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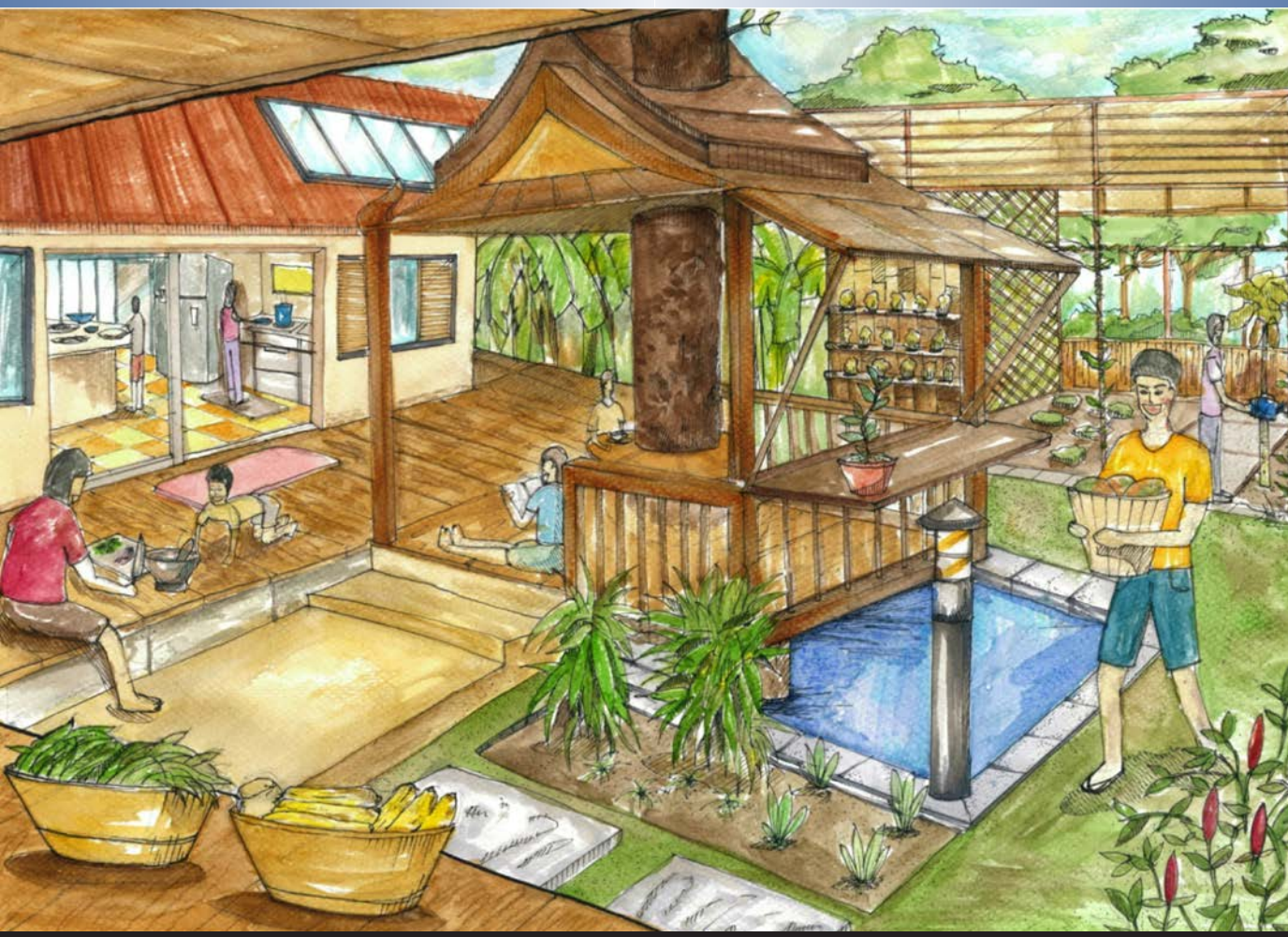

SUCCESS STORIES ON

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR AGRICULTURE AND RURAL DEVELOPMENT

Second edition

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SUCCESS STORIES ON INFORMATION AND COMMUNICATION TECHNOLOGIES FOR AGRICULTURE AND RURAL DEVELOPMENT

Second edition

Edited by

Gerard Sylvester

Regional Office for Asia and the Pacific
Food and Agriculture Organization of the United Nations
Bangkok, 2017

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Foreword

Agriculture has undergone many transformations over thousands of years. Humanity has moved from a society of hunter-gatherers to an agrarian community and then to one where agriculture is handled as an industry, yet still primarily supported at the source by smallholder family farms. While machines have, largely, replaced the manual plough, modern technology, or e-agriculture applications, hold out great promise as the next transformation in this sector.

As we know, the task of producing food for more than seven billion people is not an easy one. This is further compounded by difficulties posed by climate change, competition for increasingly scarce resources, limited availability of arable land, disease and pest infestations, food loss and waste among others.

These challenges are immense for smallholder farmers and family farmers. There are more than 500 million family farms in the world. They range from smallholders and medium scale operations, to peasants, indigenous peoples, traditional communities, fisher folk, pastoralists and many other groups worldwide who rely on the land and the seas for subsistence.

The growth of information and communication technologies, or ICTs, over the last decade has been phenomenal. From 2G/3G connectivity, we are now in a phase where we discuss sensor networks, machine-to-machine (M2M) communication, Internet of Things (IoTs) and Big Data. These developments should be harnessed in an affordable way to benefit the majority of small holders. If a simple SMS message can alert the farmer or fisher – indeed alert the whole community – about important information, then this is a major step in the right direction and it benefits everyone, from producers to consumers.

Information and Communication Technologies can transform lives and improve livelihoods – more so for people involved in agriculture and allied activities. ICTs can also increase access to financial services for rural communities, helping to secure savings, find affordable insurance and tools to better manage risk. ICTs also widen the reach of local communities, including women and youth, and provide newer business opportunities thereby enhancing livelihoods.

The following pages document a collection of case studies, originally printed in 2015, and highlight some of the promising uses of ICT in the agricultural and rural domains. Going forward, FAO, together with our partners, will continue to identify and promote sustainable and scalable ICT solutions for the benefit of all.

Dr Kundhavi Kadiresan
Assistant Director-General and Regional Representative
FAO Regional Office for Asia and the Pacific

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Gerard Sylvester
Regional Knowledge and Information Management Officer
FAO Regional Office for Asia and the Pacific

Acronyms and abbreviations

ACFS	The National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives
AIGS	Agricultural Innovative Grant Scheme
AgriCommS™	Agri Commerce System
AgriKnoB™	Agri Knowledge Base
AusAID	Australian Agency for International Development
APIs	Application programming interface
B2B	Business to Business
B2C	Business to Customer
BAIF	Bharatiya Agro Industries Foundation
BIID	Bangladesh Institute of ICT in Development
BoP	Base of the Pyramid
CB	Certification Body
CHPCL	Chennai Horticulture Produce Producer Company Ltd
COCO	Connect Online Connect Offline
COCOBOD	Ghana Cocoa Board
CROPS™	Crop Rotation, Optimization and Planning System
CRPs	Community Resource Persons
CRS	Catholic Relief Services
DA	Development Agent
EFR	Electronic Farm Record
FPDA	Fresh Produce Development Agency (FPDA), PNG
G2B	Government to Business
GAP	Good Agricultural Practice
GDP	Gross Domestic Product

ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid-Tropics
ICT4D	Information and Communication Technology for Development
IFAD	International Fund for Agricultural Development
IQS	Institute of Product Quality and Standardization, Maejo University, Thailand
IT	Information Technology
IUU	Illegal, Unreported and Unregulated
IVR	Interactive Voice Response
JSON	JavaScript Object Notation
KM	Knowledge Management
KVK	Krishi Vigyan Kendra
MIT	Massachusetts Institute of Technology
MJU	Maejo University
MOOC	Massive Online Open Course
MMIS	Mobile Market Information Service, PNG
NDFA	National Directorate of Fisheries and Aquaculture
NECTEC	National Electronics and Computer Technology Center, Thailand
NSTDA	National Science and Technology Development Agency, Ministry of Science and Technology Thailand
OS	Operating System
PHP	Personal Home Page
PLB	Personal Locator Beacon
PNG	Papua New Guinea
PRIDE™	The Progressive Rural Integrated Digital Enterprise
QR	Quick Response
RFLP	Regional Fisheries Livelihoods Programme for South and Southeast Asia
RMUTL	Rajamangala University of Technology Lanna, Thailand
SAAO	Subassistant Agriculture Officers

SAR	Search and Rescue
SFAC	Small Farmers Agriculture Business Consortium
TAC	Technical Advisory Committee
TCS	TATA Consultancy Services
TNAU	Tamil Nadu Agricultural University
T&V	Training and Visit (method)
VMS	Vessel Monitoring Systems
WSVGA	Wide Super Video Graphics Array
WVGA	Wide Video Graphics Array
WXGA	Wide Extended Graphics Array

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Introduction

Family farming remains the predominant form of agriculture in Asia and the Pacific. There are more than 570 million farms in the world of which over 500 million are family-owned. They are responsible for at least 56 percent of agricultural production. These smallholder resource-poor farmers are confronted by many challenges – the negative impact of climate change, increased frequency of natural disasters, loss of biodiversity, crude oil price hikes, rapid expansion of bioenergy development, increasing food price volatility, inefficient supply chains and others. The information needs of farmers will only increase as they have to make more and more complex decisions on the use of their land, selection of the agricultural commodities they plant, choice of markets to sell their agricultural products and other necessary decisions that impact the livelihoods of their families and society. Indeed, agriculture is becoming increasingly knowledge-intensive.

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Conversely, we have witnessed the development of information communication technology, or ICT, as a major driver of economic growth. In addition, emerging ICTs have provided new opportunities to address the challenges faced by agriculture. For example, increasing use of mobile phones for information exchange, such as disease surveillance and pest tracking, is now common practice. Linking knowledge to innovation is also crucial to addressing the information and knowledge gaps in the agriculture sector. Therefore, ICTs can also play a very important role in bridging information gaps.

FAO has been promoting the use of ICTs in agriculture and has focused on ICT innovation for improving agricultural production and enhancing value chains. This publication is an effort to share success stories on the use of ICTs for agriculture and rural development. A follow up to the FAO publication *Information and communication technologies for sustainable agriculture (http://www.fao.org/docrep/019/i3557e/i3557e.pdf)*, this knowledge-sharing effort helps to ensure that innovations are widely shared and a wide range of stakeholders is benefited, thereby contributing to efforts for creating a 'world without hunger'.

This publication showcases a few case studies where innovative use of emerging technologies together with capacity development has brought about rich dividends. Digital Green's experiences in knowledge sharing among rural communities to Nano Ganesh's innovative use of technology in switching on irrigation pumps have the potential to contribute significantly to the livelihoods of farming communities.

Case Study 1: Digital Green: Leveraging social networks for agricultural extension

Rikin Gandhi[1]

Philosophy and strategy: Participatory video to improve existing agricultural extension systems

Overview

Digital Green's early roots were formed as a Microsoft Research Project in Bangalore. Founded in 2006 by Rikin Gandhi, the project was part of an effort to test different ways of using technology for social development. More specifically, the project focused on testing the use of participatory videos as a means of agricultural extension. The approach was substantially more effective as a means of extension than existing conventional agricultural extension programmes.

The use of video for agricultural extension was by no means a new approach and Digital Green was inspired by a number of different projects. These can be broadly categorized as information technology for agricultural development, video in agricultural extension and mediated instruction for effective training with video. Digital Green weaves together the best of these three strands into a novel system that maximizes the impact of agriculture extension workers and adds the critical element of community engagement and participation throughout the process. Based on the success of the project, Digital Green was formally established as an NGO in 2008, with offices in Bangalore, Karnataka in India and Berkeley, California in the USA.

Background and context: Agricultural extension systems in India

Small-scale farmers make up about 70 percent of India's farming community, but experience deep economic and social inequities in comparison to large land-holding farmers. Indeed, recent studies have revealed that most small-scale farmers no longer view farming as a sustainable livelihood source. Even Mr Santosh Sharma, who is regarded as a relatively well-off farmer in his village, says, "Farming is no longer a dependable source of income. It was during my father's and grandfather's generations, but now everything is changing, from the market to the environment. Now I tell my children that they should study well and get jobs outside the village, because that is the only way they can have a good life." Mr Sharma's story is related in Box 1.

[1] Digital Green, India: contact@digitalgreen.org

Box 1. A farmer's story

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A farmer explains the effects of the climate on his crops

In January, the wheat fields sown in the previous year all over Rajgarh District of the Indian state of Madhya Pradesh are flourishing. Their long stalks sway elegantly in the breeze and the ears of the grain are ripening into plump seeds. However, the picture is not as rosy as it appears to the untrained eye and the changing weather has wreaked great damage on the crop. Everywhere, large patches in wheat fields have been flattened by excessive rain and wind. The kernels of wheat are full of water from dew and fog, and the seeds inside are rotting from the uncharacteristic lack of sunshine.

Despite the obvious problems caused by the weather, Mr Santosh Sharma, a long-time farmer from Biaorakala village (Khilchipur block, Rajgarh District) remains positive about his own wheat fields. When prompted, he explained that this year he has chosen to plant a different variety of wheat. This newer strain, called Variety 322, is more resistant to climate change in addition to giving a higher yield of grain. Each seed produces a greater number of individual stalks – about ten per seed as opposed to about six per seed in the older varieties and each stalk is thicker than earlier varieties. Variety 322 is better able to withstand the wind, rain and excessive moisture that the region is facing this season. While Mr Santosh still anticipates a lower yield than if the weather was more amenable, he is grateful that his crops have managed to withstand the climatic challenges to some degree.

Santosh is one of the few farmers from his village who has managed to cope with the weather this year, and attributes this to the videos on wheat cultivation that he watched. These short eight-to-ten minute documentaries, developed by Digital Green along with its partners in the local NGO ACCESS, as well as the village community, demonstrate best agricultural practices for farmers. The videos are

made in the local language by the community, for the community, using members from the community as actors. Santosh has not only seen most of the videos developed in his district, but also featured in some of them. He has adopted several of the practices, and is a strong advocate of the video-based learning process amongst his peers.

Explaining what he finds successful about the approach, Santosh says, "Not only do videos allow farmers to see a visual demonstration of the entire process, they also feature practices that can easily be tested. For example, I planted Variety 322 on a small part of my land last year. When I saw that it gave me a bigger yield than the other variety, I decided to plant more of it this year. I am lucky, because it is also stronger and better at surviving in this bad weather." Furthermore, he adds, "Farmers are always keen to learn new and better ways of growing their crops. The videos are helpful because the entire process is visually demonstrated and explained in our own language by farmers from our own community. All this makes it easier for us to understand."

Public investment in agriculture has also fallen over the past few decades. While some of this decrease has been offset by the private sector, these investments tend to concentrate on larger, more mechanized farms. The largely traditional approach to agricultural extension in countries like India has further isolated and increased the vulnerability of small-scale farmers. During India's green revolution of the 1970s and 1980s, the most commonly used method of extension was the Training and Visit method (T&V method), which followed a top-down approach to information dissemination. The purpose of the T&V approach is to encourage farmers to increase production of specified crops. However, planning is controlled centrally and field personnel tend to be dependent on central resources; there is a rigid pattern of visits to farmers and in-service training of field staff. While the approach provides scientific and technical support, it lacks genuine two-way communication and the flexibility required to make it responsive to the local situation. The T&V approach gave way to extension programmes that have focused instead on developing more participatory, decentralized, demand-driven services. These approaches are also better tailored to addressing the diversity of culture, language, geography and other socio-economic and environmental factors, tailoring information to the local context.

Despite several efforts to reach small-scale farmers, however, India's current extension system often fails to effectively communicate with them. This is largely due to issues such as generic, top-down content to which the farmers cannot relate. While the content may be scientifically accurate, it may not be presented in a way that the farmers can easily grasp, either due to language barriers or because it is presented in brief or abstractly. Mr Narsingh Lal, another progressive farmer from Santosh's village says, "Earlier, people

from NGOs or the government used to come and visit us and tell us about good farming practices. While it was helpful, it was sometimes difficult to understand exactly what they meant, because they were explaining everything verbally. The videos are better, because we can see the entire process on the field, which makes it easier to understand and also remember all the information." Figure 1 shows the orange trees planted by Mr Narshingh Lal after watching a Digital Green video.

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Figure 1. Mr Narshingh Lal, an orange farmer, proudly showing the orange trees he planted after watching the video from Digital Green

Even in cases where field demonstrations are part of the extension system, restrictions of resources and personnel mean that the demonstrations take place at wide intervals with little or no interaction with farmers in between. The lack of a local facilitator or resource person who can assist farmers in implementation often means that these extension efforts do not result in actual adoption.

Digital Green has demonstrated that a participatory process of engagement combined with simple technology solutions can enable small-scale farming communities to produce and share information on best practices for improved productivity and sustainable livelihoods. Initial pilot studies not only indicated a higher uptake of practices through the video-based approach, but also revealed that the Digital Green model was more cost-effective than classical systems of agricultural extension. Gandhi et al. (2009) state that the Digital Green approach was at least ten times more efficient and seven times more likely to encourage farmers to adopt new practices compared to conventional agricultural extension systems.

The Digital Green approach: Technology, partnerships and community engagement

The Digital Green approach is essentially a technology-enabled means of behaviour change communication, which is cost-effective, scalable and brings together researchers, development practitioners and rural communities to produce and share locally relevant information. Digital Green's participatory, video-based learning approach aims to engage the community to the greatest extent possible within the extension system. To do so, Digital Green integrates its processes within existing private and public extension systems to build the capacity of rural communities to produce and share short videos, i.e. it serves as a digital exchange platform.

The hub-and-spoke model

Typically, Digital Green partners with government agencies, independent NGOs or private sector agencies that help to identify progressive and enthusiastic members of the community, who then serve as champions for the extension efforts. At the block level, teams of three or four individuals are trained in video production skills using simple, handheld cameras. The skills encompass the entire gamut of processes for creating a video: from the development of a storyboard, to shooting the video with appropriate lighting, ensuring that it is culturally and aesthetically appropriate, editing and incorporating a soundtrack, and so forth. These video production units at the block level act as a kind of hub for the production of content. This content, in the form of short eight-to-ten minute videos, is then shown to small groups of farmers in different villages across the block. At the village level too, selected community resource persons (CRPs) are trained in facilitation skills. These CRPs are responsible for screening videos in three or four villages within the block, and directly liaise with the community – answering their questions, clarifying doubts and assisting farmers in the adoption of new practices. This forms a hub-and-spoke model, wherein content is developed at the 'hub', or block, and distributed across all the 'spokes', or individual villages.

Partnerships

Partnerships are critical to the success of the Digital Green approach; its partners are carefully chosen, particularly for their strong integration and relationship with the community. In Madhya Pradesh, for example, Digital Green's partner, ACCESS, has been working in Rajgarh District for over 15 years, bringing information about better agricultural- and livelihood-generating practices to farmers. Similar strategic partnerships enable Digital Green to work around the challenges and pitfalls of working in unfamiliar contexts, while also amplifying the reach of its government, civil society organizations and private partners through efficient dissemination methods. Additionally, as Digital Green's approach leverages community groups such as women's self-help groups or farmers' groups, some of its partners, such as JEEViKA in the Indian state of Bihar, are seeding new social groups and initiating livelihood programmes. In

sub-Saharan Africa countries as well, where community groups did not previously exist, Digital Green's implementing partners are experimenting with the formation of farmers' groups and strengthening community bonds.

Local relevance of video content

The videos are produced in the regional language, ensuring easy comprehension and immediate connection with the local community. They are then screened among small groups of farmers on a regular basis using portable, battery-operated pico projectors. About once every two weeks, the CRPs facilitate screenings to engage groups of farmers with the videos and one another in an interactive learning process. During these screenings, members of the community not only watch videos about new practices, but are also encouraged to discuss and debate the featured practice, ask questions and clarify doubts. The CRPs are key within this process, and facilitate the discussion by asking different community members to share their opinions and experiences. They clarify doubts, ask participants to recall what they saw in the video and even repeat the screening, if required. The CRPs also record the main questions and points of discussion at each screening, which are later shared with partners, uploaded as comments on the Digital Green Web site and even used as feedback to inform further iterations of the videos.

The content of the videos is generally chosen based on both top-down and bottom-up decision-making. While government, civil society organizations or private partners usually bring subject matter expertise, farmers are sounded on their specific requirements regarding the practices they would like to learn about. The final content, therefore, is tailored to be locally relevant, while still maintaining scientific accuracy. In Rajgarh, for example, Santosh and other farmers from the community are regularly asked to share their areas of interest, and as a result, most videos feature wheat and soybean cultivation, as they are the most important cash crops of the area. However, Santosh indicates, "Recently, when the price of onions was very high, we realized that onion cultivation would also be profitable. Therefore, we (the farmers' group) asked the ACCESS team for a video about the best way to transplant onions, since that's the tricky part of the process. They responded quickly, and since then all of us have adopted this new way of transplanting onions."

Community participation and engagement

Community participation is essential to the success of the approach, since the information being given to the farmer comes from a familiar source, leveraging the principles of homophily, also described as the tendency of individuals to learn and bond with that which they share mutually. This element of sameness, or deep similarity, allows for better learning and engagement with the topic. In other words, the farmers are better able to relate to the actors in the video (Figure 2) because they come from the same community, and perhaps even the same village. This, along with the visual,

demonstrative medium of video, is a powerful mode of communication. The additional layer of facilitation by a trained community member, moreover, has been proven to be even more effective than simply showingthe farmers the video, or having the screenings facilitated by an external expert.

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Figure 2. A local video production team in the process of creating a video using local actors

Mr Jitendra Singh Rajput, the programme director of ACCESS, feels that the deep community engagement is one of the most successful aspects of this approach. Elaborating on this, he says, "Previously, the extension workers in the programme would get to interact with farmers only around once in two or three months. Now, they get to attend screenings as often as once a week, and the facilitators are from the surrounding area and are much more approachable. This has been a massive change, and has helped build greater trust within the community, which in turn has helped raise the number of adoptions."

Mr Kushal Dange, the CRP for Biaorakala village, where Santosh Sharma lives, prepares for the evening screenings by watching the video once or twice in advance. He also makes sure that all the necessary materials are in place, including the paper form to record the names of those who attended, the pico projector, the speakers, mats for the viewers to sit on and so forth. During the screening itself, Mr Kushal pauses the video at intervals and invites the group to reflect on what they've seen, ask questions, voice their opinions and share their experiences. In his opinion, "Watching the video more than once, or asking the farmers to discuss the video among themselves is very useful. It helps them absorb and retain the information more effectively, and also helps me (the facilitator) gauge the interest within the group." Mr Kushal notes down the names of those who seemed most interested, and over the course of the next week, he visits

them individually to check the practice adopted, verify that it has been implemented as instructed and discuss the best way to take the adoption forward.

This degree of engagement with the community throughout the screening and adoption process is an extremely important facet of Digital Green's work. The fact that the CRPs are from within the community means that villagers are able to reach out to them for assistance even outside of the formal video screening sessions. This helps build greater trust between the local partner and the community, as well as within the community groups themselves, therefore not only increasing their willingness to adopt a new practice, but also helping to create a stronger community support system for the farmers.

©Digital Green

Figure 3. A vibrant discussion amongst the community, following a video screening in Ghana

These community groups are invaluable to the learning process because of the lively discussion and sharing of experience that they enable (Figure 3). As Mr Jero Gelgelu, a farmer from the Arsi Negelle Woreda (district) from Ethiopia says, "Before the end of the video dissemination, there is an active and open discussion among group members. Farmers are able to ask as many questions as they like. This discussion helps to minimize any doubt farmers may have with regard to the new technology or farming practices. Through the video dissemination process, farmers learn new practices from three sources: the videos, the development agents and the farmers themselves." Speaking more about the enhanced learning through group discussions, Mr Jero adds, "The group environment of video disseminations increases peer to peer interaction between farmers and promotes the exchange of experiences and best practices."

Mr Teshale Amde, a development agent who works within the Ethiopian Ministry of Agriculture's agricultural extension programme, is a big supporter of the Digital Green approach. Citing community participation as one of the main elements of success, he says, "The discussions at the end of video screenings are one of the most important parts of the process. Not only can farmers clarify their doubts easily, but the discussion also helps to increase trust between them, and creates a spirit of healthy competition in implementing practices. When a farmer hears about a neighbour implementing a practice successfully and improving his livelihood, he thinks: if he can do it, why can't I?"

Achievements and possible impact

To date, Digital Green has produced nearly 3 000 videos in more than 20 languages, and reached more than 300 000 farmers across more than 3 900 villages[2] across India, Ethiopia and Ghana. These videos have been collectively screened more than 200 000 times and have resulted in more than 370 000 adoptions.[3]

Strengthening local communities

The Digital Green approach is designed around building the capacity of local communities in producing and sharing knowledge products, specifically short videos, for improved livelihoods. As its geographic scope scales up, its training strategy has evolved to include building the capacity of a cadre of master trainers (within the partner staff as well as community level), with a special emphasis on enhancing the facilitation skills of these trainers. In addition, by modularizing its own training sessions into short videos, the organization plans to add a layer of accessibility to global partners interested in leveraging the Digital Green approach.

Digital Green focuses on increasing the efficacy and cost-efficiency of agricultural extension. The criteria for measuring the success of its approach are based on factors such as the number of videos produced, the number of community members engaged and the number of new practices adopted by farmers. The organization's technology stack helps to track these parameters accurately and efficiently. At the core of the stack is Connect Online Connect Offline (COCO), a data management tool which is specially designed for use in areas with little or no Internet connectivity. Partner staff at the block or district levels is trained to use this software to upload information on a near real-time basis. These data can be easily accessed by anyone from anywhere in the world through an analytics dashboard, and are completely open-source, allowing partners and supporters to view, analyse and use them.

[2] Statistics as of April, 2014.

[3] Please see Digital Green Analytics for more details (www.digitalgreen.org/analytics).

Social empowerment

Apart from these tangible factors that can be tracked using numbers or percentages, it is also worthwhile to note the other 'social' effects of the Digital Green approach on the community. The most significant is the community's sense of empowerment through exposure to new skills and technologies. Most of the villages where Digital Green functions have little or no access to electricity or even basic technology like television, computers or mobile phones. Yet, the younger generation is interested in accessing them and is enthusiastic about learning the new 'modern' skills, and becoming more 'tech-savvy'. Digital Green allows them access and training in using technology such as video cameras and projectors, as well as the software for editing the videos, and for recording and uploading data to COCO.

Mr Ram Prasad, the young and enthusiastic block coordinator for the Khilchipur block of Rajgarh District, is one of these young persons who feels empowered with his newly acquired knowledge of videos, projectors and the Internet. He explains, "I had never even held a camera before I started working with Digital Green, but now I don't even have to think about it. Now I can use computers and the Internet with ease." Mr Kushal Dange also feels that the training he has received, and the role he now plays, have contributed to his social standing within the community. He explains, "Before I started working with Digital Green, I was just another farmer. Now, everyone knows me as the video wallah (the video man), and they come to me to ask about not just their crops, but even when they have problems with their cell phones and other technology!" Women such as Ms Pinky Devi have experienced a great improvement in their social status, and are now even consulted by the men in the village about better agricultural practices (Figure 4).

©Digital Green

Figure 4. Improved social status – a group of empowered women farmers with Ms Pinky Devi (centre)

Mr Bawa Kurubie, a community extension agent from the New Edubiase District of the Ashanti Region of Ghana, also experiences this sense of empowerment. Describing how the videos have helped him his work, Bawa says, "I initially doubted the Digital Green approach and was worried it would only add to my workload. But now, I can say with confidence that the videos have helped make my work simpler. For farmers here, seeing is believing, so the videos are a powerful way of giving them information in a way that it is truly useful for them. Now, I have to do less talking and explaining, and they have made my work much easier." For Mr Kurubie Bawa, the video production training has even been useful at the personal level. He used his newly acquired videography skills to create a short video of his birthday celebrations, which he then proudly showed to his family and friends.

Lessons learned

Strong community groups are essential for the success of the approach

Digital Green first began working in villages where its partner organizations already had established activities working with local community groups such as self-help groups, women's groups and farmers' groups. As such, deploying the Digital Green approach in these villages was a straightforward process. As it expands, however, the approach is being taken to areas that are new to both Digital Green and its partners. This has meant that Digital Green has had to reconsider the way in which the approach is operationalized in new villages. To address this challenge, Digital Green has begun working with its partners to share content related to mobilizing community groups and building grassroots-level institutions in advance of agricultural messaging. In Ethiopia, for example, existing social groups, such as farmer development groups, were not as strong as those in India. Digital Green, therefore, supported and provided training in social mobilization to its partners in Ethiopia to help strengthen them. In addition, it is also exploring means of leveraging other existing community groups, such as student groups, youth networks and womens' groups, for its work.

Staying flexible is necessary to be relevant within new contexts

The Digital Green approach is now being extended in the health and nutrition sectors through projects in India and Ethiopia. Initial results show that the approach is malleable enough to be effective in the new domains as well, albeit with minor changes. For instance, one area of discussion is the definition of adopting a health behaviour. In the agriculture sector, adoptions are typically more tangible and visible. In the health domain, however, behaviours are far less evident and can often be private in nature, which can make them more difficult to track. The way in which adoptions are defined in health, therefore, has been expanded to not only include actual changes in behaviour, but also gains in knowledge.

New partnerships require handholding support

As Digital Green expands its network with new partners, it has found that different partners have varying levels of competence in terms of their domain expertise, their familiarity with technology, their ability to engage the community and their ability to track progress and manage data, for example. Therefore, it is necessary for Digital Green to provide a higher degree of support to new partners, especially in the initial phases of a partnership. For instance, when Digital Green first began its work in Ethiopia, there was far less traction for the approach until Digital Green invested in local human resources that could provide the necessary technical and process-related support.

Learning, experimenting and iterating the approach for maximum impact

Another major learning curve, as Digital Green applies its approach to new sectors, concerns the tracking of social impact. Videos focused on health and nutrition have a wider target audience: instead of solely targeting those members of the community who can adopt a practice, outreach extends to community members who can act as promoters and influencers. An example of this can be seen in the case of Ms Malli Lohar, a member of a women's self-help group in Odisha. Ms Malli's group is part of a project that provides video-based nutrition-specific messaging to pregnant and lactating mothers. While she is neither pregnant nor lactating herself, and hence not the primary target of this messaging, she is an active and influential member of the community. She has watched all ten videos produced within the project and is keen to take the information to other women in her village. "I see that children in the village are not so healthy and if I can help new mothers with useful information, then I feel it is my duty to do so," she says. Ms Malli is an excellent example of the kind of wider social impact that is enabled through the Digital Green approach, and indeed this concept of 'promoters' is one that the organization also plans to track and study further as it works more extensively in the health and nutrition domain.

Maintaining the quality of content at scale is a challenge

As Digital Green expands, the importance of ensuring high-quality content has come to the forefront. In order to ensure that only rigorously vetted content – from both audio-visual production and scientific standpoints – is shared with farmers, Digital Green has found it necessary to bolster its Technical Advisory Committee (TAC), comprised of domestic and international researchers and practitioners, and is recruiting subject matter specialists to review videos under the guidance of TAC members. These specialists, who are experienced agricultural researchers or scientists, are responsible for vetting both individual videos and bundles of agricultural best practices across the variety of domains in which Digital Green operates.

Innovative solutions are required to maintain the quality of training

As Digital Green operations expand, it is becoming necessary to rethink the ways in which mediators are trained in order to maintain high quality standards. In order to accomplish this, Digital Green is working to create a cadre of master trainers who have been selected from among high-performing mediators working with its existing partners. Once Digital Green staff has ensured that the master trainers are capable of conducting high-quality training without supervision, they take over new training by themselves. However, quality assurance responsibilities with regard to dissemination quality and adoption verification will continue to remain with Digital Green, as will quality oversight for the mediator training process.

Digital Green is also in the process of creating a learning platform for mediators that will be available globally. The platform will build upon and improve the quality of Digital Green's existing training curriculum, incorporating both technical skills on specific subject areas as well as process-related skills such as video production, dissemination facilitation and data tracking. The learning platform will combine both on- and offline components, in which master trainers who work within Digital Green partner organizations might facilitate the presentation of videos through the learning platform to groups of mediators. Usage data and feedback from trainees can be leveraged to improve the quality of future training programmes. In essence, the learning platform will function as a hybrid Massive Online Open Course for mediators affiliated with Digital Green partners that combines technical elements with in-person facilitation and assessment.

Conclusion

Digital Green is currently in a phase of rapid growth and has expanded its approach to new sectors and geographic zones. The simplicity and flexibility of this video-based approach has allowed for its effective application in multiple and different social, economic and cultural contexts.

In India, Digital Green's network extends to eight states [4] along with government and social sector partners. The organization has recently signed an agreement with the Government of India's flagship National Rural Livelihoods Mission to act as its national-level support organization to help empower rural communities across the country through increased access to information. In Ethiopia, Digital Green works with the Ministry of Agriculture to strengthen its extension system as well as those of other NGO partners. In Ghana, it partners with the World Cocoa Foundation and other commodity trading groups such as the Ghana Cocoa Board.

[4] The eight states are: Andhra Pradesh, Bihar, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh (as of April 2014).

Digital Green has plans to expand its reach across 11 000 villages in India and involve more than a million farming households by 2015, building the capacity of local individuals to serve as community knowledge workers. The organization is gradually working toward leveraging its global network of partners and supporters to create an e-learning and knowledge-sharing hub for rural development, taking the concept of learning to the virtual world.

Recommended reading

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Case Study 2: e-Krishok: Making ICT work for farmers A 360-degree ICT- enabled solution to empower farmers

Md. Shahid Uddin Akbar [5]

Context setting and readiness

Agriculture is one of the major contributors to the Bangladeshi economy. Approximately 45 percent (Katalyst 2012)[6] of the labour force is involved in the agriculture sector and the GDP contribution of this sector is 17.5 percent (CIA Factbook 2014)[7]. Studies have shown that significant proportions of this labour force are yet to take advantage of the information revolution. While people are enjoying the opportunities brought about by ICT in the era of globalization, farmers in Bangladesh are still employing traditional methods. For most of the farmers and many agricultural field agents, developing business models for agriculture remains a challenge.

In general, during the agricultural seasons approximately 83 percent of the farmers seek information on disease prevention, 57 percent on market price and 29 percent tries to get advice on improving the quality of land (Katalyst 2012). Business planning and commercial approaches among farmers and agro-entrepreneurs in rural areas are still largely absent. Thus there is an urgent need for information to assist in raising the income levels of farmer and microbusinesses. However, offering information and advisory services according to demand is not an easy process. Meeting the information demand requires a strong platform (ICT and institutional) and from that perspective fortunately Bangladesh has improved radically. Since the last decade Bangladesh has been experiencing revolutionary growth in the telecommunication sector. Ninety-seven percent of Bangladesh is now covered by mobile phone networks with Internet connections. This increasing mobile penetration has created a strong platform to develop mechanisms for providing information and communication services to actors in the agriculture sector (GSM Association 2012)[8].

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[5] Bangladesh Institute of ICT in Development (BIID), Bangladesh. Contact info@biid.org.bd

[6] Making ICT work for Bangladesh's farmers, The Katalyst Cases Number 6, November 2012

[7] CIA Factbook 2014 available at: https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html

[8] What is the impact of mobile telephony on economic growth?, A Report for the GSM Association, November 2012

Main philosophy/strategy of the approach

Keeping this backdrop in mind, Bangladesh Institute for ICT in Development (BIID) has taken the initiative to use the existing ICT network for developing and delivering services to create access to information for different actors of the agriculture sector. BIID has been engaged in developing ICT-enabled products and services to support private and public (government and NGO) initiatives that target the 'Base of the Pyramid' segment in particular. BIID envisions a vast range of opportunities in the ICT4D sector in Bangladesh and other developing countries; using its existing capacity, expertise and knowledge, BIID wants to focus on the agriculture sector, providing different services and offering 360-degree solutions covering preproduction, production and postproduction phases, i.e. from extension to market linkage.

The service basket of e-Krishok covers a wide range of service propositions including the information portal www.ekrishok.com which is basically an online information repository. Various contents in the form of factsheet and query solutions are available in the portal. Any user can directly communicate for any information and a back-end service desk provides the solution within a very short period. To make the e-Krishok service more popular and easily reachable for farmers, BIID introduced the short code-based Help Line 16250. Another major objective in this context is to make the service commercially viable in the long term. At the moment the service is only available to Grameen Phone customers and farmers can enjoy call back and SMS-based advisory services.

The Web site www.extension.org.bd has been launched to facilitate a platform for knowledge sharing among stakeholders in extension services. Based in Sher-e-Bangla Agriculture University, this platform shares updated information on extension services and technology. BIID and the Department of Agricultural Extension are also working to develop an e-Learning model to facilitate knowledge transfer among field-level extension officers.

'Batighar', or lighthouse in English, is a physical access point, popularly known as a telecentre, to ensure that farmers and other target groups can avail services as well as communicate through a human interface. Various e-Krishok services are profiled and available in the centre and BIID conducts various promotional activities keeping the centre in focus.

The Market Linkage Program (MLP) is the most complex service proposition BIID has addressed to date. Jointly with Grameen Phone, ACI and Katalyst, BIID is piloting an online market place for farmers and traders, where buyers and sellers can directly communicate, negotiate, trade and transact. BIID as the aggregator of the platform, ensures proper operation of the value chain.

Business planning is the most essential component for transforming agriculture as a commercial activity for the farmer who has never considered farming as business

in Bangladesh. BIID in collaboration with Catholic Relief Services (CRS) introduced Farmbook to offer an ICT-enabled solution to assess profitability and frame a business plan. By using Farmbook, farmers can predict possible return on investment as well as understand the cost structure which can help them to make proper business decisions.

Jointly with Green Delta Insurance Company, BIID is working to develop an insurance product to cover the loss of any damage to crops. Index-based insurance will be introduced in selected locations with selected crops.

BIID is offering various value-added services to members of e-Krishok (who enlisted through different activities and registered for services) like training and awareness building on new technology and solutions. Simultaneously, BIID is engaging Sub-Assistant Agriculture Officers (SAAOs) to facilitate various ICT-enabled services.

Mobile payment service has become very popular in Bangladesh and BIID has introduced optional payment facilities for farmers for all kinds of payment transfer. Also BIID is working with different organizations to develop quality control manuals for the online trading platform and has developed a network of traders to ensure smooth operation of the MLP.

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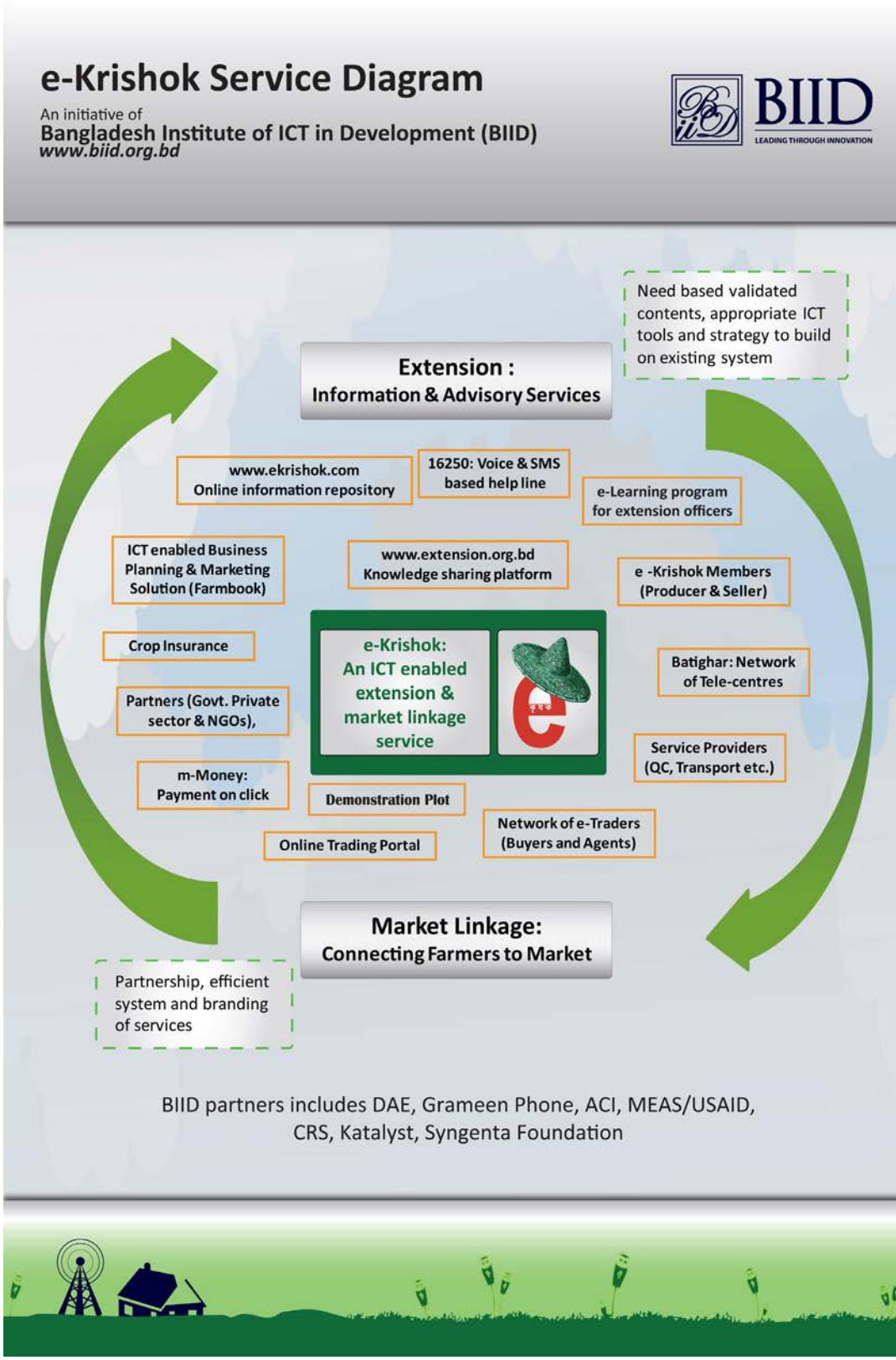

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Figure 5. The e-Krishok service

Key elements/methodology adopted

e-Krishok: A 360-degree solution of BIID includes extension to market linkage information to online trading

©BIID

Figure 6. e-Krishok logo

In BIID's service basket, e-Krishok is the flagship initiative consisting of different service components such as the information repository (www.ekrishok.com) including fact sheets, short code 16250, Info Centre (Batighor), www.extension.org (the knowledge-sharing platform) as well as the MLP and Crop Insurance. e-Krishok is the concept of integrating ICT as a 360-degree solution from preproduction to postproduction levels. Indicators that exemplify the model's excellence are: farmers' accessibility to make informed decisions; business management skills; knowledge to assess profitability and performance; availability of information and support services from diverse sources; and building of networks of all sources, links and individuals that are useful to provide support services regarding farming. In terms of concrete performance, there are approximately 140 000 e-Krishok members and more than 350 service centres from which information is disseminated. The strategies that have been adopted for scaling up of the programme are: creating awareness of the positive usage of ICT in agriculture through BIID's service centres; publicizing different forms of dissemination of the information related to e-agriculture and BIID's initiatives (in this case through public events); and organizing national events and workshops to disseminate BIID's initiatives.

Most smallholder farmers do not keep records. Most field agents have not received any formal education in business management and therefore rarely help farmers to plan their enterprises. Their focus, therefore, remains mainly on productivity enhancement. However, for development processes and upgrading strategies to work successfully in a business environment, more attention needs to be given to monitoring the profits that farmers gain from using technologies and linking to markets. Recently, BIID partnered with Catholic Relief Services to implement Farmbook in Bangladesh. Farmbook is a tool that provides farmers with access to a business planning process that is focused on their products and market opportunity. For farmers, it provides customized business solutions, rather than general market information.

©Noah Seelam

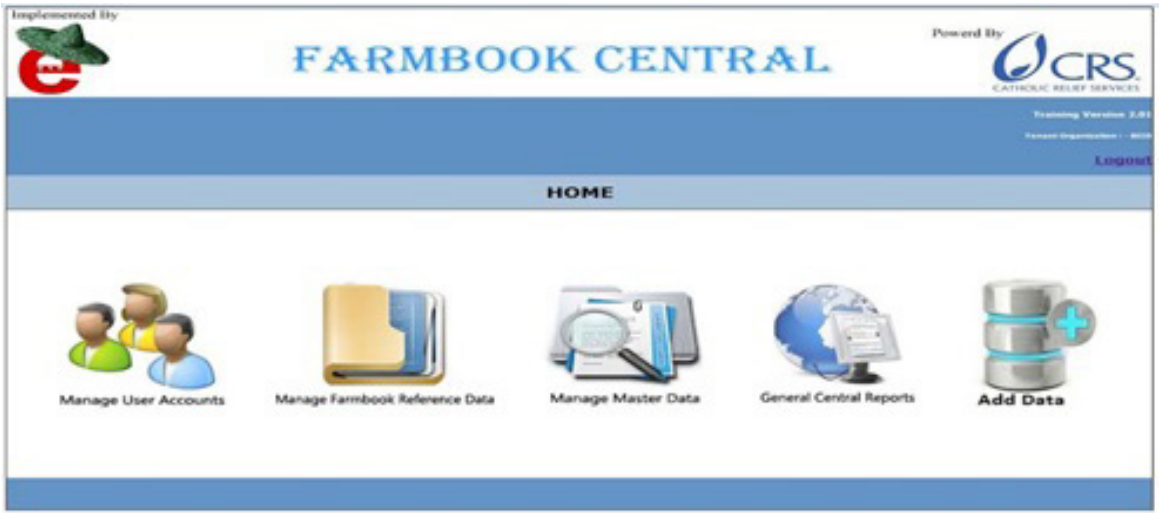

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Figure 7. Farmbook's administration panel

Farmbook is an innovative ICT solution for business skill development (planning, profitability assessment and marketing) and is designed to enable extension agents to help farmers to plan their farm businesses more effectively and quickly evaluate their productivity and profitability. Farmbook also includes a set of learning modules on five skill sets (Group Organization, Natural Resource Management, Financial Education, Marketing and Innovation).

Implemented By

FARMBOOK VALIDATION REPORT

Powerd By CRS CATHOLIC RELIEF SERVICES

Farmer Group

Sno.	Country	District	Village	Farmer Group Name	Business Identifier	Formed Date	Phone Number	User Name	User Email
1	Bangladesh	Manikgonj	Chor Jamalpur,Baira,Singghair	Alauddin Group	001	24-Sep-2013	01923-475594	Dulal Hossain	dulal3641@yahoo.com
2	Bangladesh	Manikgonj	Chor Jamalpur,Baira,Singghair	Charjamalpur	001	20-Aug-2013	01731958133		gafurdae@ekrishok.com

©BIID

Figure 8. Farmbook validation report

BIID and CRS have contextualized Farmbook for the different actors in the agriculture sector of Bangladesh and also branded with e-Krishok.

Demonstration is still the best way to convince the farmers, especially when introducing ICT tools and the partnerships with local actors including SAAO's are crucial for ownership and trust

Achievements and possible impacts

Making ICT work for farmers - ICT = enabled solutions help farmers make proper business decisions and improve livelihoods

©BIID

Figure 9. Mr Md. Awal and his tomato farm

People of Charjamalpur village have never seen such huge production of tomato from 10 decimals of land (approximately 4 300 square feet). The farmer behind this successful production is Mohammad Abdul Awal a member of e-Krishok. When BIID established Batighar centre in Baira Union, District of Manikgang, around 35 km from the city and informed local people that BIID would help farmers to scale up their income levels via computer and mobile phone use, people were puzzled about these new terms. It was very difficult for them to understand the computer which seemed like an ambiguous box; and the mobile phone's purpose appeared to be for chatting only. How these devices could have any useful application to enhancing a farmer's life perplexed them.

Mr Awal cannot remember when he started working the land. His parents and grandparents, and maybe even ancestors, were farmers. Therefore, the profession of farmer has been passed down to him since antiquity. When he was just a young boy of seven or eight, Awal's father started to make him his assistant in different steps of farming. Therefore Awal grew up as an experienced and knowledgeable farmer, having inherited both land and traditional cultivation skills from generations of family members. Whilst such experience and historical knowledge provides him with a firm foundation for cultivation, much of it is extraneous to the modern information society; this results in knowledge stagnation and missing prospects for earning additional income and mitigating threats. According to Awal, he occasionally receives public services from government extension agents during the cultivation season. Mostly he depends on fellow farmers and input sellers for information about agriculture. In general, the local farmers still trust the SAAO as the first point of contact.

Awal learned about BIID services through the Batighar centre situated in Baira bazaar. Md. Taslim, the local manager, registered him as an e-Krishok member. Since registration Awal's farming has been completely guided by BIID. BIID experts suggested a new variety of tomato called 'Bigol' which would grow well according to land, weather and market characteristics in his area. Research shows that at this level most farmers

lose significant proportions of profit as they select low-quality seeds because the crop selection decision is mainly influenced by fellow farmers and input suppliers. However expert advice, Web-based content and factsheets helped Awal to choose the best crop production methods. Communication was carried out by phone and through the Batighar telecentre.

After crop selection, Awal was assisted by the BIID team in developing a business plan using the business canvas tool and Farmbook. They sketched out every detailed plan of action from preproduction to postproduction levels. Awal compared his profitability with the previous year's production of eggplant (Brinjal) which suggested better financial return from the new crop. In general, most of the local farmers do not have a business approach to farming and do not develop a proper plan of action before starting cultivation in terms of quantifying their profit. At this phase, for the first time Awal considered cultivating tomato from the business perspective. Based on his business plan, he scheduled crop production activities. He followed the suggested activities and availed 16250 services which helped him to complete all the tasks within the right time. Whenever he faced any problem he asked for solutions at the Batighar centre; often he directly called the BIID helpdesk.

©BIID

Figure 10. Farmer consulting with the BIID team

Over the cropping season, Awal recorded all the financial information with the Farmbook portal through the BIID extension agent. By the end of the season, he usually achieved almost 50 percent increase in production compared to usual tomato cultivation (1 000 to 1 200 kg on 10 decimals of land). This time Awal produced 1 600 kg of tomato from 10 decimals of land. At this production level his profits increased notably. Awal said "availing e-Krishok service and cultivating tomato gave me a kind of confidence and encouragement to use my phone and contact BIID for the next cultivation. Now I am not alone when I work in the field. When I carry my mobile phone I feel I am with the full solution package."

ICT has the magical power to change the colour of life

Like Md. Awal, Md. Sadir Uddin Pradhan is another beneficiary of our services. He is from Mirzanagar village which is located 12 km from Kapashia upazilla (subdistrict) in Gazipur District. Agriculture is the primary means of livelihood in this village. Over

the past decades, diversification of crops and practices has occurred in this village. However, farmers still do not have adequate knowledge of modern farming technologies. Erratic climatic conditions have resulted in changes in crop patterns as well as in pest and disease epidemics. But there is still no provision of timely and appropriate information or advisory services in the village although such facilities could save the farmers from incurring losses.

©BIID

Figure 11. Mr Md. Sadir Udding Pradhan in his lychee orchard

Sadir Uddin Pradhan lives with his wife and three children. He has a lychee orchard with 19 lychee trees on 14 decimals of land. He learned about growing lychee from his fellow farmers and input suppliers and with the knowledge he has gathered, he makes a profit of around 8 to 10 000 taka each year (US$1.00 = 77 taka) from selling his fruits in advance to the wholesaler. But he has limited knowledge on the proper methods of taking care of his groves and whenever he faces any problems, he takes advice from his input supplier. Once, his fruits were dropping before reaching maturity and he did not know what to do about it. One of his neighbours suggested a visit to the community information centre at Aralbazar. He followed up described his problem. The query was sent to an agriculturist in Dhaka who then provided him with the solution. He was advised to apply the pesticide Ripcord in a solution of 100 litres of water and spray it on the trees. This finally saved his fruit and he earned 20 000 taka during that season.

Future strategies for improvement of this business model

BIID has developed an inclusive business model for e-Krishok targeting the Bottom of the Pyramid segment of the market. This ICT-enabled platform will be scaled up nationwide and reach 3 million farmers within 2016. To achieve targets and develop a sustainable business model BIID framed the following strategies:

a. Multistakeholder partnership with various relevant organizations to bring institutional expertise;
b. Initiate cooperative models at the field level and establish locally-owned subsidiaries for offering value-added services;
c. Introduce institutional learning programmes for farmers, value chain actors and extension officers;

d. Brand and position e-Krishok as the leading ICT4D solution for developing countries; and
e. Mobilize resources to ensure proper implementation of the activities.

Conclusion

When BIID launched the e-Krishok service in Baira bazaar as well as in different parts of the country, farmers did not properly understand the benefits of registering as members. They were a little skeptical about BIID activities as they were ignorant about ICT technology. But the success of Md. Awal boosted their interest. Now, other farmers have started to understand the power of modern ICT technology. They also understand that proper information at the right time can save them from potential losses, increase their productivity and profit. Farmers, as well extension agents, are beginning to realize that through proper planning and a smart approach, traditional farming can be turned into successful business enterprises. Nonetheless, in developing countries like Bangladesh, where traditional farming methods are the norm, continuous efforts are required to motivate farmers to adopt ICT and develop into business entities.

Recommended reading

South Asia: Bangladesh. Available at, <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html>.

Making ICT work for Bangladesh's farmers. Available at, <http://www.springfield-centre.com/wp-content/uploads/2014/01/Case-Study-Number-6_3rd-version-3-12-2012.pdf>.

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Case Study 3: Adapting consumer technology to combat illegal fishing in Timor-Leste

Steven James Needham[9]

Introduction: The problem of illegal, unreported and unregulated (IUU) fishing

Timor-Leste is a relatively new nation which faces many social and economic challenges. Its fledgling government institutions must ensure that the growing population has sufficient food and nutrition while also seeking to generate sustainable economic growth. The marine resources of Timor-Leste have an important role to play in this regard.

Similar to many developing countries, Timor-Leste suffers the negative consequences of illegal fishing activity. With limited resources, Timor-Leste's state institutions face huge challenges in managing the country's waters. The lack of law enforcement capacity off the rich southern coast is well known by the foreign fishing vessels that illegally operate there on a regular basis.

©FAO/Steven James Needham

Figure 12. A type of fishing craft commonly used around Timor-Leste

[9] Regional Fisheries Livelihood Programme for South and Southeast Asia (RFLP). Contact: http://www.fao.org/fishery/rflp

To address this challenge, The National Directorate of Fisheries and Aquaculture (NDFA) working in partnership with the FAO-Spain Regional Fisheries Livelihoods Programme for South and Southeast Asia (RFLP) has introduced technology in the form of low-cost personal locator beacons (PLBs) as part of a community-based IUU fishing reporting system.

©FAO/Steven James Needham

Figure 13. A fisher with a PLB

This innovative and award-winning initiative has played a number of important roles: building knowledge on the level of illegal fishing so that effective management strategies can be developed; enhancing fisher safety; and boosting relations between government staff and small-scale fishers. Just as importantly, the technology is also low cost and easy to use.

The Timor-Leste fisheries sector

Timor-Leste has 706 km of coastline and a marine exclusive economic zone (EEZ), over which it has fishing rights of approximately 75 000 km2. According to the Government of Timor-Leste's Strategic Development Plan (2010-2030) this fishing area has the potential to provide valuable animal protein to feed the population as well as to provide employment, income-earning opportunities and foreign exchange from fish exports.

The main fishing grounds, which are along the northern and southern coasts, offer considerable potential. However weaknesses in policy and limited capacity to manage, monitor and protect its fisheries resources have resulted in the sector remaining undeveloped with most fishing traditionally done from small boats close to shore. Illegal fishing by foreign fleets, particularly off the south coast and in the area of the Sahul Banks, also threatens to deplete fish stocks.

Malnutrition is another major challenge facing the country. The 2010 Demographic and Health Survey highlighted the risks that current and future populations may face in their physical development and overall health status with special emphasis on women and children.

It is well known that fish is an important source of animal protein containing important micronutrients, fatty acids, iron, zinc, calcium and vitamins, which are vital for a balanced diet. However according to the first-ever protein consumption survey in

the county carried out by the RFLP the mean per-capita level of fish consumption in Timor-Leste (6.1 kg/cap/year) was significantly lower than the world value (16.4 kg/cap/year). Only in the coastal areas of Timor-Leste did fish consumption (17.6 kg/cap/year) approximate the Asian fish consumption level (17.8 kg/cap/year).

For these reasons, better management of Timor-Leste's fish stocks and maximizing their potential for the nation's benefit takes on added importance.

Implementing a community-based IUU reporting system

Using technology to track the movements of fishing boats is not new. Vessel monitoring systems (VMS) are commonly installed on larger commercial boats that allow governments to monitor and control the movement of vessels which have purchased licences or quotas to fish in a specific area.

However, with boats from a number of neighbouring countries fishing illegally in Timor-Leste's waters such systems would be of little practical use.

The community-based IUU reporting system piloted by the NDFA in Timor-Leste took a different approach. Although based on the use of technology, the true foundation for the initiative was the creation of trust between small-scale fishers and the state, where the fishers were not the target of control, but those controlling their resources.

"When it comes to illegal fishing or safety at sea Timor-Leste suffers from a lack of data. There is anecdotal and incidental data but nothing hard. As a result, there just isn't enough information upon which to develop management strategies," explained RFLP's Crispen Wilson.

"The main factors behind using the personal locator beacons were increasing safety at sea, gathering IUU data and building relationships with fishers. Development organizations often do a 'stop and drop' when they never follow up or determine what is being done. What we wanted was to foster a real relationship between the National Directorate of Fisheries and Aquaculture and fishers."

How the system works

The community-based IUU reporting system is based on a partnership whereby the government loans PLBs to small-scale fishers. These devices are widely available in the consumer electronics market and are commonly used by outdoor enthusiasts. PLBs are hand-held GPS tracking devices that automatically transmit their position every 15 minutes in near real time via satellite. The devices have two buttons: one (911) that is used in the event of a life-threatening or other critical emergency to notify the emergency services. The second button (ILLEGAL) has been reconfigured as a means for fishers to anonymously report illegal fishing activities.

©FAO/Steven James Needham

Figure 14. One button to report IUU, one for emergencies

With these devices, fishers now have a means to call for help if they get into trouble at sea and in exchange for their enhanced safety, they have agreed to use the devices to report illegal fishing activity in their area to the relevant state authorities in near real time.

When the 911 button is pressed the device sends an emergency distress signal giving the boat's location through the same network as the emergency position indicating radio beacon (EPIRB) emergency system used by larger boats. The international monitoring centre then sends an SMS message to the cellular phones of the head of the Maritime Police and the head of the Fisheries Inspection Department. At the same time the civil aviation authority is notified that a boat is in distress at a specific location and the national authorities are notified by telephone.

When the ILLEGAL button is pressed the system immediately alerts the head of the Maritime Police and the head of the Fisheries Inspection Department that a fisher has observed illegal fishing. The system transmits the time, date and position of the IUU activity. It also ensures the anonymous involvement of fishers, while staff of the NDFA can view all this information on a map through a password-protected Web site. The Timorese authorities can then decide how to respond in a coordinated way.

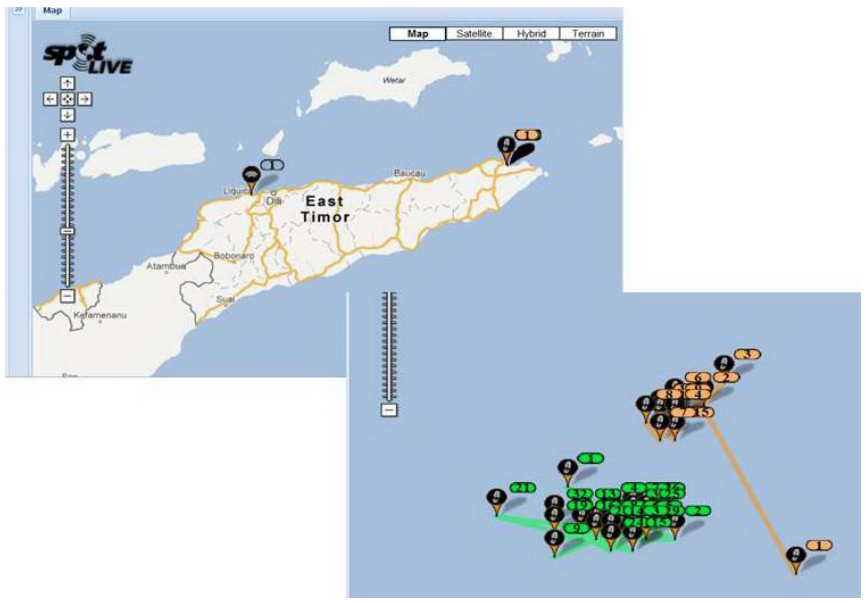

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Figure 15. Data from the PLBs can be tracked online

Delivering the devices, training the fishers

Several steps were taken to establish the system. A pilot phase was developed from February to July 2012 during which two boats operating in the southern waters of Timor-Leste were each loaned these devices. The concept was then presented to relevant state institutions and partner NGOs working in fisheries-related matters as a real working model.

©FAO/Steven James Needham

Figure 16. Fishers learn to use the devices

Once the first results were available, questions such as "If a fisher pushes the 911 button indicating that they are in serious danger, what happens?" and "If a fisher pushes the button to report illegal fishing, what should happen?" were raised. Relevant institutions were summoned to discuss these issues and to decide and agree appropriate response measures, communication lines and operation and coordination mechanisms. In August 2012, after the system had proved to be feasible and shown its potential, it was scaled up. An additional 14 devices were loaned to fishers located in several fishing centres throughout Timor-Leste.

Village leaders were involved in the selection of the participants from each area and all parties agreed to sign a contract describing their respective roles and responsibilities within the project. These fishers were trained on the use of the devices and provided with instructions in the local Tetum language.

Operation of the system was explained, as were the benefits it could bring, and the current constraints faced by state authorities regarding emergency response. The potential consequences of inappropriate use of the devices were also discussed and stressed.

Within the NDFA, the Department of General Fisheries Inspection was assigned responsibility to record emergency and IUU reports and the regular updating of databases with information on fishing patterns, areas and illegal fishing hot spots.

Budgetary issues

The fact that the PLBs used in this pilot phase were readily available resulted in equipment cost being kept low. For the pilot phase the purchase and operation of 14 units and their operation for a year cost a total of US$2 400. During this phase considerable efforts were made to train government staff and fishers in their use. Transport and training costs to develop the capacity of government staff and to train

fishers in districts around the country came to approximately US$10 000.

Factors for success

A number of factors contributed to the success of the pilot scheme. Key amongst these is undoubtedly the fact that the use of PLBs offers clear and tangible benefits to both the fishers who use them as well as the government.

The waters around Timor-Leste are hazardous. Fast-moving currents swirl past the Timorese coast, quickly sweeping away boats with engine problems. Previously there was no effective way for vessels in distress to summon assistance. For fishers, having a device with which they can call for help in emergency is a major incentive to use the PLBs and to cooperate with the government to help report IUU fishing.

In addition to making distress calls, fishers and their families now know that if a boat is overdue, the authorities can check to see exactly where it is. For example, if a boat crew is arrested for illegal fishing in a neighbouring country's waters the location of the boat can be seen and families informed whereas previously families remained unaware (often for years) whether the fishers were alive or dead.

For the government the devices help to generate detailed information on IUU in Timor-Leste's waters at an affordable cost. For a developing country like Timor-Leste this is a major factor.

The devices are widely available and are inexpensive (they can cost as little as US$100 each plus an annual service fee of approximately US$150 per year). Furthermore their activation, maintenance and use do not need special skills. They can be purchased on the Internet directly from suppliers who provide the service and provide assistance to activate the units. The worldwide satellite coverage allows their use in the most remote places, and presents a good opportunity for co-managed control of IUU fishing in developing countries.

Constraints and limitations

A limitation of this type of equipment is that it can only provide a basic record that suspected illegal fishing has been reported. Extra details about the type of vessel, direction it was heading, gear it was using and so forth would have to be provided at a later date when the fisher who made the report could be contacted. In addition, the equipment cannot in itself bring about a reduction in IUU fishing. Timor-Leste lacks the patrolling capacity to act upon reports of illegal vessels. However the act of gathering data where none previously existed is a vital step in helping to understand the scale and scope of the problem so that effective management plans can subsequently be drawn up.

A further lesson learned during the early phase of the pilot was that for IUU reporting to

succeed, units need to be given to the right boats operating in areas where they are likely to encounter IUU.

“During the design phase of our IUU pilot, fishers in Atauro said they went to the south where IUU fishing was most common,” explained Crispen Wilson.

“They were given personal locator beacons and we waited for two months for them to go south. But they never went and they really just wanted to be given something. So we took the units back. They were a little surprised as no one had done this before. The NDFA staff was great and explained the situation logically. It was doing them no good and if the NDFA gave the units to fishers who were going south then we could stop IUU there. They gave the units back and they were redistributed to commercial boats which were travelling to the south.”

Despite the simple ‘two-button’ nature of the devices mistakes were also made. In one instance a vessel captain pushed the wrong button when he intended to report illegal fishing and instead called for emergency help. When the vessel could not be contacted (the radio had been switched off) an Australian Coastguard aircraft flew over the area to check on the vessel, which was found to be in no distress. The event made the relevant institutions (Navy, Maritime Police, Port Authority and NDFA) discuss and agree appropriate lines of communication and more effective operational practices in cases of emergency. An agreement was reached at a technical level on more effective communication lines and the most appropriate ways of coordination in emergency cases.

Initial results of the experience in Timor-Leste

The following are examples of tangible outcomes from the initiative:

- The first database on illegal reports and IUU fishing hot spots created;
- The first maps with information on illegal fishing activity hot spots drafted and regularly updated;
- The first database created with information of the fishing patterns of local fishers and the most heavily exploited fishing areas; and
- Improved communications and trust between fishers and state institutions. A new channel of communication has been opened; communications and coordination among the relevant state institutions have been notably improved and also at the political level as a direct consequence of the new challenges posed by the introduction of the system to the institutions involved in maritime affairs. As a direct response to these challenges and based on the experience gained during the pilot phase, an agreement was reached on 19 April 2012 between representatives of the F-FDTL (Timor-Leste army), the Port Authority, the Maritime Police, the NDFA-Ministry of Agriculture and Fisheries and other ministries involved to create a National Maritime Authority that will deal with issues of illegal fishing and rescues at sea in-country.

Potential upscaling and replication

Following the early successes of the use of the system in Timor-Leste plans are now underway to scale up the pilot to become a national vessel monitoring system.

The system is not necessarily tied to a specific brand or piece of equipment, but is more about the relationships and the motivations of the different stakeholders. As a consequence, the community-based IUU reporting system could easily be replicated over a wide range of fisheries.

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Figure 17. Fisheries inspectors equipped with PLBs aboard a commercial fishing vessel

The system is ideal for many developing countries where there are very few patrol boats or extremely limited human resources to patrol remote sea areas. This system could also be used to facilitate management of marine protected areas, marine reserves or remote areas with limited access. For example, in marine reserves where much of the illegal fishing activity is conducted by fishers based outside the protected area, the ability to report in near real time provides a means by which those living in the area can help to enforce management plans.

International recognition

In February 2014, Timor-Leste's Community-Based IUU Reporting System was selected as the winning entry from a global field in the 2014 STOP IUU FISHING AWARDS.

Officially announced at the 4th Global Fisheries Enforcement Training Workshop held in San Jose, Costa Rica, Michele Kuruc, Acting Senior Vice-President of Marine Conservation of the World Wildlife Fund and Cephas Ralph, Chairman of the International MCS Network presented the award to Pedro Rodriguez, Fisheries Inspector and former RFLP National Project Manager, on behalf of Timor-Leste.

Speaking at the event Kuruc stated: "One of the objectives of the contest is to showcase the winning entries as an example and inspiration to other countries and organizations to combat IUU fishing. This successful project carried out by Timor-Leste shows that there are low cost solutions which can support both the long- term interests of fishermen in combating IUU activities which undermine sustainable harvests of marine living resources and improve safety out on the water in an environment which can sometimes be deadly."

What are the benefits?

The key beneficiaries of this approach are fishers, natural resource managers and state institutions.

The benefits to fishers:

- If they are in danger, the fisher now has a way to call for help;
- If a boat is overdue, families can contact the authorities and check where a fisher is and if he is OK;
- Fishers can anonymously report IUU without being threatened by foreign vessels which may have weapons on board;
- Reporting IUU becomes safer as there is no need to make any open transmission over the radio that illegal fishers may hear;
- Hand-held units can be circulated between boats so that illegal fishers do not know who has one;
- Helping to patrol and prevent IUU fishing means more fish for Timor-Leste fishers;
- If a fisher is arrested in waters of a neighbouring country, the fisher and the boat can be located and evidence will be available on where they were fishing; and
- If a boat capsizes, its last position and time are recorded; search and rescue (SAR) services are more likely to be able to locate any missing fishers and their boat.

The benefits to natural resource managers:

- Engaging local fishers to help combat illegal fishing provides detailed information on where the fishers are going and what they are catching;
- Provides solid data upon which policies or management strategies can be used to address IUU;
- Starts to build trust and respect relationships with fishers, so when management plans are discussed, agreed and implemented, the existing relationship fosters and encourages fishers to participate; and
- PLBs can be issued to fisheries observers working on commercial fishing vessels, allowing cross-checking against written log-books.

The benefits to the government:

- A very affordable option. Larger commercial VMS systems can cost upwards of US$3 000;
- Saves time, fuel, money, boats. Increases surveillance at very little cost;
- Increased likelihood that IUU offenders will be caught, making patrolling more cost-effective;
- Relationships and trust are built so that when fisheries management plans are implemented there is greater buy-in by fishers; and
- Significantly facilitates SAR operations by pinpointing a starting location for SAR from which a vessel and fisher may have drifted.

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Figure 18. A local fisher brings home his catch

About the RFLP

The RFLP set out to strengthen capacity among participating small-scale fishing communities and their supporting institutions in Cambodia, Indonesia, the Philippines, Sri Lanka, Timor-Leste and Viet Nam. By doing so RFLP sought to improve the livelihoods of fishers and their families while fostering more sustainable fisheries resources management practices.

The four-year (2009-201313) RFLP was funded by the Kingdom of Spain and implemented by the Food and Agriculture Organization of the United Nations (FAO) working in close collaboration with national authorities in participating countries.

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Case Study 4: Mobile GAP Assessment System: New technology for family farms involved in quality assurance schemes

Pisuth Paiboonrat [10]

Introduction

Agriculture plays an important role in Thailand's economy. In 2013, agriculture, forestry and fishing contributed 12.0 percent of GDP. Labor forces work in agriculture sectors is 47 percent of total employment. (Agriculture & Rural Development, 2013)[11].

Although Thailand is a major rice producer and exporter, the country faces many problems similar to other rice-growing countries in the Asian region. These include an ageing farming society, with the average age of a farmers being 67 years, lack of skilled farm labour and higher cost of production. All these factors drive the farmers out of their farms to find a job in the city, hoping for a better quality of life. In order to make the agriculture sector more profitable and attractive for the younger generation as well to attract new agri-entrepreneurs, it is necessary to create a paradigm shift in farm investment concepts. A multitechnological approach for more efficient farm management is needed; the development of such a system would also take into account the importance of data collection, data analysis and time series management. Such integration would facilitate the ease and efficiency of farm management. This case study outlines one such effort to make farm management more efficient.

Increasing awareness about food safety raises consumers' demand for the quality and safety of food produce. In response, the Government of Thailand has made significant steps towards the development, introduction and implementation of quality and safety programmes. At the farm level, a quality assurance system has been introduced to farmers in order to ensure safer food production. The Good Agricultural Practice (GAP) system as part of the country's food safety strategy was first introduced in 2003. The Ministry of Agriculture and Cooperatives established a national GAP system for crops,

[10] National Electronics and Computer Technology Center (NECTEC), Thailand. Contact paiboonrat@nectec.or.th

[11] World Bank, 2015, http://www.worldbank.org/en/country/thailand

livestock and fisheries and is responsible for control and inspection. The National Bureau of Agricultural Commodity and Food Standards (ACFS) is an accreditation body, while the Department of Agriculture provides certification and implementation functions (see http://www.acfs.go.th/). The objectives of the GAP programme are to ensure that food crops are safe, wholesome and meet high standards while ensuring the safety of growers and minimizing adverse impacts on the environment. Farmers who apply for GAP certification are assessed for their production processes. The assessment contains eight element standards; i) safety of water used, ii) site safety and sanitation, iii) use of agrochemicals, iv) product storage, v) data records, vi) pest-free products, vii) quality management and viii) harvesting and postharvesting handling. Farmers who fulfill the requirements of the national GAP programme can label their products with the GAP logo (Figure 19).

Figure 19. The 'Q' mark on an agricultural product certified by the Department of Agriculture

The GAP system for rice started in 2006. It is a government policy to raise the standard of rice production through certification that conforms to international standards. This procedure tries to address the food safety concerns of consumers. However, due to the stringent requirements and documentation involved in applying for GAP certification, this system has met with limited success. These factors also create a burden for farmers and certification officers. Moreover, farmers involved in the GAP process are not getting GAP certification on time because of the excessive paperwork to be completed. Concomitantly public concerns about food quality, safety and source of origin from buyers are increasing and addressing this issue is becoming a marketing strategy component.

This case study describes a new technology designed to overcome the problems associated with the previous paper-based GAP certification – the Mobile GAP

Assessment System. The system is designed as a tool for farmers and Certification Body (CB) officers to list farm activities and newly adopted techniques which will later be assessed following the certification procedures. This works on both mobile devices such as mobile phones, tablets with Android OS and also can work on notebooks and PCs. In 2013, a pilot project was launched in a small village in the northern region in Thailand that was successful. One of the main challenges of this initiative was in getting farmers to learn the new system so that they could apply for GAP certification for their farms easily and efficiently. It is a good example of extensive cooperation among community, government agencies, universities and ICT-based organizations to promote community learning programmes as well as to support the social, economic and cultural life of the community.

Samkha village: The community that learns

Samkha is a small village located in the north of Lampang Province in Northern Thailand. It is located in a valley surrounded by a national park and mountain range. Approximately 160 ha are used for rice farming. The village comprises 159 households and most of them are farmers.

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Figure 20. Samkha village, representative of family farms in remote areas of Thailand

The mountainous natural park is a major water source for the community; water flows downhill from the higher elevations to supply the villagers and nourish their crops. However, for four years (1957-1960) logging concessions generated serious damage to the forest. In tandem came drought and lack of drinking water in the summer, while flash floods in the monsoon season damaged paddy fields in the lowlands. Otherwise, forest fires caused by the villagers while hunting for wild animals and harvesting non-wood

forest products were also responsible for natural resource depletion. After the forest deteriorated, the villagers began to perceive significant impacts on their livelihoods as the forest was their main source of food, income and water for consumption and irrigation. Many villagers fell into in debt.

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Figure 21. Wild fire, flash floods and drought resulting from human activity upset the natural balance

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Figure 22. Ms Srinuan Wongtrkul acts as a community information broker

In April, 2000, Ms Srinuan Wongtrakul, a teacher at Samkha elementary school and her six students participated in the workshop on 'Constructionism Lab' at the office of non-formal and informal education, Lampang. It was an opportunity for people to learn about the story of the Samkha community. It was also the beginning of many community learning programmes set up with funding from both local and international organizations. The village worked to identify and analyse problems they faced, and brainstormed to find solutions with the support of partner organizations. This learning approach is based on the constructionism theory of Prof. Seymour Papert of the MIT Media Lab. The constructionism concept places special emphasis on learner-centred learning in which people use their experiences from real-life practices and acquired knowledge to solve problems. The processes of learning focus on establishing a knowledge-based society for better quality of life. Many projects have been implemented to tackle specific problems; for example, check dams, firebreaks, credit unions and information and technology centres.

Owing to these learning initiatives, the forest encompassing Samkha village has regenerated and more water is stored in the community reservoir, sufficient to sustain agricultural production.

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Figure 23. Before (2005, left) and now (right), Samkha reservoir and a check dam network have rejuvenated the community

The learning paddy

On 26 July 2009, the National Electronics and Computer Technology Center (NECTEC) and Rajamangala University of Technology Lanna (RMUTL) organized the workshop 'The Learning Paddy' in the community to introduce new rice-planting techniques with selected rice varieties for that area. The community adopted the new practices and learned to design packaging and branding of their produce. At present, Samkha village has two local rice products for sale at the village shop which is managed by the community committee.

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Figure 24. Rice camp organized by RMUTL and NECTEC in July, 2009

In 2013, The Learning Paddy initiative moved its focus to the assurance of rice quality via GAP certification. This new learning programme was jointly organized by NECTEC, RMUTL, the Institute of Product Quality and Standardization (IQS), Maejo University

(MJU), the Rice Department, Ministry of Agriculture and Cooperatives and Samkha community. Each partner played significantly different roles in implementing the GAP Assessment System:

- RMUTL provided extension services and worked closely with the community to improve farming techniques and select suitable rice varieties for the area;
- The Rice Department was the main CB for certifying the farmers' cultivation techniques;
- IQS-MJU was the local CB certified by the Rice Department to conduct in-field assessment at farm sites;
- NECTECT was the application developer working with all official CBs to create electronic forms for GAP certification application; and
- Selected farmers acted as GAP internal auditors. Village volunteers served as co-creation learners and technology assistants.

Box 2. A perspective from a community leader

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Mr Chai Wongtrakul, a community leader

Mr Chai Wongtrakul, a community leader and internal inspector observed, "Samkha village is surrounded by mountains of which 1 920 ha are classified as community forest. The forest is a source of water suitable for organic farming. The village has produced safe agricultural products for more than ten years. In this context the community held a meeting and voted to stop applying agricultural chemicals on crops. We have learned that improper use of chemical products affects our health and degrades biodiversity. We adopted the organic farming approach by keeping soil more fertile through organic matter application. Consequently we produce safe food products for the external market. Samkha villagers on average own approximately 0.8 ha per household. Arable land is located on foothill terraces. Most of the agricultural products are for local consumption and the rest is for sale. As we employ small-scale agriculture, most farm activities employ manual labour and we do not

use heavy farm machinery. The village grows two rice varieties, Chiangrai (aromatic rice) and Thanyasirin (sticky rice). In 2013, the community agreed to learn how to apply the GAP system to raise the rice production standard; our intention was to create trust among customers and obtain higher retail prices. With cooperation from NECTEC, RMUTL, MJM and representatives from the Rice Department, trials for the Mobile GAP Assessment System were ongoing during the cropping year 2013-2014. The first group of learners comprised 40 members (with participation by students from Samkha Elementary School). The children used computers and tablets for data inputting and certification application purposes; working with farmers during field inspection resulted in successful acceptance by paddy owners and quick results from inspectors. At the same time some improper farming procedures were corrected in order to pass the verification process. Involving the children in these technological activities and in field work was instrumental in encouraging their parents to be more positive about the introduction of new technologies to assist with the cultivation of better crops in the future."

Implementation of the Mobile GAP Assessment System

Although many villages across the country were nominated for participation during the programme's launch, Samkha village was unanimously selected as a pilot community because of its dynamism and previous experiences with community learning processes. Dr Supakij Sornprajak of the IQS, Maejo University (MJU) obtained a licence from the Rice Department to serve as a CB. Dr Pattama Sirichanya of RMUTL was the GAP trainer to organize training for community members. Both team members attended a community meeting and explained to the farmers the importance of getting their produce GAP-certified and the ease with which they could do so with the Mobile GAP programme. As a result, the village agreed to adopt this new process. Forty family farms volunteered to apply for GAP certification via the new procedure. In addition, ten students in grade 6 from Samkha Elementary School and two youths, who managed the community's Constructionism Lab, joined the team as technology assistants.

The software and application for the Mobile GAP Assessment System was developed by NECTEC, the IQS-MJM and RMUTL. An orientation workshop on GAP certification was organized for the farmers' group. NECTEC staff trained the workshop's participants to use the Mobile GAP Assessment System. The workshop's orientation focused on the data input process and the students were very quick to understand the process as they were more familiar with PC and tablet computer use. At this stage, the generation gap was bridged because participants from different age groups worked together for the same goal. At the same time, NECTEC staff also trained IQS-MJM and RMUTL staff to use computer tablets for the certification process, reporting and providing recommendations. The working timetable for internal and external CBs was three times in one crop production cycle of 120 days – at the seedling, flowering and harvesting stages.

The young generation as community IT facilitators

Farmers have usually been skeptical about the introduction of new technologies into traditional farming practices. Hence, it was a challenge to find a delicate balance when introducing new and beneficial technologies into traditional farm activities. Youngsters on the other hand are more open to adopting and implementing ICT-facilitated processes into traditional practices. Thus they were ideal candidates to be trained as IT facilitators in the community.

As Samkha is a strong learning community, members have learned many lessons from the past. The learning process and knowledge gained are well established. The community has a Constructionism Lab as a centre of learning for community members and visitors. This building is equipped with a computer and network facilities. This facility aims to be a constructive place for people to learn about new technologies and find solutions to their problems.

Learning to implement the Mobile GAP Assessment System was one of the goals for the laboratory and it provided a platform for others communities to learn from this case.

- The roles of the young generation as IT facilitators are: helping farmers, mostly their parents, to input personal data online on the GAP-01 form at <www.gapthailand.in.th>;
- Helping farmers to identify their farm location and area on a digital map and online map;
- Facilitating farmers to use tablets for internal auditor activities by completing the GAP-03 form; and
- Interviewing and collecting data on farmers' farm management to enter into the system's GAP-02 form.

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Figure 25. Students of Samkha community as IT facilitators

Box 3. A farmer who learned how to use technology with children

Mr Bunsong Bunchareon, 63, the lead internal auditor of the community, has learned how to use the new certification technology together with the students. He notes, "I have grown rice for more than 40 years. At present, I grow rice as a staple crop for my family and close relatives. What remains is put up for sale. I am proud that my product has good quality and is safe to eat. I have considered how to make customers trust the produce they are buying and GAP is the way to guarantee this. I have had experience in registering for GAP certification with the government agency but as it was very time consuming, involving many forms to be completed, I gave up. I think that this is another major constraint for farmers like myself. Once I decided to learn how to apply GAP with the Mobile GAP Assessment System, I witnessed the results in a short period of time. I can see the possibility of connecting Samkha rice products to the outside world and hope this system can be made official in the near future."

Role of NECTEC as an appropriate technology developer

NECTEC is one of the members of the National Science and Technology Development Agency (NSTDA). The Smart Farm Flagship aims to support national food security, food safety and better quality of life. Under this policy, NECTEC is responsible for:

- IT enabling: IT for better agriculture production, IT for quality assessment in the production process and quality assurance, and IT for mitigating climate change impact and pest outbreaks; and
- Knowledge management (KM) engineering: IT for KM engineering for better information and knowledge services.

NECTEC took part in this learning programme with IQS-MJM, RMUTL and the Rice Department for system design of the Mobile GAP Assessment process based on the standardization format from

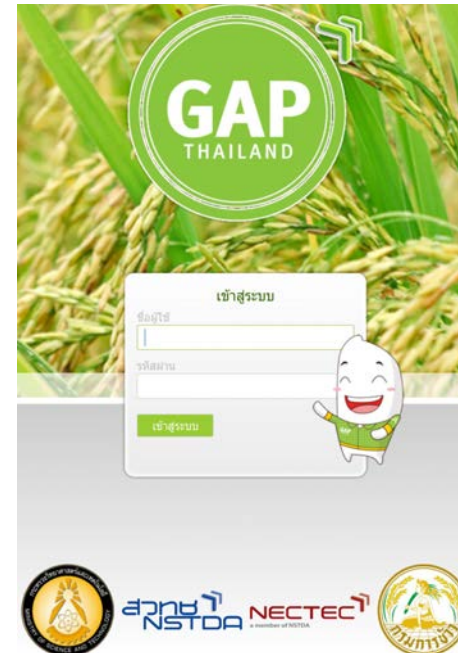

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Figure 26. Home page of the Mobile GAP Assessment System

the Rice Department as a National Standard Format. The target of the system focuses on farmers and officers at the same time in order to encourage them to become Smart Farmers and Smart Officers. Moreover, the system is laid out to allow tracing back of data to the source of origin. As the system is developed to overcome tedious paperwork that existed before, it can be used on mobile devices such as mobile phones, tablets with Android OS and can also work on notebooks and PCs. An offline component in the programme assists where there is no satisfactory connectivity in remote area.

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Figure 27. CBs and internal auditors learning together for system implementation

Box 4. A software developer

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Mr Watcharakorn Nutong, the programmer who developed the system

Mr Watcharakorn Nutong, an application developer, reflected, "This Mobile GAP Assessment System was originally designed to facilitate farmers looking for GAP certification. Farmers can source GAP certification details from <www.gapthailand.in.th>. The system will convey requested information to the Rice Department's server. The data will be transmitted to mobile devices of certified CBs in each area automatically. Thus the CB has the farmer's information and can contact the farmer to implement the process. The certification (code GAP-03) includes check lists for environmental health and farm management such as water sources, soil condition and so forth. After review, farmers can obtain their unofficial results. Any mis-management issue will be relayed back to the farmer on the GAP-04 form for correction. The official reply will come after the CB gets the result of laboratory tests on water and soil quality, but not more than 15 days after harvest."

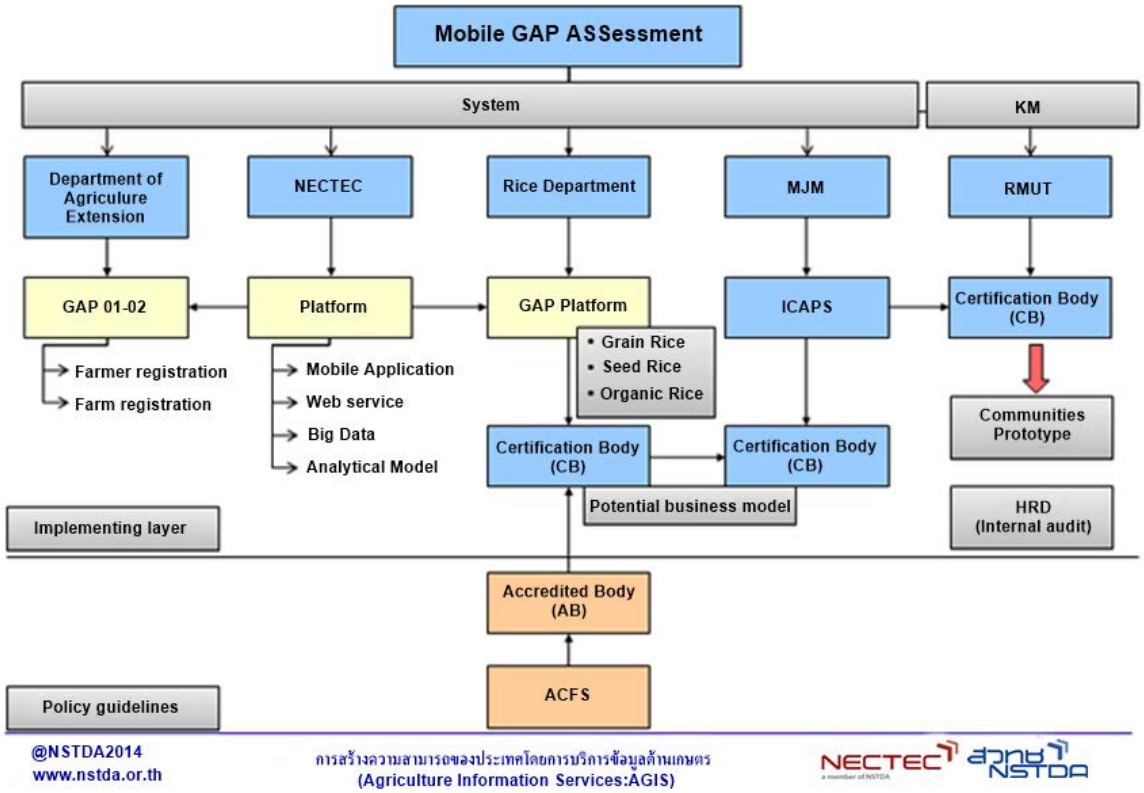

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Figure 28. Workflow of the Mobile GAP Assessment System

Mobile GAP Assessment System details

The Mobile GAP Assessment System is designed to facilitate GAP certification by reducing time-consuming paperwork via digitization of the entire process. The system upgrades the GAP certification process to facilitate the work of people involved such as officers, farmers, KM services (extension officers) and policy-makers.

The Mobile GAP Assessment System has four modules:

1. GAP-01: The farmer and farm registration module is a data input form readable on mobile devices or PCs. It is designed to collect farmers' personal data. It can also read data from the national ID card through a card reader. The farm location data are collected to position the location of the farm on a digital map. The Google Map API is used to draw the boundary and calculate the farm size of each farm on the screen. This also serves as a navigation device for officers or CBs when they visit the farm. Finally, the system will generate a QR code that contains the farmer's profile and associated geographical area. It will later be used by the CB for inspection purposes or traceability.

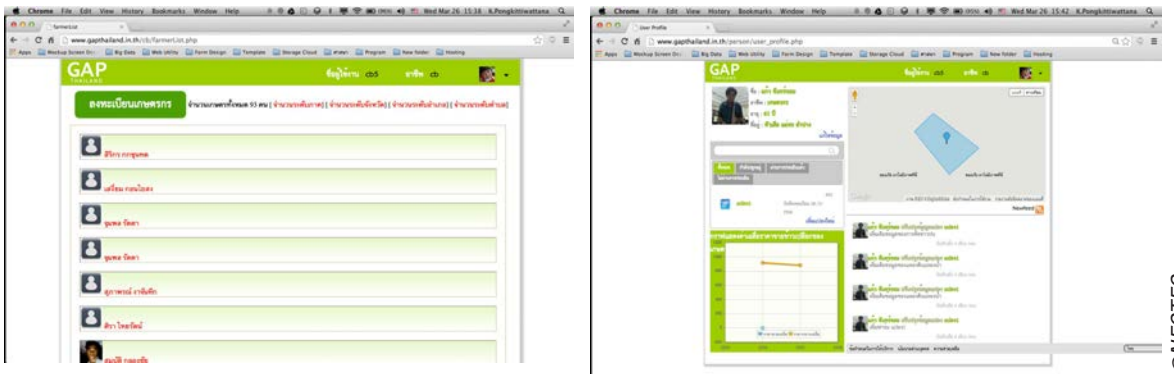

Figure 29. Screenshot of the GAP-01 form. Farm and farmer's registration format

2. GAP-02: The farm management data input module records working procedures on the farm. Details to be entered include fertilizer types, water sources, irrigation management, agricultural chemicals, farm machinery, labour, logistics etc. All these data are important for the traceability system as the source of original data.

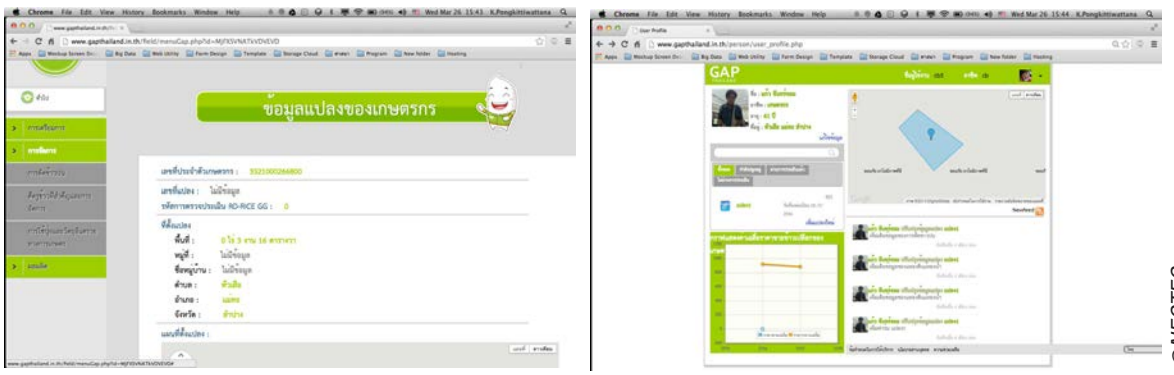

Figure 30. Screenshot of the GAP-02 form. Farm data input form for the traceability system

3. GAP-03: The certification module is for CBs or inspection officers. This module runs on Android tablets and is handy and easy to use in the field. The system can work offline in remote areas that do not have sufficient Internet connectivity. There is also a navigation tool for CB officers to find the registered farm; CBs can use this data for planning their daily inspection routes. The data will be transferred from Android tablet devices to the server for processing and reporting. It is a paperless system when compared with the present GAP certification process. And it is almost real time – the farmers can get their certification results immediately online.

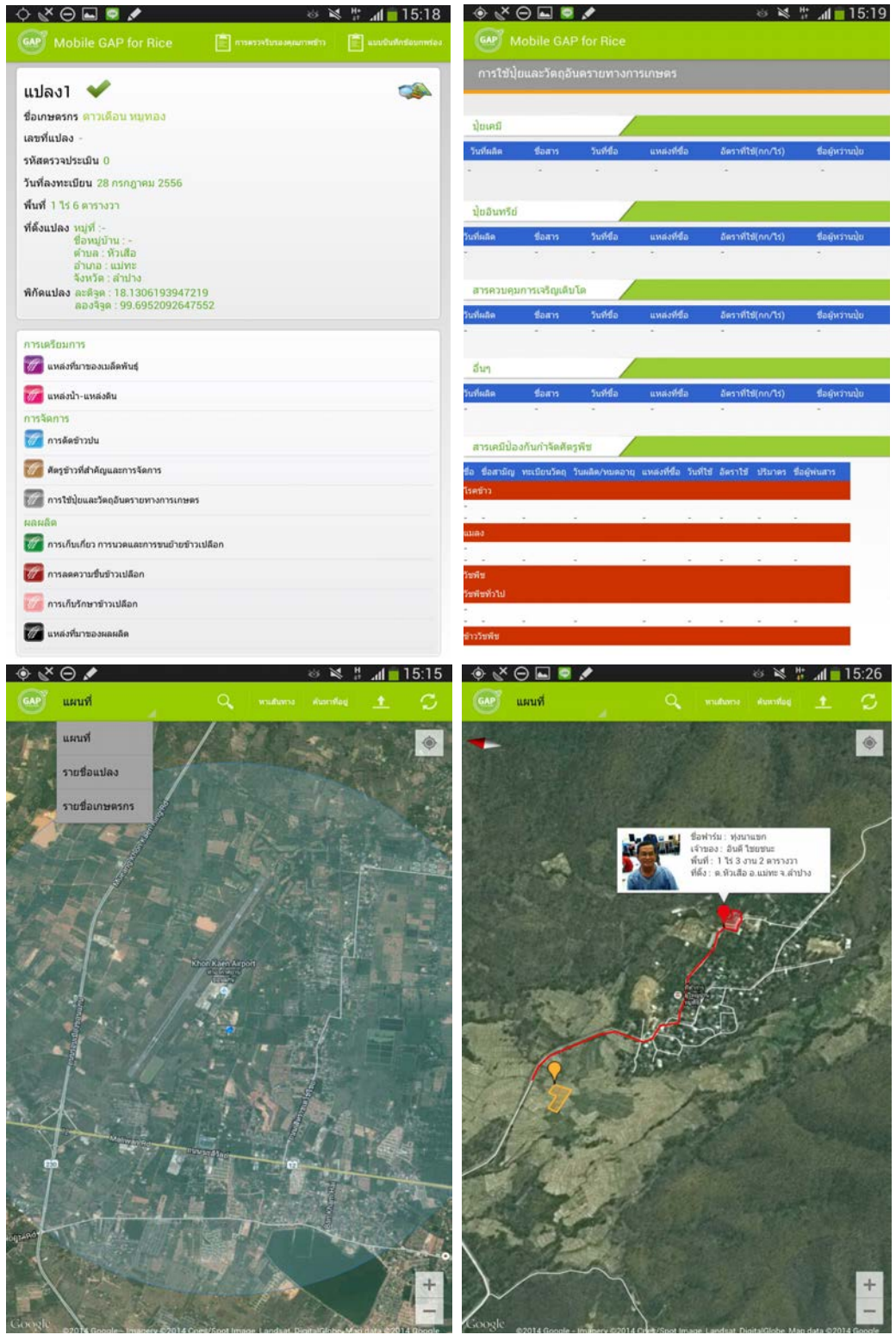

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Figure 31. Screenshot of the GAP-03 form on Android devices. Farm location and certification check lists

4. **GAP-04, the farmer's report module** is designed to return the certification results to the farmers. Farmers can check the certification results from mobile devices or PCs. Any recommendation on mismanagement on farm will help the farmer to rectify his mistakes before the next inspection. Farmers can check the inspection result by using web services or mobile devices.

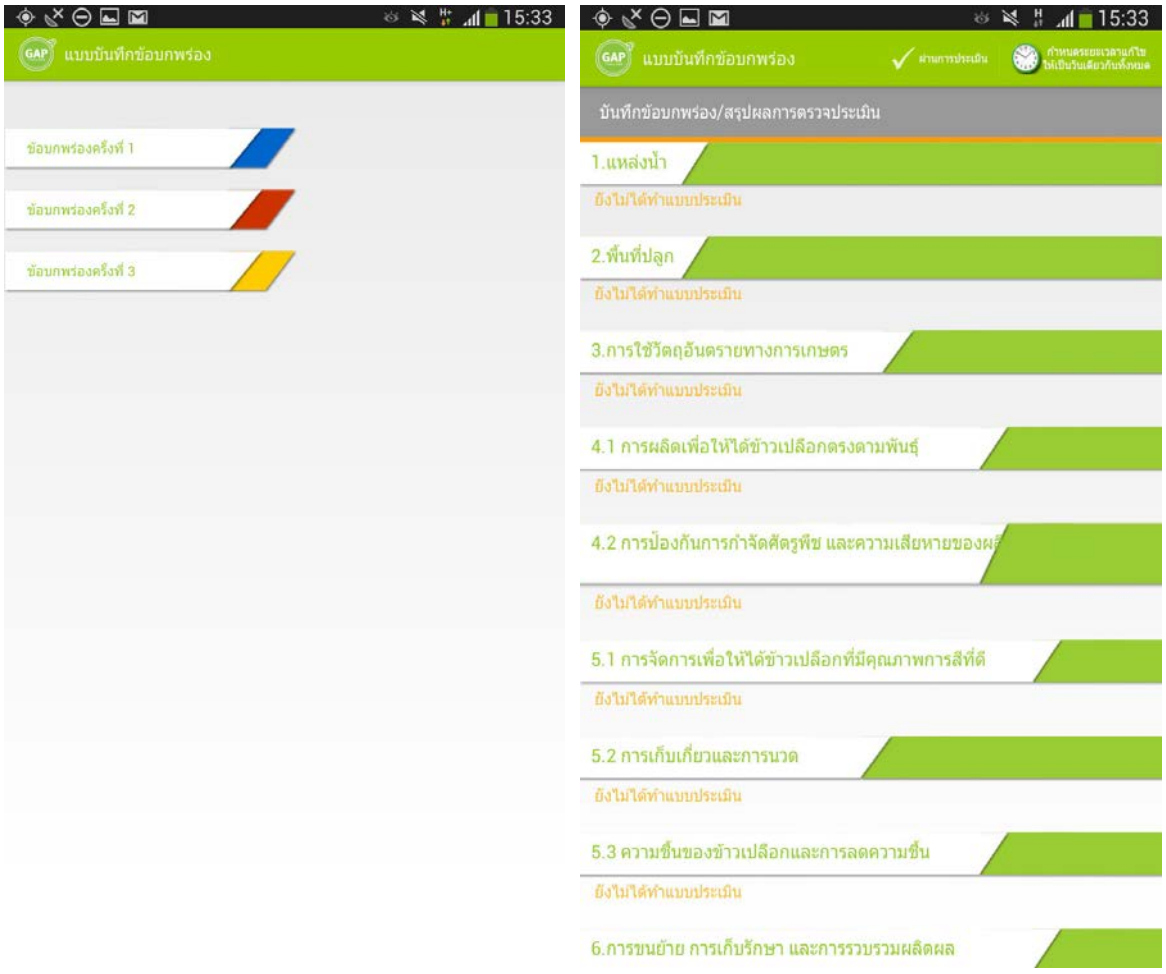

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Figure 32. Screenshot of the GAP-04 form on Android devices. Recommendations to improve production based on certification results

Box 5. System components

Components

- PHP programming language
- QR code
- Hastag
- Google Map API
- Java programming language
- Android SDK
- Android multithreading
- Content provider
- JSON

Features:

- Web application
  - Can use with browsers such as Firefox, Google Chrome, Internet Explorer (version 9 or higher)
  - Use for registration requested online (GAP-01)
  - Generates the QR code for each registered user automatically, useful for personal traceability
  - For input farm management data (GAP-02)

- Android application
  - Can use with Android version 4.0 or higher
  - Easy to search registered data
  - Has map and navigator functions
  - Can adjust screen resolution as WVGA (800*480), WSVGA (1024*600), WXGA (1280*768)
  - Useful for CB officers to certify registered farms (GAP-03,04)

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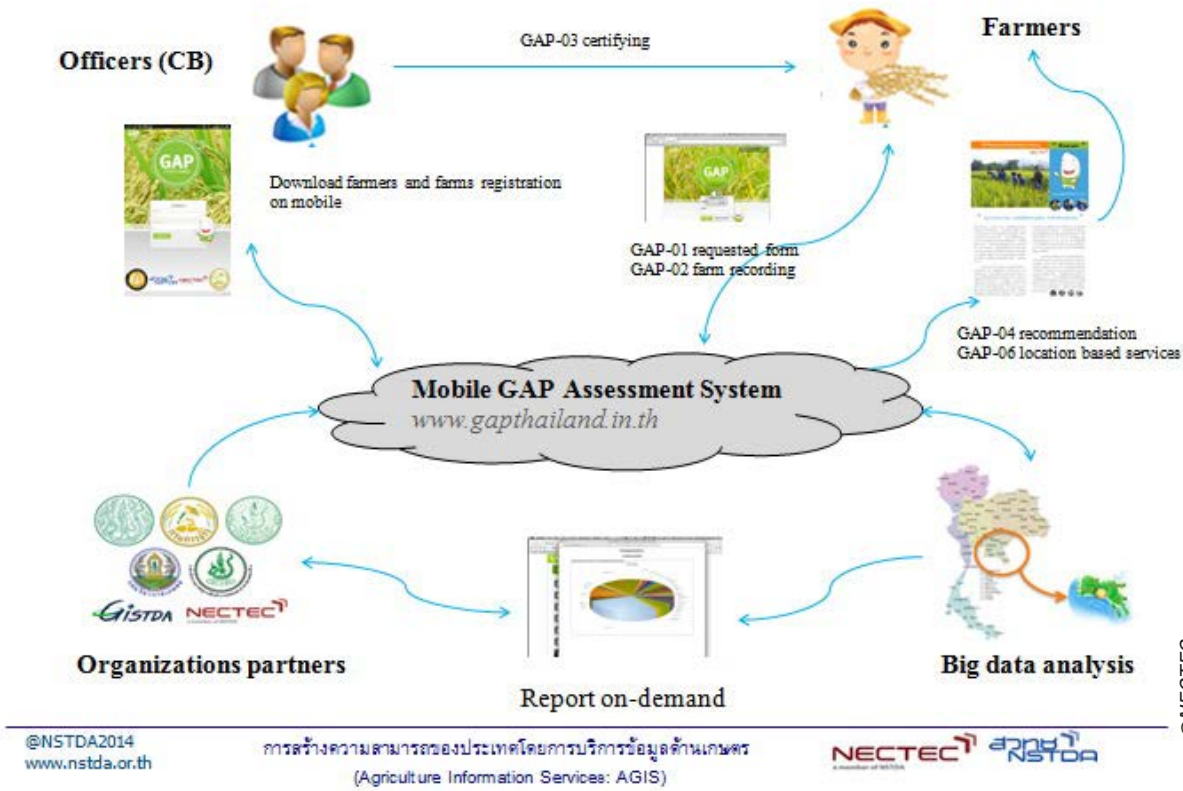

Figure 33. Components of the system

Benefits and impacts

The Mobile GAP Assessment System overcomes complicated procedures and paperwork which have proven to be costly and time consuming. Farmers regardless of their location can apply for GAP certification by using the Mobile GAP application, while officers are able to provide services instantly by using real-time information being fed into the system. All 40 volunteer farmers who applied GAP certification via the Mobile GAP Assessment System passed the assessment and received certification for their produce. As reports and recommendations from the CB are uploaded constantly into the system after each farm assessment, farmers can check them and use the recommendations to improve their farm practices in order to meet the GAP requirements.

The farmers from Samkha who received GAP certification have developed their own brand namely 'Sarp Samkha' (Samkha's treasures) and registered themselves as a community enterprise to sell their produce with GAP labels on the packages.

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Figure 34. Ms Nari Inmapan with her quality rice products for sale; a pioneer group of internal auditors trained on system use

The launching of this programme has developed a new community learning model which engages people from different generations in the village to take part. The generation gap is bridged by different age groups working and learning together. Farmers are exposed to new technologies and learn to use them to add value to their produce.

Key success factors

The success of the programme depends largely on:

- The culture and perception of local people that differs from location to location. Success or failure depends on geographical location;
- Information brokers or people who devote their time and effort to teaching and empowering others;
- The younger generation who serve as intermediaries between adults and technology. They help to bridge the generation gap and introduce new knowledge through family learning;
- Insight Out or 'learning how to learn' helps the community to solve problems by themselves;
- Team building is the first step to set up collaboration networks inside and outside the community; and
- Good facilitators who approach and work closely with the community.

Constraints and limitations

- Culture and perceptions of local people that differ from location to location;
- How to change the mindset of local people and/or officials working with the community;
- How to build a Learning Community to provide knowledge but also provide protection from the complex world;

- Ageing society; older farmers are unwilling to learn how to apply new technology;
- Youth leaving the agricultural community as the negative perception about farming remains strong;
- Lack of research and implementation in using ICT for agricultural benefits;
- Lack of 'smart' officers who devote themselves to learning within the community; and
- No clear national agenda on precision agriculture.

Looking to the future

The development of the Mobile GAP Assessment System and the case study with Samkha community is a significant turning point for better understanding of the needs of farmers, officers (CBs) and programme developers to lay out the appropriate technology for better services and better adoption by farmers. The impacts from this learning model are well recognized by the Rice Department of Thailand, which is expected to officially announce the Mobile GAP Assessment System as the official system in 2015. The estimated number of farmers that will benefit from this system is around 16 million. The lessons learned from this case study should be transferred as practising procedures and community approach techniques for smart officers. The approach of the younger generation as IT facilitators in each farming family and community should be extended.

Acknowledgements

NECTEC would like to acknowledge people of the Samkha community, especially Ms Srinuan Wongtrakul, Mr Chai Wongtrakul, Mr Bunsong Bunchareon, Ms Nari Inmapan and students of Samkha elementary school, Maetha District, Lampang Province, Thailand who through the Learning Paddy initiative helped Samkha village to become the first community in the country to apply this system.

We would like to thank Dr Supakij Sornprajak, IQS-MJM and Dr Pattama Sirithanya, RMUTL for their contributions to the CB process and reflections on the implementing system. Dr Ladda Viriyangkul, Rice Department, Ministry of Agriculture and Cooperatives, who participated in this project and extended every effort to transfer the concept into official procedure.

We would like to thank the NECTEC team – Mr Watcharakorn Nutong, Mr Pirun Panitpol, Mr Chotravee Nanan, Mr Kiit Pongkittiwattana and Ms Panary Polchan – for their contributions. NECTEC would also like to thank FAO and APAARI for the opportunity to share this learning story with the world.

Case Study 5: The revolutionary PRIDE™ model by mKRISHI® – empowering farmers to live with dignity

Srinivasu Pappula[12]

The Indian farmer – in dire straits

Agriculture is an important focus area for India providing livelihood to nearly two-thirds of the Indian population, yet contributing to only 14 percent of the Indian GDP. Thus, agriculture is being forced to support far more people than it possibly can accomplish. Even though food production has touched new highs in recent years it has not kept pace with the exponential jump in the population. Productivity is extremely low due to unscientific farming practices, fragmented landholdings, lack of agroclimatic focus for crop selection and lack of access to the right farming advice at the right time. Farmers are plagued by myriad issues such as timely and reliable access to farm inputs, access to markets, access to reliable information at the right time and cheap access to credit. To resolve these issues, new policy reforms were introduced for re-organizing the production system in the form of corporate and contract farming. These production systems have been well adopted in farmer producer organizations/producer cooperatives and have overcome many issues but still lack the technology to facilitate the market-driven production approach and to access market demand data. An integrated system would serve as a one-stop knowledge base, creation engine and delivery channel for distributing personalized cultivation practices to all farmers and optimized supply chain practices, thus bringing traceability of produce and transparency in transactions. Farming is turning into a 'dead' profession with many marginal farmers opting to leave their lands barren and migrating into the cities in the hope of a better life. Over nine million people have abandoned farming and the number of landless labourers has increased by 36 percent in the past decade. In the cities, the situation is even worse than anticipated and the once proud farmer who was the cornerstone of the Indian economy is leading a wretched life of economic desperation and angst.

This situation has led to serious introspection within Tata Consultancy Services (TCS) and various initiatives leveraging technology to alleviate the issues in the agriculture sector have gathered momentum. The Progressive Rural Integrated Digital Enterprise (PRIDE™) powered by the mKRISHI® platform is one such initiative innovated by the TCS.

[12] Tata Consultancy Services Ltd, India. Contact srinivasu.p@tcs.com

The PRIDE™ concept and the mKRISHI® technology framework

A typical PRIDE™ framework is shown in Figure 35

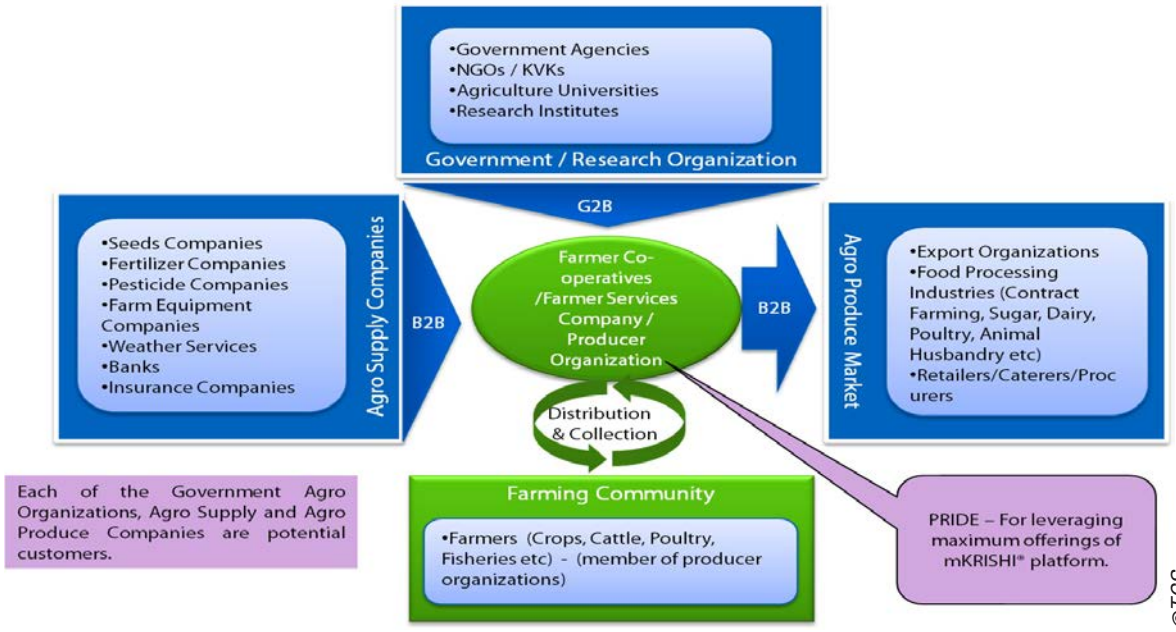

Figure 35. Conventional PRIDE™ framework

In such a system, a collective group like a cooperative or a farmer producer company is the central channel through which various business and agricultural activities are carried out. This collective group is generally an entity that operates in the field to connect various organizations like agri-input industries, food-processing industries, government organizations, financial institutions, agricultural machinery industries and the stakeholders, i.e. the farmers. In addition, they also trade in large quantities collectively associating with all the farmers.

However managing this entity manually is very difficult considering the diversity and distribution of every end-consumer, producer, partner and stakeholder. In addition, economics of growth and self-sustenance are a major challenge to overcome. Hence, a solution is needed to effectively manage it through appropriate injection of technology in all aspects of its interaction so that the end-result is a scalable, self-sustaining and economically viable entity.

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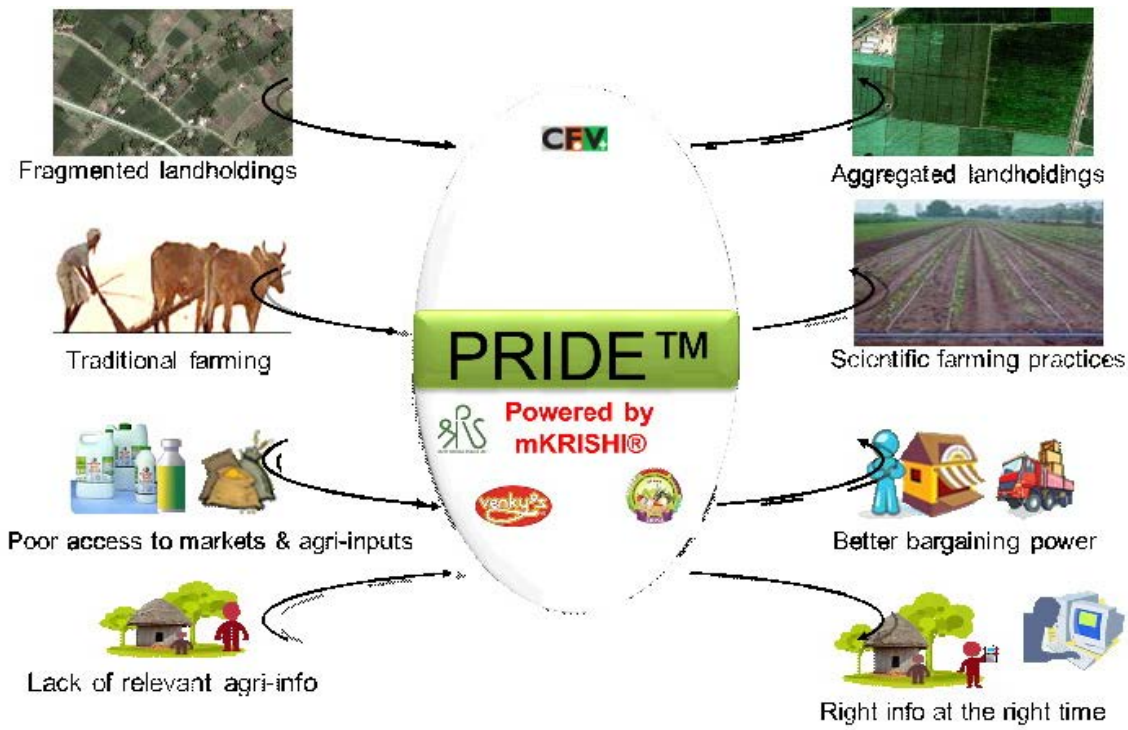

Figure 36. The impact of PRIDE™ empowered with the mKRISHI® technology

It was in this context that the mKRISHI® platform was designed by TCS to improve the operational efficiency and performance of these entities that are critical to the working of the rural collective enterprise ecosystem. This involves professional and optimized management of resources, grouping of growers, forward (market) linkages, backward (agri-inputs and credit) linkages, provision of access to advisory or consultancy information, improving data visibility and enabling data analytics in such an unorganized and unstructured sector. To this end the mKRISHI® platform effectively harnesses the power of farmer numbers under a common umbrella and delivers smooth flow of data and information to bring structure into the sector. Operational optimization can be achieved and the collective enterprise's performance can be improved multifold so that it can be effectively converted into a PRIDE™ model.

About mKRISHI®

mKRISHI® is a patented mobile-based personalized services delivery platform that enables two-way data and information exchange between the end-users such as farmers and field agents and repositories of knowledge such as virtual knowledge banks and agriculture experts and procurement officers. Currently, mKRISHI® offers a bouquet of agricultural capacity development needs such as agri-advisory, best practice, alert, weather forecast and agrisupply chain management (e.g. farm produce procurement) services. It is not merely a technological platform, but a business solution that encompasses technology and enterprise management.

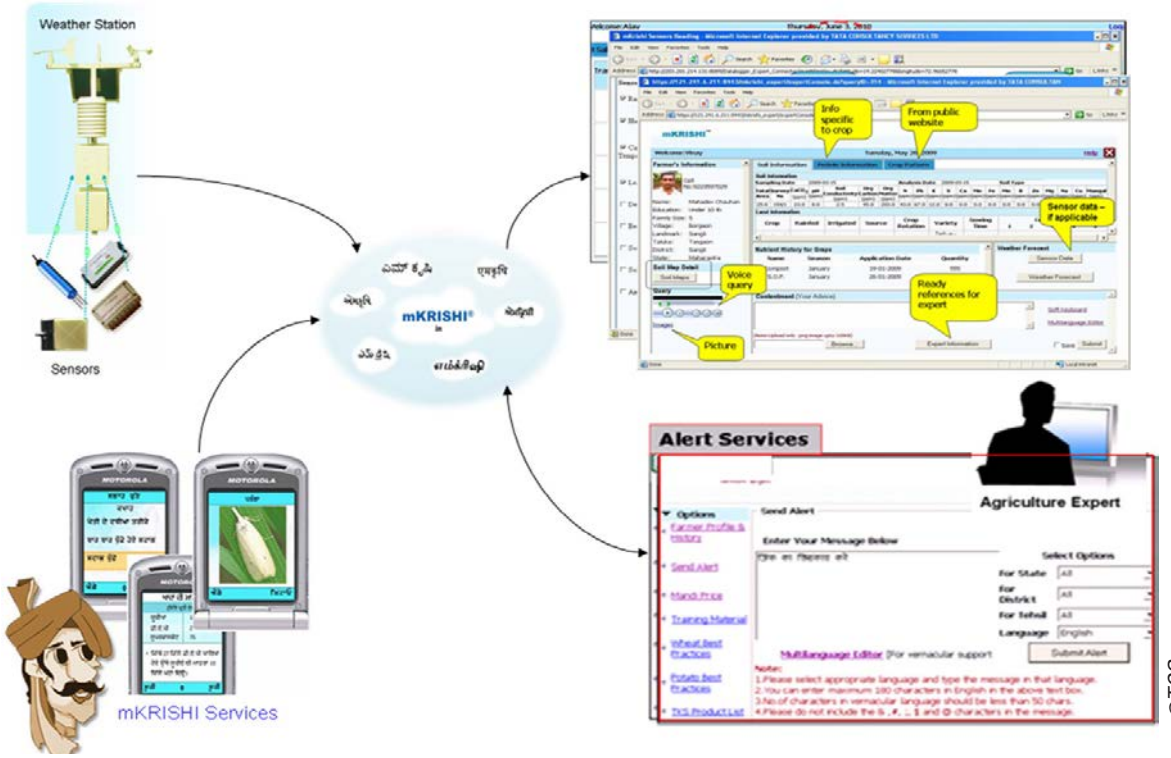

Figure 37. Interactions among various mKRISHI® components

Based on extensive research in the field and interaction with farmers, TCS has determined that value creation in the agriculture sector is mainly accomplished by increasing agricultural productivity, creating fair and transparent markets and collectivizing small and marginal farmers. The mKRISHI®-PRIDE™ model has been designed towards adding values along these dimensions as follows:

- Increasing agricultural productivity through the Crop Rotation, Optimization and Planning System (CROPS™), Agri Knowledge Base (AgriKnoB™) and plant disease forecasting modules of mKRISHI®;
- Creating fair and transparent markets by eliminating the intermediaries on the input and market sides and letting PRIDE™ replace them. PRIDE™ negotiates on behalf of the member farmers with the agri-input companies and the markets/ exchanges through the agricultural commerce system (AgriCommS™) and e-auction modules of the mKRISHI® platform; and
- Collectivizing small and marginal farmers by improving farm operations and supply chain efficiency. Improved data visibility can enable PRIDE™ to move towards data-driven decisions. PRIDE™ can plan its production based on market demand with the advanced crop planning strategies brought by CROPS™. In addition, it interacts better with the various agri-input companies and harnesses the advantages of proactive input procurement.

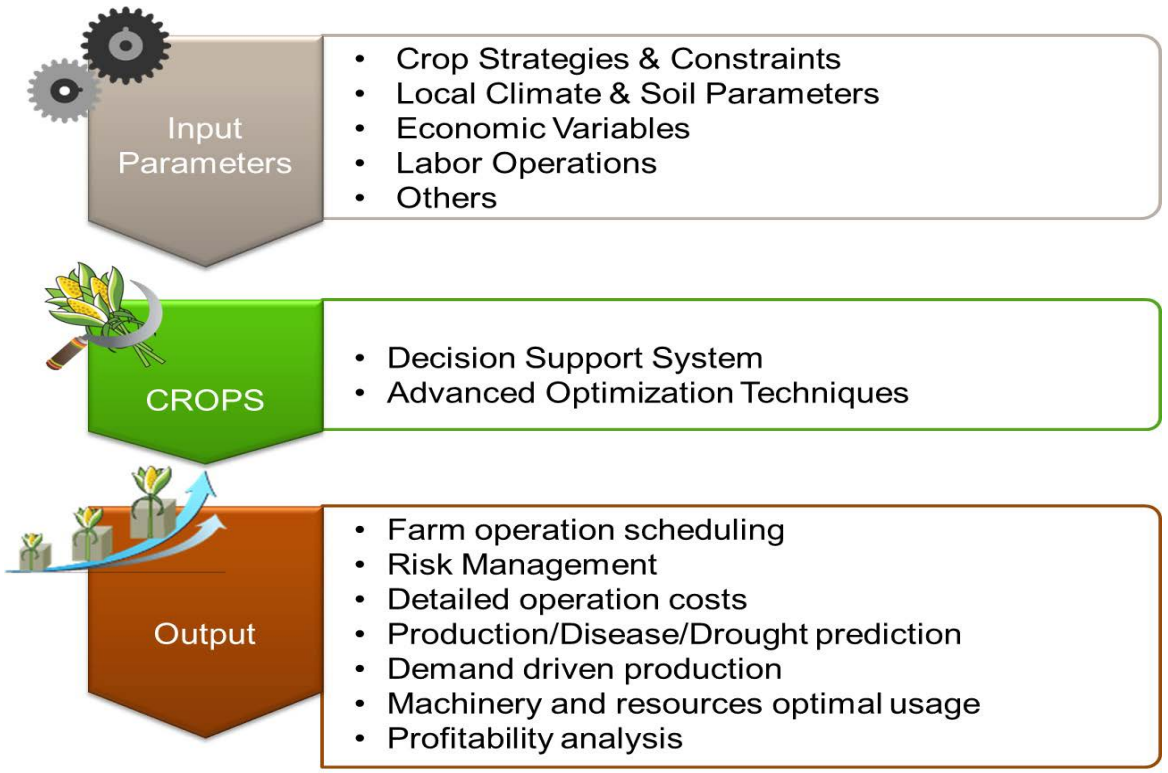

Figure 38. The CROPS™ framework

Thus, with the mKRISHI® platform, the intelligent management of the collective entity becomes possible due to the instant digitization of the available field data through the mKRISHI® mobile component, the transmission of these data over the general packet radio service (GPRS) or any other equivalent network, and the ready availability of this data for analysis by experts and operational planners through the mKRISHI® web component. The analysed data are again transmitted back to the field for implementation.

Success factors of the business model

The introduction of mKRISHI® technology to the conventional concept of a rural enterprise leads to its subsequent transformation into a well-oiled, economically vibrant PRIDE™. The 'digital' feature of PRIDE™ is the core critical component for this model's success; it delivers:

- **Content for agricultural practices:** mKRISHI® through CROPS™ provides personalized farming practices;
- **Content delivery for stakeholders:** An integrated cross-platform delivery system through mobile/IVR/web technology;
- **Business inclusion models:** Strategic collaboration among different stakeholders;

- **Scalability:** Scaling up similar platforms across many different locations;
- **Localization and optimization:** Macrofactors are optimized at the microlevel;
- **Market-driven production approaches:** Enables demand-driven production providing traceability and transparency in the process; and
- **Risk-mitigating value added:** Implementing crop insurance, produce storage facilities and processing units etc.

Chennai Horticulture Produce Producer Company Ltd. (CHPCL)

The TCS-mKRISHI® project at Kancheepuram in Tamil Nadu has successfully demonstrated the concept of PRIDE™ with the formation of CHPCL and subsequent appropriate technology injection in the form of the mKRISHI® platform.

For any innovation to be successfully accepted by the target market, there are two major components:

(a) Scientific innovation (in terms of technology and other major core competencies); and
(b) Business operational innovation (strategy to launch it to the market with focus on sustainability and commercialization).

Figure 39.
CHPCL company logo

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CHPCL has incorporated such innovations and created a unique solution that can potentially make a significant impact on the industry and hence the large population it serves.

Implementation challenges

Some of the key challenges faced in the field were mobile compatibility issues, mobile network connectivity and changing farmers' mindsets so that they could trust in and adopt new technologies.

A key component of the mKRISHI® technology is the mobile device. It was found in the field that only a few farmers actually owned mKRISHI®-compatible phones and this considerably hampered adoption of the technology. This was overcome by introducing an interactive voice response (IVR) version of the mKRISHI® platform so that any farmer owning a mobile phone could avail the service. In addition, the inclusion of field executives into the mKRISHI® technology platform ensured that they could raise queries on behalf of the farmers they were servicing.

Even though most rural areas are supposedly within the range of a mobile tower, there are abundant pockets of dead coverage. To overcome these 'dead pockets', technological innovations such as caching the data for later transmission and automatically resorting to SMS transmission in areas of poor GPRS connectivity were introduced.

It was a new experience for a technology company like TCS, with limited knowledge of agriculture, to directly face farmers, interact with them and understand their problems and issues. TCS overcame these constraints by building rapport with the farmers and addressing their issues with a great deal of interfacing. Once the benefits of the association were clear to the farmers, technology was introduced slowly without significantly altering the status quo. Regular on-the-ground and classroom training was conducted and agricultural best practices were disseminated to the farmers.

©TCS

Figure 40. The TCS mKRISHI® team's field training for PRIDE™ farmers (vermicomposting)

In addition, progressive farmers were identified for early adoption of the technology to become its champions once the benefits were made obvious. Demonstration farms were created in conjunction with these progressive farmers so that other farmers could 'touch and see' the benefits of new technologies for themselves.

Numerous other operational-level issues such as dealing effectively with scattered farmers and farms; getting farmers to sign up for joint liability groups which involved

mutual trust, shared risk and collective decision-making; changing the mindset of farmers so that farming was treated as a scientific profession rather than economic drudgery; transitioning farmers away from conventional and traditional methods of cultivation to modern scientific methods; and finding reliable partners for implementing the 'Last Mile Connectivity' with them were encountered. These were solved through various innovative means such as farmer 'clustering', novel methods of classroom and field training involving multimedia and ICT technologies to 'hook' the farmers, introducing the farmers to key Department of Agriculture and Horticulture initiatives, which were hitherto unknown to them, and working with reputed NGOs active in the field and trusted by local farmers as Last Mile Connectivity partners.

Costs and timelines

The investments included the entire software integration cost and field operational cost. Otherwise, CHPCL also had to consider the mobile hardware requirements and the associated GPRS connectivity costs.

In the first year, the cost per farmer was approximately Rs.2,000 (± USS35). Once CHPCL established itself and started to generate revenues through the sale of produce and farmer membership costs, the net cost dropped significantly. CHPCL is expected to reach economic self-sufficiency towards the middle of the third year.

The timelines associated with the project involved a phase-wise implementation plan as described below:

Phase 1: Training and capacity building (June 2012 to date)

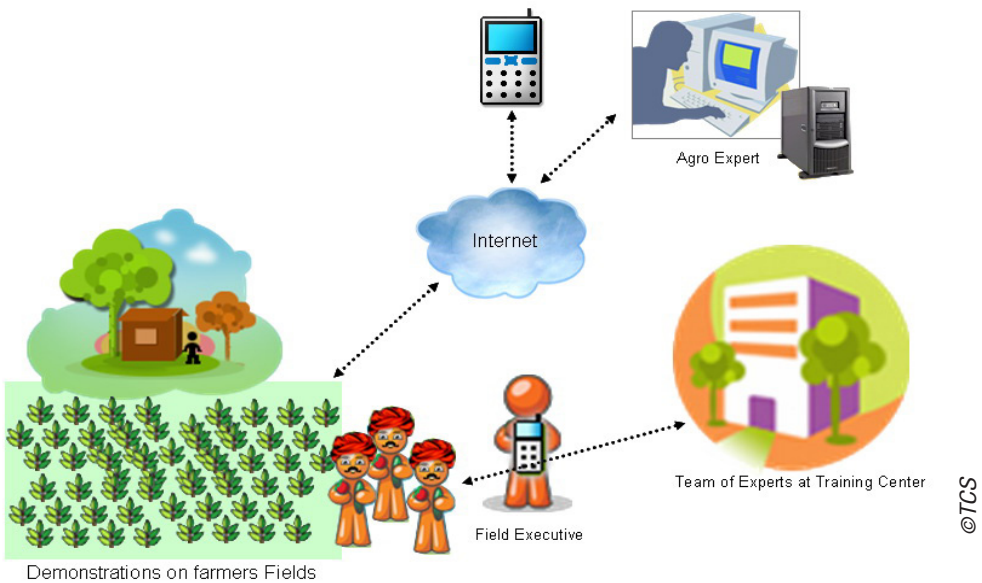


Figure 41. Capacity building flow – CHPCL

Phase 2: Forward and backward linkages (December 2013 to date)

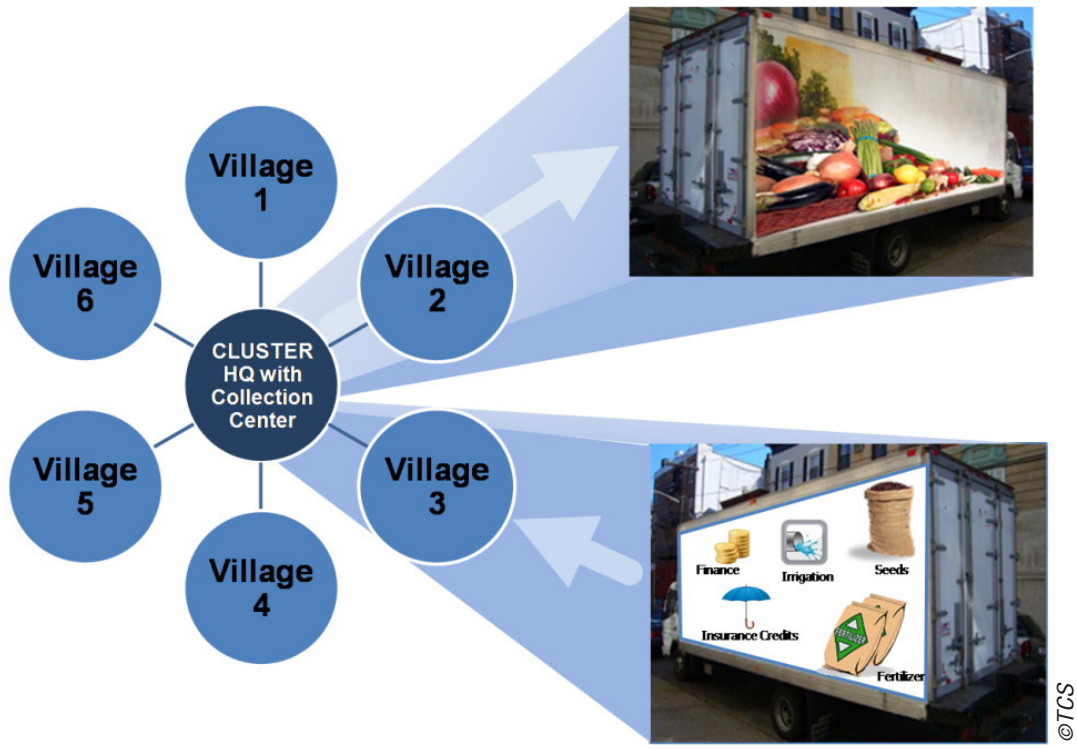


Figure 42. Linkages – CHPCL

Benefits/impact of the innovation

(a) **Employment in rural areas:** Establishing PRIDE™ creates direct employment opportunities in rural areas by employing about 50 persons for the operations of each PRIDE™ entity. Further, a vibrant PRIDE™ also creates peripheral employment in the logistics, packaging and supply chain sectors. Round-the-year farming activities also guarantee employment for labourers. TCS is in the process of conducting various research studies to quantify the numbers in terms of the indirect employment created.

(b) **Income of rural people:** The success of the PRIDE™ model is dependent upon increasing the disposable income of the member farmers. The following factors aid in increasing the income of the farmer which in turn help to raise his standard of living.

- Increased production
- Increased farm productivity
- Reduction in costs
- Better and cheaper access to credit
- Better and timely access to markets and agri-inputs
- Demand-led diversification leading to year-round employment

(c) Standard of living: Due to the power of PRIDE™'s collective bargaining approach, the farmer members enjoy the benefits of better prices at the farm gate and lower cost of inputs. This leads to a better standard of living for members and their families.
(d) Increase in disposable income due to improved production and farm productivity, better access to markets and agri-inputs and year-round employment.
(e) Better access to healthcare: PRIDE™ can ensure that better health care facilities are brought to the doorstep of the member farmers and their families through the power of collective bargaining with the health care providers.
(f) Better and cheaper access to credit: PRIDE™ ensures that the days of being dependent on usurious moneylenders are past. Farmers and their families have more peace of mind and can focus more on their families and their farms.
(g) Risk mitigation plans which are part of the technology platform ensure that the farmer is shielded from drastic losses, which previously led to suicides and rampant exoduses to cities.
(h) Environmental conservation: The holistic approach to agriculture promoted by PRIDE™ ensures that environmentally friendly techniques such as vermicomposting, Panchakavya, Gomutra and neem-based pesticides are advocated. Chemicals are only used when the situation demands them which in turn leads to a reduction in input costs. Biological control, integrated pest management and optimal use of nutrients are promoted thorough soil testing and analysis in PRIDE™ during implementation by CHPCL. The technology platform enables the capture of all field information so accounting and planning for environmental factors become possible. It also enables tracking the organic stature of a farm.
(i) Policy changes: Considering the impact of technology made in implementing, monitoring and digitizing the data points instantly, direct from the field, the results have led various institutional bodies to invite us to implement it in their purviews. As the concept is validated and the power of such instantaneous information resonates across agri-industries, eventually, TCS believes that government policies will recommend every farmer to register and digitize their farm data leading to the development of electronic farm records that will revolutionize the field of agriculture, food processing and other allied industries.

Replicability

The model furnishes foundations and accommodates customizations according to regional characteristics and specific sectoral requirements. The mKRISHI® technology is an engine that will ensure the endurance of the entire process and corresponding performance.

The idea behind TCS's involvement in Kancheepuram PRIDE™ was to provide a framework for replication across the length and breadth of the country. The further replication of this project could potentially be formulated into a franchise model, where

a successful PRIDE™ entity in a region could license its best known practices and 'localized' technologies to neighbouring villages.

The Kancheepuram PRIDE™ was designed to inspire multiple replications and to be considered as the proto-type for the extendable PRIDE™s to which this would be the concrete and proto-type of reference.

Further expansion would be taking feedbacks from the field to optimize the performance of the enterprise for additional improvement.

Some of the key factors which enable replication are:

- Well-defined processes covering every aspect of the PRIDE™ operations – finance, business development etc.;
- Flexibility for accommodating regional characteristics and other specific variations; and
- Integration into pre-existing systems of various stakeholders.

Future potential and scalability

The entire digital enterprise was designed to be scaled across the country, eschewing dependencies including geographical location or the crop under cultivation or other agricultural concepts. The model was strategically framed to demonstrate the potential and capability of collective trading and procurement with the power of technology.

The scalability of the innovation cuts across various fronts. In terms of technology, the structure has been designed to handle millions of transactions. Active research is ongoing to make the system, including the infrastructure, even more robust so that the response time can be further reduced. In addition, intelligent knowledge bases and retrieval systems are being designed so that responses can be answered in real time and automatically. These and many other similar initiatives are being funded through the TCS advanced research budget. The timeline for their release will be over the next 12 to 18 months.

Regarding operations and business, at the microlevel, the mKRISHI® platform enables scaling up in terms of the number of farmers serviced by each field executive. Before technology intervention, a field executive would typically service about 50 to 80 farmers on a consistent basis. This can be scaled up to about 500 farmers by following best practices and processes through the mKRISHI® technology platform. At the macrolevel, PRIDE™ with its well-defined processes and underlying scalable technology platform, is very relevant for every private and cooperative enterprise in the food-processing industry, dairy cooperatives, sugar cooperatives and so forth. This helps to understand the issues, feedback mechanisms, timely interventions and infusion of professional management for willing organizations. The platform can be extended

on a national level to **the Animal Health and Artificial Insemination Programme** in collaboration with organizations like paraveterinarian associations, IndiaGen, BAIF, the JK Trust and dairy cooperatives. In addition, active pilots are ongoing in the fisheries and aquaculture sectors.

As this framework penetrates, the geographical distribution challenge will cease to exist; for example farmers from Surat can communicate with the experts at Chandigarh for advisory and trading services with the entire database available instantly on screen. An integral grid and collective growth become possible with the power of this technology which can aggregate growth across regions as the success stories resonate in this sector and adoption multiplies. All the PRIDE™s are linked together through the platform so that a PRIDE™ in Uttar Pradesh, which specializes in lettuce, can sell its produce to a consumer in Chennai. Figure 43 illustrates expansion plans over the next year.

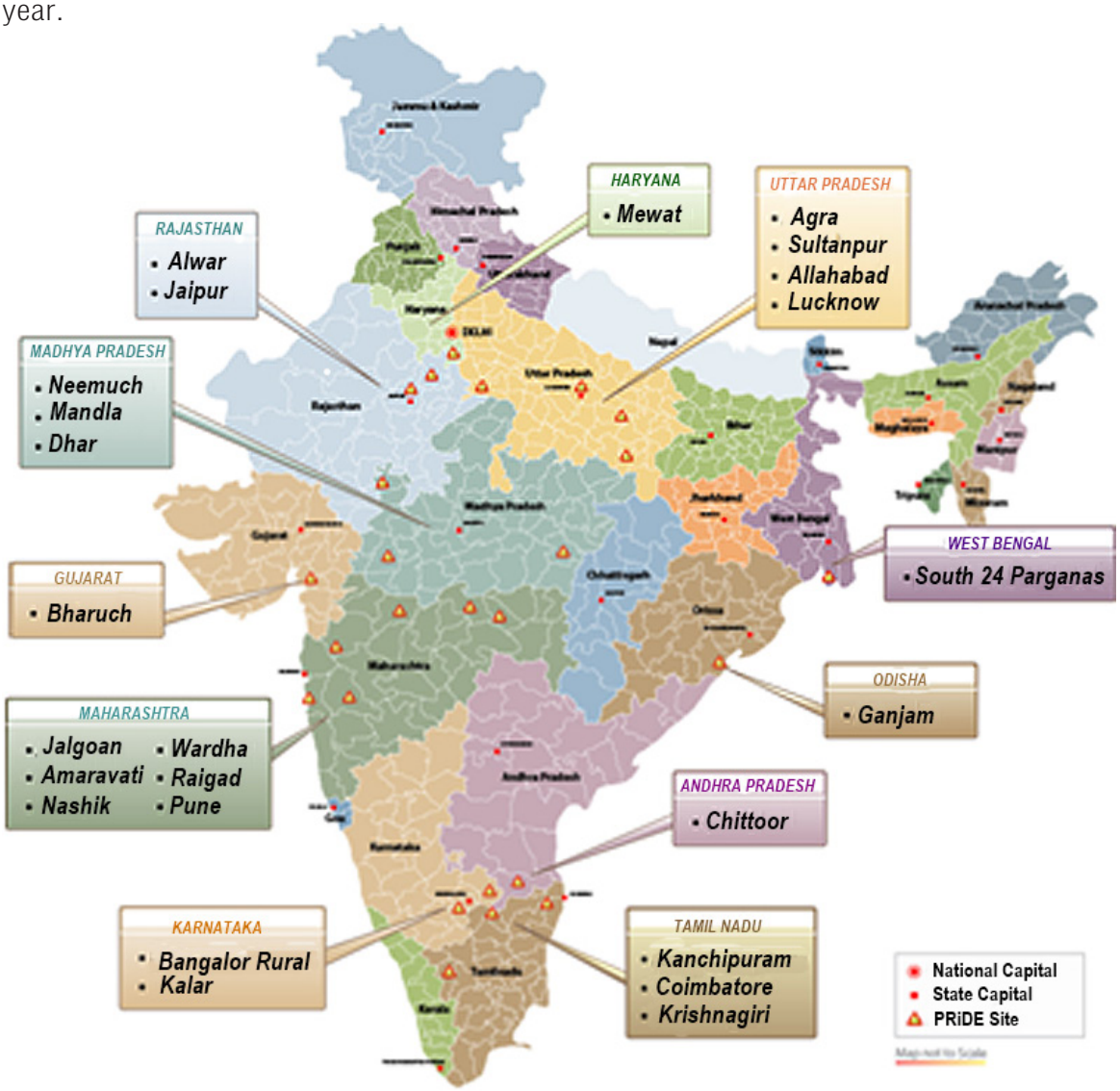


Figure 43. TCS's expansion plan

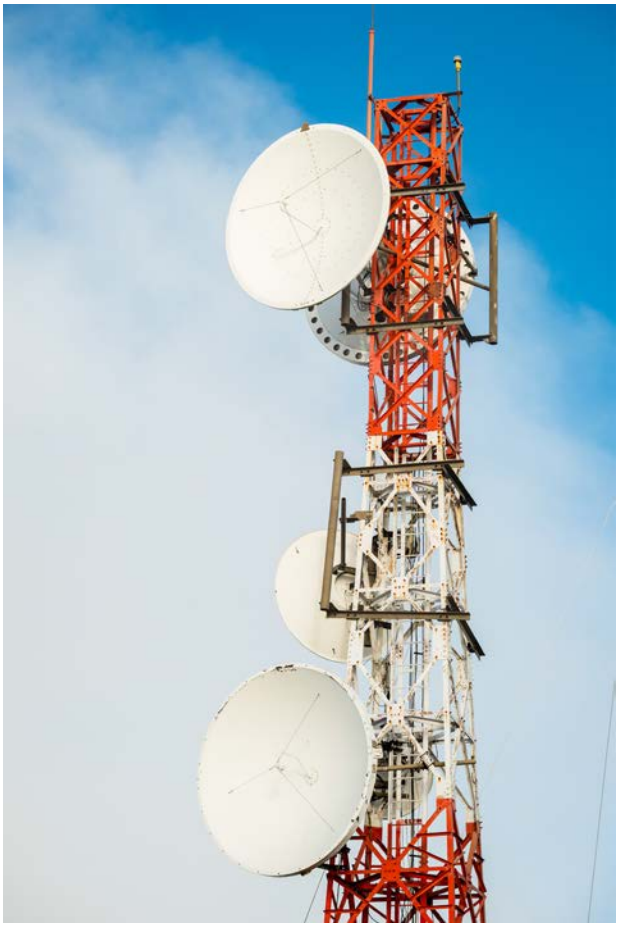
In addition, TCS is looking to align itself with various like-minded entities such as ICAR, SFAC, the World Bank, IFAD, ICRISAT, and TNAU to create a network effect, through which PRIDE™ can scale up even faster, both internally as well as externally.

The next ten years

PRIDE™, enabled by the technology nexus, application of agricultural best practices and processes and tried and tested management principles, can address farmers' issues by systematically delivering services to their doorsteps. With the Technology-driven Enterprise Business Model, the TCS vision for the next ten years is:

1. To reach a sustained repeat user-base of ten million farmers covering 10 000 PRIDE™s in ten years while promoting collective establishments;
2. To promote and replicate economically viable and vibrant PRIDE™s engaged in market activities and healthy competitive practices that positively impact their respective stakeholders; and
3. To foster the formation of specialized PRIDE™s which leverage the strengths of a particular region and ensure a unique brand value for each of the specialized PRIDE™s.

This innovation will dramatically alter the rural landscape in India over the next ten years. The fostering of economically vibrant PRIDE™s across the country will enable them to act as nodes within rural communities for economic job creation, market linkages and enhancement of bargaining power. This will lead to a better standard of living in rural communities and stop the present-day mindless urban migration and the subsequent squeezing to the hilt of already constrained urban resources.



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Case Study 6: Mobile market information service: A pilot project of ICT use for smallholder farmers in Papua New Guinea

James Laraki[13]

Background

Agriculture plays a critical role in the national economy of Papua New Guinea (PNG). The sector employs over 80 percent of the people, who are mostly smallholder farmers and depend on agriculture for their livelihoods.

While the sector has the potential to empower people and create wealth, it is confronted with many challenges to increase production to feed the growing population and to improve the market accessibility of small-scale farmers.

Information and communication technologies (ICT) play an important role in addressing these challenges and improving the livelihoods of the farming community. This article reports on a pilot project initiated in PNG to provide timely market information to smallholder fresh produce farmers via mobile phones and explores how it could contribute to improving the livelihoods of rural farmers.

ICT use and its importance

New knowledge, based on innovative ideas and systematic research, is crucial for agricultural and rural development. However, the extent of the positive impact of new knowledge depends on how effectively this knowledge is transferred to and adopted by the farming communities and other end-users.

ICT tools are increasingly becoming useful in this process and can play an essential role to facilitate the flow of relevant information and technologies to farming communities (Anzu 2009).

[13] Sir Alkan Tololo Research Center, National Agricultural Research Institute, Papua New Guinea. Contact james.laraki@nari.org.pg

Modern tools such as geographic information systems, mobile telephony, Web 2.0 technologies and social networking are offering new and innovative approaches for enhancing the dissemination of agricultural information in support of conventional extension systems which are almost dysfunctional in PNG. These tools are promising and are seen to play an important role in facilitating interactive knowledge creation and real time information dissemination for improved agricultural development and productivity.

Access to mobile phone and Internet coverage has seen an increase in the use of the ICT tools. However, ICT use in agriculture, especially by smallholder farmers in PNG, has been limited due to various constraints. This has denied smallholder farmers access to useful information on improved farming practices, climate updates, market information and other important inputs.

Improving market access

Providing up-to-date market information on prices of commodities, supply and consumer trends can improve farmers' livelihoods substantially and allows them to negotiate for a better price for their produce (Stienen et al. 2007). Such information is vital in assisting smallholder farmers to make informed decisions on their future crops as well as about the best time and place to sell their produce.

Due to poor communication facilities, smallholder farmers in rural areas generally have no idea of prices for their produce before they travel to the urban markets. They often rely on intermediaries, who in some instances have been accused of taking advantage of this ignorance. As reported by Stienen et al. (2007), access to accurate and timely market information can significantly reduce transaction and associated costs. This is very much the case for rural producers in PNG where perishable produce has to be transported to distant urban markets. Poor transport infrastructure and other vital facilities missing in the market chain in the country have led to high loss of income by smallholder farmers.

Mobile phone use

Mobile phones are transforming the lives of many users in developing countries and are widely recognized as an important current and future technology platform for developing nations (Kenneth 2010).[14]

The use of mobile telephones in PNG, especially in rural areas, is relatively new, but they are already having a noticeable effect in the country (ABC Radio Australia 2010). ABC Radio Australia (2010) noted that the use of mobile phones has expanded rapidly across the country, with an estimated 80 percentage coverage achieved since the introduction of competition in the mobile phone market in 2007.

[14] http://mak.ac.ug/documents/IFIP/RoleofMobilePhonesAgriculture.pdf

The increased coverage is a result of the national government initiative to introduce competition in the mobile phone market, allowing Digicel, a Caribbean mobile phone company, to compete in the domestic market with the state-owned mobile phone firm, B-Mobile. The introduction of competition has seen an improvement in mobile telephone network coverage, reaching far more areas than in the past with the state monopoly of the mobile phone industry. With wider network coverage, many rural people, including smallholder farmers, have seen significant improvement in communication. The increased use of mobile phones and wider coverage of the country makes the mobile market information service initiative a promising one.

Mobile Market Information Service project

The Mobile Market Information Service (MMIS) project was initiated by the Fresh Produce Development Agency (FPDA) to provide up-to-date market information of fresh produce to smallholder farmers and other players in the value chain. The project launched in October 2009, is in line with the efforts of the FPDA to transform the way it conduct its business in disseminating market information to smallholder farmers and other actors (Worinu 2009).

The project is being implemented in partnership with Digicel, one of the two mobile phone companies operating in the country, with funding support from the Agricultural Innovative Grant Scheme (AIGS) of the Australian Agency for International Development (AusAID).

The FPDA, the state agency responsible for the development of the horticulture and fresh produce industry, initiated the project in efforts to address the challenges confronted by growers along the fresh produce value chain.

Potential benefits

Access to accurate market information in a timely manner by the vast majority of rural farmers and other players along the value chain is a major constraint to the efficiency and effectiveness of marketing locally produced fruits and vegetables in the domestic market (Worinu 2009).

With this initiative, smallholder farmers have the opportunity to get up-to-date market information on their produce through their mobile phones which was something that they were unable to do in the past. The initiative allows smallholder farmers to have some idea of the prices, status of supply and quality available at the selected urban markets. Having this information on hand will allow smallholder farmers to make informed production and marketing decisions for their produce (Worinu 2009). FPDA (2012) noted that with readily available market information, it would allow growers and consumers to decide on what to grow, when to grow and harvest, how much to grow, where to sell, and what and where to buy.

This service provides information on prices, supplies and quality of various fruits and vegetables available at any given time at selected urban markets around the country.

In the past smallholder farmers had difficulty in accessing market information and they would bring produce to urban market such as Port Moresby without knowing the prices and the available supply of their produce there. Worinu (2009) noted lack of market information led to poor marketing decisions by smallholder farmers leading to high losses of income. FPDA (2009) hopes this initiative will ensure market information is at the fingertips of farmers and is a step forward into the information age.

Steps to accessing market information

To access market information, users are required to send a short message service (SMS) using a specified call code to Digicel, the service provider, with an appropriate product code and the variable required as shown in Table 1.

Table 1: Crop type, code units and variables

Crop	Code unit
Avocado	AVO
Bean – (Snake/French)	BEAN
Broccoli	BROC
Cabbage	GAR
Carrot	CAR
Garlic	GAR
Onion	ONN
Orange	ORA
Pineapple	PINE
Irish potato	POT
Sweet potato	SPOT
Tomato	TOM

Variables
Price
Supply
Quality

Source: FPDA (2012).

Table 2: Steps used in creating SMS to obtain market information

Steps	Required input
1	Create an SMS (Digicel mobile phone)
2	Type CODE UNIT, and leave space
3	Type desired VARIABLE
4	Send text to 4636
5	A return SMS received with requested information

Source: FPDA (2012).

After sending the SMS, users will receive a return message containing the desired information at any urban market instantly. Figure 44 exhibits the information received from the return text message.

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Figure 44. Mobile phone screen with composed message for potato

The service is currently providing market information for a total of 12 crops at eight urban markets. The eight urban markets are Goroka (Eastern Highlands Province), Lae, Morobe Province, Mt. Hagen (Western Highlands Province), Port Moresby (National Capital District), Madang (Madang Province), Wewak (East Sepik Province), Popondetta (Oro Province) and Kokopo (Eastern New Britain Province).

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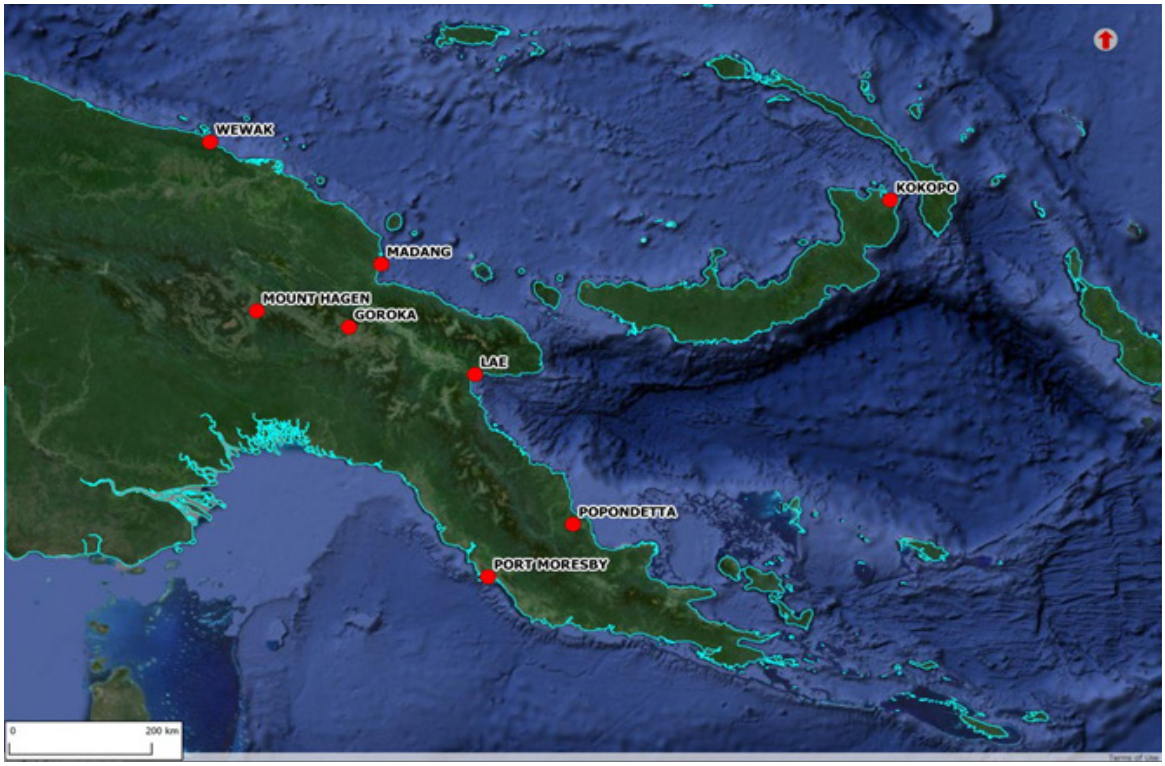

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Figure 45. Map indicating the urban markets

The FPDA has placed surveyors at the various urban markets who collect and analyse the information on a weekly basis and make it available to Digicel for distribution through its network (Worinu 2009).

Users' feedback

Due to the wider coverage of the mobile phone network, the initiative is accessible by many rural farmers and other players in the value chain, although the exact figure cannot be verified.

While the initiative is a step in the right direction, little improvement is expected in terms of level of income and overall livelihoods of rural farmers because there are many other factors such poor postharvest handling, lack of cooling facilities, transportation difficulties and other factors faced along the value chain that influence and have significant impacts on the livelihoods of smallholder growers.

Julie Manoroh, a female sweet potato grower from Henganofi, in the Eastern Highlands indicated that while she had tried getting market information from this service, it was a minor factor in determining where and when to sell her produce. "It is easier and cheaper to bring my produce from my village to Lae market. I am more comfortable going to Lae market as I am used to it now that I have been regularly doing my marketing here.

Besides I have relatives in Lae who accommodate me when I have to sell my produce over a couple days. I wish I could go and sell my produce in places like Port Moresby where the price is higher, but I am unable to meet the cost of shipment and accommodation and other associated cost while in Port Moresby" (J. Manoroh, personal communication, 22 March 2014).

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Conversation with this end-user of the services reflects that the market information made available through this initiative has little bearing on farmers in deciding an appropriated place and time to sell their produce. High transportation cost, security issues and accommodation in urban centres continue to play a large part in decision-making by farmers.

The actual benefits of the initiative would become clearer with analysis of users being surveyed electronically and other studies conducted to determine the impacts of the initiative on users.

Outscaling

The project is the first of its kind in terms of ICT use in agriculture in PNG where smallholder farmers and rural communities are seen to be directly participating. This initiative signified a milestone for the agriculture sector in PNG in its efforts to better communicate market information and other relevant information to farming communities.

While the initiative will no doubt allow farmers access to up-to-date market information, it will be a learning experience for the FPDA, smallholder farmers and other players. The outcome of this project will go a long way in determining its replication to other areas and also venturing into the use of other promising ICT tools available.

Before any attempt is made to replicate this technology, it is essential to have clear picture of how it has benefited users, especially with regard to improvement in income levels and livelihoods of rural farmers.

Ensuring sustainability is another major challenge. Several studies indicated most major donor-funded projects implemented in the country in the past experienced difficulties with sustainability.

Plans for programme continuity should be in place to ensure the sustainability of donor funding (AIGS support) once it comes to an end. Cost-sharing arrangements between local stakeholders, NGOs, farmers' organizations, local-level and provincial governments need to be formalized so that the project is sustained after donor support is concluded. Awareness is also needed to ensure all stakeholders take ownership of such initiatives and encourage users to prepare for any cost incurred in using such services.

Freight costs, law and order issues along the value chain, weather data and other useful information which are necessary in the value chain also need to be considered and built into this service to make it a complete package.

Once it is fully tested and proved satisfactory the technology could be replicated to other agricultural commodities such as coffee, cocoa, oil-palm and copra for smallholder farmers to get maximum benefit and be better prepared when negotiating prices.

The market data collected could also be disseminated through other traditional media such as local radio, newspapers, television and also posted on notice boards at district headquarters around the country to ensure as many smallholder farmers as possible have access to this vital information. Putting such information online could be an option in the future with increased Internet access and awareness.

Lessons learned

Mobile telephony coverage has improved recently, with introduction of competition in the local mobile phone market. This is big jump as most rural areas in PNG have never had landline phone and telegraph systems, Internet access or computers. Having access to mobile phones enables people in rural areas to communicate with the outside world and in the process skip several steps in the evolution of phone technologies. This in itself is an important change.

This evolution in mobile phone use makes the MMIS project a promising venture. With wider mobile network coverage, many rural people have access to the market information service, but to what extent smallholder farmers benefit from this development remains to be seen.

Recent studies on the use of mobile phones in PNG conducted by ABC Radio Australia in 2010 indicate the key benefit felt by the rural population is on social uses of the technology rather than functional uses. This means people view the mobile phone as a means to communicate with relatives living in other parts of the country – working in a city like Port Moresby, or a child who is attending school away from home. The use of mobile phones is becoming widespread but use of SMS and other features is not so popular. For rural people, it is becoming a tool that enables them to hear the voice of their loved one and reconnect with family members and relatives.

The study indicated that even if many farmers have access to market information through mobile phones, this does not lead to significant improvements in their livelihoods. This technology certainly provides an opportunity to get useful information but mobile phone service alone is not the solution to all problems. Other requirements such as cooling facilities, transportation, freight subsidy and access to credit facilities need to be improved in order to ensure farmers gain better returns from selling their produce.

While use of mobile phones and other ICT tools have potential, there is still more to be done.

Way forward

This initiative is by far the most outstanding example of ICT use in agriculture in the country where smallholder farmers are seen to be participating. It is also seen as an initiative that is more formally facilitated through institutional arrangements.

While service is now free, it is likely that users of the service may be charged for access to such information in the future, which may be discouraging. This may affect its sustainability, expansion and popularity in the future. The FPDA and other concerned organizations need to devise ways on how best to sustain this initiative and also to explore other options further to expand the use of mobile technology to improve the livelihoods of rural communities and the overall economy of the country.

While there is an indication of expanding this initiative (FPDA 2009) to cover 60 products (crops) and to identify more markets, creating awareness among all players in the value chain is required in order for them to become better organized to make use of this technology. All concerned stakeholders must be engaged in these processes to ensure that they take ownership of such an initiative.

It is also essential to improve human resource management and capacity development for staff on site at urban markets to collect, analyse and validate the information collected. This will ensure information made available through the service is accurate and up to date.

There is also a need to develop more practical communication strategies, both at institutional and national levels, to clearly define various procedures and measuring tools for fostering better use of ICT in the agriculture sector.

Conclusion

Effective communication is essential for sharing of information and innovations among all players of the agriculture sector in the country. ICT certainly provides an opportunity and has a role in our efforts to share, manage and disseminate information. Initiatives such as the MMIS need to be supported and strengthened to ensure their sustainability; at the same time other options must be explored to assist smallholder farmers to have access to and utilize modern tools available to help them make informed decision to get better returns for their produce. Such efforts will go a long way to improving food security, cash income and the overall livelihoods of rural communities.

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Case Study 7: Nano Ganesh – a revolutionary ICT tool for farm irrigation

Santosh Ostwal[15]

Midnight in winter of 1981 in a small village in India – 81-year-old Sukhlal, a passionate farmer is sleeping with his family. Suddenly an inner alarm bell rings and Sukhlal wakes up and informs his wife, "I have to rush to the farm". His wife is worried about the dangerous path that Sukhlal has to take to reach the field at this time of night.

Sukhlal takes his walking stick and a lantern and walks about 1 km through the dense bush. The fear of animals, snakes and other elements of the wild plays on his mind as he walks through the dark night. This is his daily routine. He does not know when he will return home.

The reason for Sukhlal's visit to the farm is to switch on his water pump. There had been no power for the whole day and when it was restored at 02.00, he had to walk to his farm to switch on the motor to irrigate his crop. Besides switching on the pump, he would have to wait for almost two hours to switch it off before returning home. The threats of theft of the water pump, cable or panel add to the difficulty in irrigating his farm.

Introduction

The story of Sukhlal is the story of most farmers in India who own water pumps. Convenient and safe pump operation, savings on labour and fuel expense and assuring family safety generated a need for a simple and low-cost solution to avoid frequent exhausting trips to distant water pumps.

This involved controlling water pumps in a remote location and could only be satisfied by the revolutionary technology 'Nano Ganesh' which is an electronic hardware-based remote control solution for controlling water pumps with the help of a mobile phone.

Nano Ganesh is an electronic modem; it is a simple and low-cost solution derived from two decades of dedicated work in e-irrigation for empowering farmers, irrespective of gender, language, age or education.

[15] Ossian Agro Automation Private Limited, India. Contact shostwal@yahoo.co.in

Twenty thousand farmers in India are benefiting from Nano Ganesh (as of August 2014). After installing the Nano Ganesh unit at the pump end, a farmer can switch it on or off with the help of a mobile phone from any distance. His phone also displays the availability of the power supply at the pump end as well as on/off status. Hence, farmers are not needed to physically visit sometimes hazardous pump sites in remote locations all the time.

©Nano Ganesh

Figure 46. A farmer controlling his pump by mobile phone

The basic version was developed in 2003-2004 and was continually upgraded over time. In 2009 the product was the Grand Winner at the 'Nokia Calling All Innovators' competition in the emerging market category in Barcelona, Spain.

Scenario for Indian rural irrigation

To understand the market scenario for rural automation in India, the scenario of the water pump industry has to be understood, because the demand for Nano Ganesh is a derived need from the demand for irrigation pump sets.

Market for irrigation pump sets

About 25 million water pumps deliver water to Indian farmers. It is estimated that the total Indian pump industry is worth around US$980 million and this is expected to grow by around 7 percent in the medium term. Domestic water pumps meet an estimated 95 percent of the country's demand according to the FICCI report for the DST Lockheed Martin IIGP Program in 2011.

The Indian economy is primarily agrarian and the country is one of the highest exporters of food grains. Water pumps play a key role in agriculture and remote automation has made the irrigation process easier.

The market for irrigation pump manufacturing is fragmented with many small- and medium-scale enterprises (SMEs), a small number of large Indian players and a host of multinationals.

The vast majority of smaller pump manufacturers have a local presence in states like Tamil Nadu, Gujarat, Punjab and Haryana, which are primarily agrarian economies. Their products find ready markets as purchase decisions are made by the farmers who are not familiar with emerging technologies.

This is also one of the reasons for minimal product upgrade as far as agricultural pumps made by the SME sector is concerned. Things are gradually changing with improved marketing efforts, thanks to the entry of multinationals.

Over the past few years, domestic players have been looking at the huge global market. This has resulted in exports growing by around 10 percent in recent years, and more importantly, a gradual improvement in quality, particularly amongst smaller players venturing into the global arena. Indian irrigation pumps are today exported to over 70 countries, including developing African nations.

The Indian irrigation pump industry is expected to grow to US$1.25 billion by 2015, fueled mainly by soaring domestic demand from water and power sectors, complemented by an increase in international exposure.

Markets for irrigation technologies in farming communities differ in India owing to:

- Education – illiterate, literate, advanced;
- Geographical locations – coastal belts, hilly areas, plains, deserts, jungles etc.;
- Cropping patterns – horticulture, cereals, rice, sugar cane, tea, cotton etc.;
- Family structure – joint, individual, nuclear etc.;
- Different types of irrigation technology;
- Irrigated and non-irrigated (monsoon-based) systems;
- Economies of scale – rich, medium and poor farmers;
- Social status – elites, marginalized, indigenous groups etc.;
- Available telecommunication connectivity;
- Population status – progressive, underdeveloped, dalit etc.; and
- Electricity and water sources.

Challenges faced by farmers in controlling water pumps

- **Distant locations** of the water pumps in hazardous areas near rivers, wells, ponds, lakes etc.;
- **Difficult terrain** through dense plantations or cultivated areas;
- **Dangerous wild animals** on the way to water pumps;
- **Erratic power** due to heavy density of electricity distribution in the irrigation zones;

©Nano Ganesh

Figure 47. Night visits to a water pump

- Odd hours or night operation schedules due to availability of power only during night hours;
- Electric shock hazards due to wet areas and electricity leakages near the water pump;
- Weather – rain, scorching heat, cold winters;
- Expenses for the operator such as fuel;
- Fear of water pump theft and accessories like cables, panels and starters etc. – replacement costs; and
- No quantification of usage and wastage of water and electricity.

Due to these challenges there is a tendency to avoid frequent trips to the pumps by continuously running them whenever electricity is available. They are not switched off after use. Different tools are adopted for running water pumps in continuous ON mode by using auto switches, automatic starters and sometimes by 'bypassing' the overload relays of the starter. This happens in sugar-cane producing belts to a larger extent.
Although it is understood that this is harmful to their water pumps and there is serious wastage of energy, the urgent need for water makes the risk of direct running of the water pump worth taking. But, due to the associated challenges, they are not switched off carefully and remain in the ON mode. There are about 25 million water pumps in India in the agriculture sector. Hence, there are huge losses of water and electricity as well as degradation of soil. Because of unavoidable visits to the pumps, the expenses for motorcycles, fuel and labour are a major burden for farmers.

Trends in irrigation automation

Two decades ago, many electronic devices like automated switches, timers, water-level controllers and indicators flooded the markets. They were simple and low-cost solutions to control the water pumps based on electricity availability, water level, dry running of pumps, seasonal need and so forth. Many local manufacturers dominated the market and very few branded products were available.

During the last decade, there was a major innovation in the irrigation sector, i.e. employing mobile phones for controlling water pumps. Since 2003, a farmer has been able to switch on/off water pumps with this technology. With some inertia in the initial period, the market accepted the technology after realizing the opportunity it provided. This concept was appreciated by the international community.

There are many experiments that address such technologies for agriculture and it is perceived that tools should be low cost with the assurance of support at the local level.

The need for an appropriate solution for remotely controlling water pumps arose from the challenges mentioned earlier. The result is the outcome of dedicated efforts and various trends in automation to solve the routine problems that farmers face during irrigation periods.

Challenges faced in implementing ICT tools in the rural and irrigation sector

- **Irregular electricity supply** in villages and farms: It is difficult to demonstrate, install, test and commission the products during the day due to erratic power supply.
- **Difficult terrain:** Field engineers sometimes face problems reaching pump sites for ICT installation owing to the rugged landscape which is difficult to navigate by motor vehicles at odd hours. Often they have to travel 5 to 10 km on foot.
- **Resistance of technicians to work in the rural sector.** There is a need for dedicated and passionate people to implement such technologies.
- **Serious hazards** at the water pump sites: Sometimes the pump area is wet which means electric shock threats. Also the presence of dangerous wild animals can be a deterrent.
- **Illiterate farmers and stubborn conventional mindsets:** Convincing farmers who are accustomed to their habitual irrigation routines to change to modern technology and inspiring confidence in it needs considerable patience by the promoter.
- **Heavy expenditure on advocacy:** Marketing, advertising, promotion, training, after-sale support etc. These expenses are a major drain on revenue from ICT products.
- **Investment for expansion:** Generating a sustainable business model to accommodate different expenses is a real challenge to convince investors. Currently a business model asks for investments which include either grants or long-term loans with low interest or demand advocacy by NGOs.
- **Low-cost needs:** There is huge disparity in the heavy cost incurred by R&D as well as promotion campaigns, the practical cost accepted by the farmers and breakeven cost for entrepreneurs.
- **Buying inertia is high:** Time taken to percolate the product into the market. This does not marry with investors' financial calculations.
- **Business revenue declines in the summer and in the rainy season:** It is a significant challenge to arrange for specific business models to accommodate labour for optimum production in these periods.
- **Expenses in advocacy for energy and natural resources:** Water and energy are provided at subsidized cost or almost free; the value of these vital resources is not being acknowledged and there is a huge wastage. Major investment in terms of time and advocacy is incurred before promotion of products.
- **Competition due to local players in rural areas after the technology is accepted:** Although much time is invested in pioneering the technology, local competition rivalry starts when business revenues are accruing. This creates a considerable setback for the pioneers who have devoted their lives to building a strong market platform.
- **Unpredictable purchase mindset of the farmers** owing to unpredictable natural disasters, market rates, policies and so forth.

Mitigating challenges and establishing optimism for ICT in the irrigation sector

In spite of these challenges, Nano Ganesh addresses them by reaching thousands of customers across the whole of India. Rural market characteristics are exponential, i.e. initially slow demand but great demand after trust is built. Technology should be low cost at least in the initial period to build trust among clients with assurance of support at the local level.

Despite the challenges there are success factors for ICT implementation in farm irrigation that should inspire rural and social entrepreneurs:

- Realization of the positive socio-economic change in their lives due to the technology. Acceptance is built through trust.
- Practicality of the remote control system: Once farmers experience drastic reduction in visits to pumps, saving money in terms of petrol and labour expenses, they will be more positive about the technology.
- Local accessibility and after-sales support – this is the most essential factor for maintaining a sustainable and scalable business.
- Demonstrations and pilot installations can help to 'win' farmers over to the technology.
- Low cost.
- Prompt service.
- A trusted brand.
- Commitment to provide three to five years service for the technology.

Description of Nano Ganesh

Nano Ganesh is a mobile phone-based remote control system by which a farmer can remotely control and monitor his water pump with the help of a mobile phone.

Nano Ganesh serves as an interface between high voltage electrical starters and low voltage mobile phones enabling a farmer to switch on/off his water pump and check the availability of water supply near the pump end.

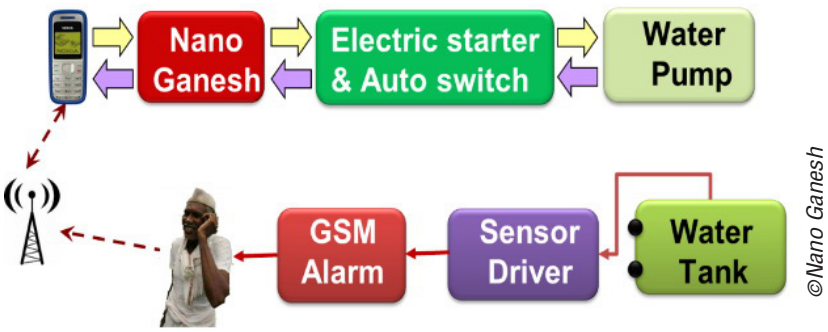
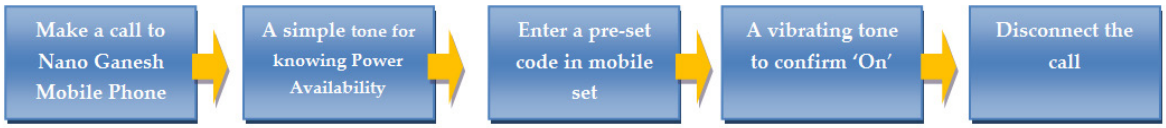


Figure 48. Nano Ganesh flow chart

A farmer can operate the Nano Ganesh modem through an inbuilt mechanism for reception and feedback. By entering a preset code into his mobile, a farmer can switch on/off the pump from any location. Figure 49 shows the Nano Ganesh operation sequence.



©Nano Ganesh

Figure 49. Nano Ganesh operation sequence

In order to switch on the system, a farmer is required to make a call to the Nano Ganesh-connected mobile phone near the electric starter. The call will be automatically received. A long beep indicates the availability of power supply at the pump end. In case of no electricity supply, the farmer will not hear a different sound on his phone. Upon receiving the power-available indication, the farmer is required to press a preset digit code to switch the pump on. After dialing the code, a typical feedback tone confirms the successful running of the pump. After confirmation of successful running of the water pump, the farmer can hang up. To switch off the water pump, a similar process is adopted using a different preset code.

Functions of Nano Ganesh

- A farmer can switch his pump on/off with a mobile or landline phone from anywhere.
- He can check availability of the power supply near the pump end.
- He can acknowledge the on/off status of the water pump.
- He can receive alert messages about 'Power ON/OFF', 'Pump ON/OFF', theft attempts etc. on his mobile phone.
- In a recent developments, water pumps are using Cloud technology for analytics of daily, weekly and monthly reports of pump operations, energy consumption, region-wise distribution of energy etc.

Unique capabilities and features

- Nano Ganesh is a pioneer technology that has been continuously upgraded based on feedback from thousands of farmers all over India since 1996.
- It is very simple and easy to use; it can be installed, repaired by local technicians.
- There is a range of products with different costs and applications (as low as US$12).
- No language, age or gender barrier for the user. An illiterate person can handle the system with ease. Housewives are effectively using this device to relieve their husbands from the responsibility of irrigation control.

- Nano Ganesh is an excellent tool in M2M applications where any electrical device can be connected to the telecommunication link with Cloud technology for computation requirements.

A farmer can purchase a Nano Ganesh modem directly from the company, local dealers, NGOs or local village technicians. A mobile phone and service connection has to be additionally purchased by the farmer.

Different models

Figure 50 shows different models. Nano Ganesh has been exclusively designed for agricultural water pumps. Its product price ranges from US$12 for the basic model NGA to US$120 for the high-tech NG GSM model. More recent models are using the GSM module-based system with additional features to connect water pumps to Cloud technology.

Ossian Agro Automation is promoting different Nano Ganesh models designed according to the specific requirements of users and farming patterns in different site conditions, specific utility needs, budgets and various markets.

Figure 50. Nano Ganesh C with a mobile phone

Nano Ganesh C is the most popular version. The product price is inclusive of input costs; indirect expenses on training,awareness programmes, advertising, travelling, promo tions and professional fees (Table 3).

©FAO/Asim Hafeez

Table 3. Nano Ganesh C product details

Description	US$	% of MRP
Product cost in US dollars	50	100
Raw materials	12	24
Labour, testing	2	4
Logistics	2	4
Variable cost I/P per product (Sr.no.2+3+4)	16	32
Fixed expenses – training, advocacy, travels, promotions, advertising, salaries, others	7.5	15
Total product input cost (fixed +variable)	23.5	47
Profit @13%	6.5	13
Selling cost to state distributor	30	60
Discount in distribution – 3 to 4 levels	20	40

Note: A mobile phone and service connection has to be additionally purchased by the farmer.

The installation cost is around US$5. This is borne by the farmer. In case of defects in the functioning of the modem, the Agro Electronic Commandos (AECs) charge a minimum referral fee of US$2. The AEC is a local village technician who is key to success in implementing electronics technology, especially in rural hazardous zones. He is a local man trusted by farmers as well as dealers and provides a useful bridge between the manufacturer, dealer and the end customer. Nano Ganesh management has always paid attention to ensuring adequate on-site and in-plant training for these technicians.

©Nano Ganesh

Figure 51. A local village electrician is vital for ICT implementation in irrigation

Socio-economic impact

Additional benefits to farmers and their families:

- Savings of sometimes US$500 per year;
- Flexibility in irrigation planning with precise control over irrigation. Every drop of water is used very effectively without visiting the water pumps;
- Enhanced quality of life due to better financial status;
- Saving of resources – electricity, water, fuel, time and labour;
- For a 5 horsepower water pump, Nano Ganesh saves 1 000 litres of water, 3-5 units of electricity, 2 hours of person time, 1 litre of fuel and 2 hours of machine time per day. Soil quality is enhanced as vital minerals are retained – otherwise lost with excessive irrigation. Carbon footprint is mitigated;
- Farmers empowered in marketing and other developments;
- Enhanced water planning;
- Enhanced information dissemination;
- Heavy saving in the fuel and operator costs;
- Technology divide bridged; and
- Farmers and irrigation operators are made technology literate.

Specific impact related on women:

- Safe and secure with husband or otherwise at home all night long;
- Record keeping of daily irrigation;
- Updates on markets, money, weather etc.; and
- Employment opportunities –rural call centre, electronics assembly, rural marketing and training.

©Nano Ganesh

Figure 52. Precise irrigation control

Economic and business opportunities

Additional income opportunities are created in the rural sector via Nano Ganesh such as installation, repair, courier services, training and demonstrations. A new business window has been generated for telecommunication companies.

Nano Ganesh activity is changing the life of the Base of the Pyramid through different channels. Apart from the farmers, other members of society benefit either socially or economically from use of the technology via new dealers' networks, employment opportunities (assembly line wok for women), delivery and repair services and so forth

Case studies

"Since we installed a Nano Ganesh mobile remote controller unit five years ago in our village, we can control the pump from any location: house, market, banks, farm, etc. Now our families can operate efficiently with a mobile phone. We save more than INR60 000 (US$1 000) every year on labour, water and petrol." Ravindra Bhujbal, Nano Ganesh owner from Sanaswadi, Shirur, Pune.

Mr Raghunath Patil Sonawane, farmer and water supplier Pune, District Maharashtra State[16]

Mr Sonawane came to our office ten years ago wanting a mobile remote control for his water pump very urgently, whatever the cost. Our engineers inquired about the reason for the urgency. We were shocked to learn that he had lost his brother in an accident on the highway en route to switch on his water pump. In fact, his brother had insisted about purchasing our product for some time.

Site description: The source of water is near a river. The pipeline is installed along the highway and the water is collected in a water tank. But when the water tank is full, the source pump has to be visited by day or at night. It is hazardous during the rainy season near the river. Much water is wasted owing to negligence in switching the pump off when required. A motorcycle is used for such supervision.

After remote control installation (2004): After installing our technology, Mr Sonawane stopped all trips to the pump. He could switch on/off his pump any time via his phone. He saved considerable amounts of water and electricity. Also, on fuel and labour costs.

Mr Sonawane observed, "This is a boon for farmers; now I depend on remote control for my irrigation activities. The system is easy to install and we do not have to rely on the company's technicians."

[16] To maintain the privacy of the users, all names have been changed.

An Unnamed Grampanchayat,[17] Mawal, District, Pune, Maharashtra State

Site description: Grampanchayat water is pumped from a well to the overhead tank of the village. The approach road to the water pump is through the forest and hilly area and there is a fear of wild animals. Hence, the operators are scared to visit the water pump starters at night. Often electrical power supply is available only at night, so an operator needs to be accompanied by another person for safety reasons. The overhead tank must be filled completely before 05:00 for water pressure in the distribution pipelines to be adequate.

After Nano Ganesh installation (First Version 2003, Second version 2009): Mr Chavan, a reputed electrical contractor from Talegaon region installed our system with telephonic support from our company. Now, the same irrigation operator can control the water pump from his house at night too. Thus he is fresh enough for water distribution work in the morning.

Another crucial benefit is that water overflow is addressed instantly. As soon as the overhead tank is full, an operator switches off the pump with his mobile phone straightaway. If the operator is away, he can control the pump from elsewhere because the remote control has virtually unlimited range.

Mr Chavan notes, “All the grampanchayats must install this system, as drinking water is a precious asset which should be used very conservatively”.

An NGO in Orissa, Orissa State

Site description: This NGO has resettled a tribal village from the forest near to a local village which is equipped with the basic facilities for standard living. However providing enough water for the additional numbers of people was a significant issue and water had to be lifted from a distant source in the forest. The approach road to the pump in the forest was too narrow. Nobody was prepared to visit this site at night due to fear of animals and the dark. Frequently electricity was available only at night. Hence, water scarcity was a serious issue as the water pump needed human operation.

After Nano Ganesh installation (12 units for different water supply schemes in 2012): Water distribution for different sites could be managed by a single person ensuring adequate supply of water at the proper time. There was no need to visit the sites as this could be accomplished remotely by the irrigation operator and money was saved on fuel expenses.

[17] Village organization.

Mr Subhash Jadhav, a farmer with an artificial right leg, Beed District, Maharashtra State

Mr Jadhav was a formerly dynamic farmer whose water pump was about 1 km away from his field. But after an accident and loss of his leg, he was unable to carry out farming irrigation and had to depend on somebody else to control his water pumps. He also had to visit the hospital for leg therapy. His son was studying in the nearby town and was anxious about his father's condition. He went to the village to support his father but fretted about his career as well.

After Nano Ganesh installation (2009): His son can control the pump from the town too. His father can also control the pump from any location (for instance from the hospital). In this case, Nano Ganesh also managed to help a family with personal issues.

Mr Prakash Patel, a progressive farmer with a banana plantation, Jalgaon District, Maharashtra State

Site description: Mr Patel once faced the problem of flooding on his farm for four to five days every fortnight. Despite ample water and electricity, sometimes he could not access the starter panel, as it was totally surrounded by water to a depth of 4 feet. So he used to run the pumps continuously with the help of automatic switches. Whenever power supply was available, the pumps functioned. But this led to huge wastage of water and electricity. Thus he had to use a small boat. Sometimes his assistant used to swim to the site to operate the starters. This case exemplifies the flooding problem that occurs in the backwater zones all over India in dam areas.

After installation of Nano Ganesh (2004): Mr Patel is now ecstatic as he has ample water and electricity and remote control over the pumps.

©Nano Ganesh

Figure 53. Advocacy of ICT at rural exhibitions

The strategy for expansion – the way forward

Nano Ganesh has proven that ICT tools can be effectively implemented in the agriculture sector.

The pioneering work of Nano Ganesh has revealed the scope of various technologies and business models suitable for specific areas. The basic version of Nano Ganesh focused on solving the root problems of the farmer at the individual level. Advanced models can use Cloud and other technologies and hence the vast knowledge resources of the telecommunication and software sectors can been tapped for enhancing the overall system.

There are two business models for ICT in the agriculture sector:

Traditional: Individual modems sold to individual customers through specific distribution networks. This business model addresses traditional farmers who buy ICT tools from the nearest available outlet, supported by trained technicians. The products are manufactured locally in-country by local businesses that can be backstopped by international institutions.

Cloud technology for water pumps in the rural sector: Computation and analytics are possible with various telecommunication platforms. This business model can be driven by the government and international institutions on a larger scale for a country or a region. One state in India has declared Nano Ganesh as one of the major m-Governance™ initiatives as a strategy for addressing rural sector resources efficiently and effectively.

The Nano Ganesh team has plans to serve as a catalyst for implementation of ICT for water pumps successfully on a global level. According to the Nano Ganesh team, expertise can be disseminated to local manufacturers for effective demonstration, installation and support services related to the technology.

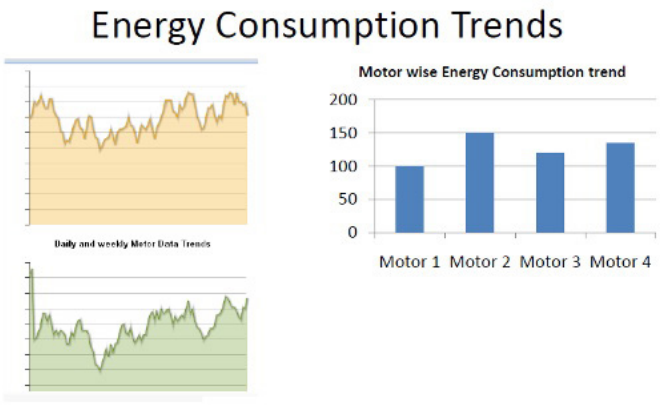


Figure 54. Analytics of water pumps possible

Conclusion

In countries like India, where agriculture is central to the national economy, adequate irrigation is crucial and the water pump is a core component. Nano Ganesh is committed to providing mobile connections for farmers and their families to enhance their quality of life. Despite the plethora of other developments in urban and industrial sectors, it is our duty to empower farmerswho bring food to our tables. It is the duty of international organizationsto ensure that water, fuel and electricity in the irrigation sector (as well as elsewhere) are conserved to the fullest extent possible and wastage is avoided; this can be accomplished by helping farmers to adopt effective ICT tools like Nano Ganesh.

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For information of this publication please contact:

Gerard Sylvester

Knowledge and Information Management Officer
FAO Regional Office for Asia and the Pacific
Email: Gerard.Sylvester@fao.org
Tel: (+66) 2 697 4000, Fax: (+66) 2 697 4445

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