integration based on agreed grades, standards and prices. It is not uncommon for farm incomes to double in the case of smallholder farmers for stable crops and to quadruple in the case of perishable produce.

Transform Rural Communities

With the Direct Benefit Transfers system and Aadhaar to support the transfer of government subsidies to citizens, India is uniquely positioned to leverage these platforms to support the earlier interventions around soil health, PMKSY, national markets and weather indexed insurance. When combined with spatial/ temporal data infrastructure, subsidies can be validated (e.g. remote sensing to validate application of fertilizer on a specific field under a targeted fertilizer subsidy program) and targeted (e.g. digital soil map and crop variety cultivated and rainfall anticipated to optimize income and reduce risk) to increase farm profitability and manage production and market risks that in turn give famers confidence to invest in their farms to further increase productivity.

Mobile money will be a key intervention to compress transaction that has unlocked tremendous opportunities for rural consumers in Africa and will do the same for India. Paper money is expensive and risky to rural consumers but mobile money is safer, especially for women, and costs less to transfer. Mobile money also allows rural consumers to bypass poor infrastructure to support savings and access credit.

M-Pesa that first started in Kenya is the most popular example

of how mobile money has supported financial inclusion in rural communities. The important nexus of finance and agriculture cannot be overstated as we look to new technology to support integration and convergence of key services to transform rural communities.

Digital Agriculture will leverage social media platforms to build human capacity at scale and reduced cost by providing a tailored learning experience based on increased understanding of knowledge exchange, learning and behavior change associated with technology adoption. One of the best examples originating from India is digitalGREEN that uses participatory video to have lead farmers explain best management practices to other farmers. This approach is ten times more cost effective than traditional extension services as farmers tend to trust other farmers living under similar circumstances.

Common misconceptions in the digital domain are the assumptions that people will delegate decisions to decision-support systems (DSS), that farmers will simply enact recommendations transmitted over digital devices and that they are homogenous in their adoption of technologies and attitudes to risk. These assumptions have led to many failed DSS examples. Like all humans, farmers blend their intuitive decision-making, built from their experience, with new sources of information and analytics and make decisions under uncertainty based on their own cognitive understanding and risk perception.

New knowledge exchange platforms are now emerging that leverage machine learning to tailor learning experiences, such as the Khan Academy for math and sciences. These are now being developed for younger children such as EkStep and can be further adapted to support technical training for agriculture practitioners (farmers, extension providers and scientists). Quality control of content is important to ensure that the knowledge being shared is sound. To achieve this, new models and coalitions are being formed. An example is One Agriculture One Science, an initiative to pool university curricula to support on-line training of scientists and extension officers by leading educators from around the globe, including partners in India (IIT-Mumbai, ICAR, ICRISAT), Africa (RUFORUM) and US universities.

Data Safety

Farming communities are no different from urban consumers, with concerns about trust and use of internet and transaction data that can be used to compromise Personal Identification Information (PII). Policies must be put in place so that the advances offered through digital technology do not compromise the trust of farmers. While the early approaches to PII security have been permission-based, the new era of cloud computing and inter-connected databases will offer augmented approaches that will include guiding principles and accreditation standards (e.g. platinum, gold, silver and bronze) that companies and governments earn based on feedback from users on how customer data are used to support them and not compromised.

Many lessons can be learned from several Open Data movements by governments around the globe but these need to be framed more broadly to interface with the private sector in a responsible manner to leverage public sector spatial data infrastructure in order to accelerate rural economic growth and scale up demand-driven innovations that are both farmer- and data-driven. New cloud-based architecture should be considered in light of the emerging role of 'containers' to partition databases to better manage exposure and risk to hacking. It will be critical to give thought to integration across allied ministries to support rural development, PII security, user requirements and policies to unlock the responsible use of digital technology while not being too prescriptive or restrictive to impede innovation and realizing a Digital India.

Conclusion

While Digital Agriculture is most advanced in the USA, the concepts are scale neutral and are being successfully applied to smallholder farmers around the globe. The Government of India, at the Federal and State levels, is moving with a sense of urgency to apply these new tools to accelerate the pace of agriculture development to not only realize the vision of the Prime Minister of a Digital India but to facilitate the achievement of Sustainable Development Goals BEFORE 2030. Digital agriculture will also help achieve the objectives of the National Food Security Act in the most efficient, effective and equitable manner to ensure ALL have access to safe, nutritious and affordable food.

(The author is the Director General, ISCISAT. Views expressed are personal.)