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Going the extra mile: helping smallholder farmers obtain the knowledge they need to lose less and grow more

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Summary

The challenges to agriculture required to feed a growing world population have been widely analysed and documented. National Governments and the international donor community have responded by pledging large investments to support the breeding of new crop varieties. Whilst this is a vital part of the solution, it is not sufficient - nor will it yield rapid results given the time taken for widespread adoption of new varieties. With existing research findings and knowledge, we can make a major contribution to food security by losing less of what we already grow, if we can deliver this information in a way that reaches the large number of smallholder farmers in developing countries.

The last mile is a widely used phrase used in the telecommunications, internet and logistics industries to refer to the final, and often most challenging, leg of delivery to end users. The title of this paper reflects the need to use more creative ways to bridge that gap and deliver the right knowledge and information to smallholder farmers, so that they can reduce losses and improve the quality of what they are already growing. The paper reviews case studies of work by CABI in Africa and Asia, drawing conclusions for key success factors today and setting a direction for the future.

Background to CABI

Through knowledge sharing and scientific research, CABI an international not-for-profit organisation, helps address issues of global concern such as improving global food security and safeguarding the environment to improve people's lives. In particular, CABI focuses on helping farmers grow more and lose less of what they produce, combating threats to agriculture and the environment from pests and diseases, protecting biodiversity from invasive species, and improving access to agricultural and environmental scientific knowledge. The organisation has 48 member countries worldwide whose input guides and influences core areas of work spanning development and research projects, scientific publishing and microbial services. CABI runs the *Plantwise* programme, a worldwide alliance of partners promoting better systems of plant health at national, regional and global levels.

The challenge to agriculture over the next 30 years

A growing world population that is projected to reach over 9 billion by 2050 from the present level of 7.2 billion, combined with economic and social development, as well as climate change, will continue to lead to increased demand for the outputs of agriculture - food, fodder, fuel and fibre. By 2050, the Food and Agriculture Organization (FAO) of the United Nations (UN) estimates that the growing population will need 60 percent more food globally (FAO, 2012) - requiring an improvement in productivity that is almost equivalent to the gains that have been made over the last 2,000 years. Based on data from FAOStat 2011, Momagri has estimated that up to 40 percent of the working population worldwide are involved in agriculture (Momagri, 2015). The vast majority are smallholder family farmers predominantly producing food to eat themselves, as well as to sell (FAO, 2015). It is estimated that 75 percent of additional agricultural output will have to come from developing regions (OECD/FAO, 2014) so smallholders must play a central role in food security. Yet ironically, of the estimated 805 million people worldwide who are still chronically hungry, half of those are smallholder farmers (FAO, 2015).

Understandably, the family farm in developing countries is under threat as more and more people - especially the young - are attracted away from rural communities into cities by the promise of jobs, better housing and access to hospitals, shops, even entertainment. While a career in the city is embraced as a step forward, life in agriculture is often perceived as a step back. Fewer and fewer young people work in family run smallholder farms. The UN forecasts that by 2030, 60 percent of the global population will live in urban areas and up to 60 percent of these people will be under the age of 18 (UN, 2001). But this problem is also an opportunity, if we can help rural smallholders access the relevant value chains supplying food to these

growing urban populations.

This challenge means we need to think carefully about the way in which we use our resources. In the context of food security, simply increasing the amount of land dedicated to agriculture cannot be easily accomplished and could have significant impacts on biodiversity and ecosystems. A far better approach is to produce more food using the same, or less, land in a way that minimises negative impacts on resources such as soil and water.

Getting information to farmers

Too often, the response to the challenge of food security has been to pile investment into research to breed new varieties of traditional staple crops - maize, rice, wheat. But it is now widely accepted that we must go beyond calorie intake and look at the nutritional balance of the crops grown and consumed. Malnutrition - that is to say lack of nutrition or imbalanced nutrition - is a concern that is fast becoming the main threat to peoples' health in developed and developing countries alike. We need more focus on horticultural crops, fruit, legumes and vegetables: helping people achieve a well-balanced diet will address 'hidden hunger.'

In all aspects of agriculture, new varieties are only part of the solution. Whilst plant breeders promise (and deliver) many potential benefits in terms of resistance to drought, salinity, pests and diseases; it can take 10-20 years for a new variety to become widely available for smallholder farmers and even longer until there is widespread acceptance or uptake. Many attempts fail, because the new introductions are less well-suited to other aspects of the local environment, tastes and economy, than the traditional varieties that have been grown for years.

In addition to growing more, we must lose less if we are to meet the 2050 food security challenge. On average, as shown in Table 1, it is estimated that approximately 30-40 percent of crops are lost to pests and diseases (Oerke, 2006) before we even consider losses in the supply chain and wastage by consumers - where total wastage adds up to a massive 1.3 billion tonnes per year (FAO, 2015). That figure can go as high as 80 percent for some crops in some countries. Yet the knowledge and technology to significantly cut those losses is already available to us - the challenge is to put it into the hands of the farmers who need it, in ways that are practical, accessible and understandable.

It will be important to share scientific knowledge of sustainable agricultural intensification and the most practical and relevant innovations for smallholders with other countries that can benefit. Or, alternatively, further disseminate local best practices that are already being used effectively in the developing world.

Table 1. Pre-harvest crop losses due to pests

Crop	Average Actual Losses (%)	Range
Wheat	28.2	14 – 40
Rice	37.4	22 – 51
Maize	31.2	18 – 58
Potato	40.3	24 – 59
Soybean	26.3	11 – 49
Cotton	28.8	12 - 48

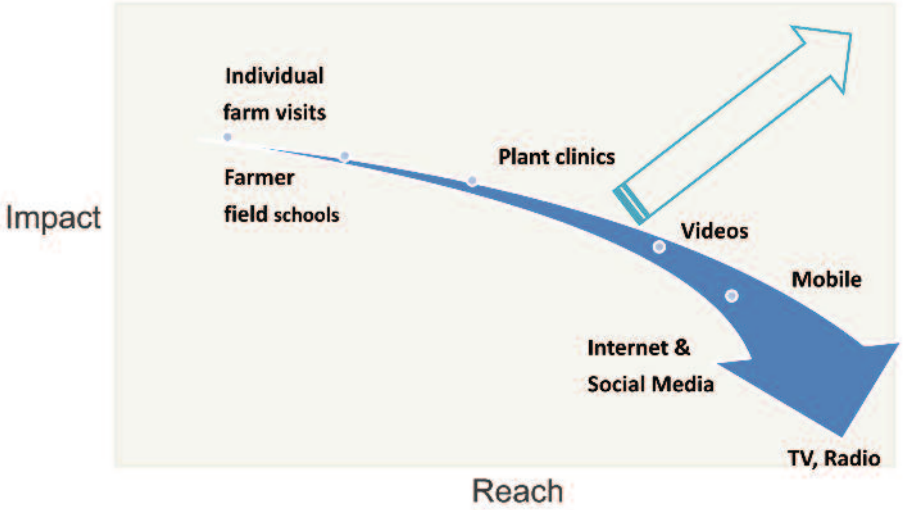

Figure 1. Communicating with farmers with greater reach, frequency and impact

Mass media communications can reach many farmers with low impact whereas the most effective communication is a face-to-face meeting between an extension worker and farmers on their farms. It is well-documented that there are not enough trained extension workers in tropical agriculture with ratios of one extensionist to every 1,000 farmers in India (Gowda, 2012) or 1:2,000 in Africa (Nyan Duo & Bruening, 2007) - rising as high as 1:3,250 in some countries (News Agency of Nigeria, 2013). We could make a step change in extension - which would make a major difference to the uptake of better varieties that we already have - by diverting some of the money that currently goes into plant breeding, but in reality that is not going to happen.

Therefore, we must find creative ways to leverage existing extension resources in reaching more farmers with greater frequency and impact. CABI is researching a variety of tools and techniques to assess their effectiveness (Figure 1). It is clear that there is no 'silver bullet' and that a combination of methods will usually be most appropriate, which will vary depending upon the local situation and the problem at hand. The explosion in modern technologies in developing countries brings an opportunity to reach more smallholder farmers than ever before, helping them to grow more and lose less. No or low literacy and language barriers can be overcome with the help of mobile agro-advisory services using, for example, voice messages. A recent report estimates that mobile services had the potential to boost agricultural income in 26 countries by an estimated $138 billion by 2020 - a prize too great to miss (Vodafone, 2015).

In addition to information flows, we need to help smallholder farmers to access markets for their better harvests, so as to translate yield improvements into higher incomes. For many rural communities, growing and selling high-value fruit, nuts, vegetables and medical herbs offer indirect health benefits, since the income gives farmers the choice to buy the nutritionally valuable produce they cannot grow. With increasing migration to cities, there are opportunities to supply urban populations that no longer have the desire, knowledge, space or time to grow their own food. Strengthening market linkages between producers and processors or buyers, can increase farm profits and supply more food resources to urban areas. Private companies engaged in this initiative are both local and multinational companies. Supportive government policies are also extremely important in adoption of best practices for food safety and quality.

Case Studies

The scale of change needed in most countries and regions is beyond both the scope and resources of any one organisation. Answering the question of how new farming approaches or produce varieties can be adopted by farmers at scale is essential. Creative partnerships are usually needed to bring together the requisite skills, knowledge, technology and local awareness. CABI has established a very successful 'Joint Laboratory' with the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences (IPP-CAAS) in Beijing. Through this linkage, in work funded by the European Union's DEVCO Directorate General (EU Devco), we have been able to work with Chinese and European scientists in the Democratic People's Republic of Korea (DPRK)to transfer and implement technologies for integrated pest management based on mass production and application of beneficial entomopathogenic nematodes. The principles of this approach are now being extended into Rwanda as part of the DFID *Agri-TT* programme (one of the first trilateral cooperation programmes on agricultural technology transfer between DFID, the Chinese Government and countries in Africa). These programmes are predominantly delivered to large groups of farmers or technicians through face-to-face training since there needs to be significant 'show-and-tell' to help establish the mass production facilities needed. Creative partnerships are needed to effect change, comprising local, national and international actors to bring new technology but ensure it is implemented in a way that is sensitive to local conditions, regulations and practices in the target country (Figure 2).

Partnerships such as the *Africa Soil Health Consortium* (ASHC) accomplish knowledge transfer in different ways. ASHC works with knowledge and delivery partners to support the development and production of high quality communication materials to get techniques of integrated soil fertility management (ISFM) into use at scale by capacity building all along the

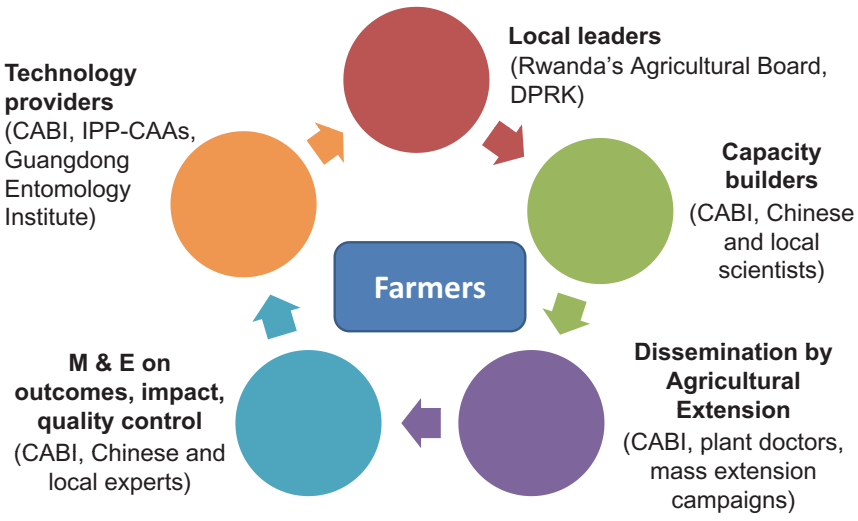

Figure 2. Creative partnerships for success

information supply chain from research to practitioners and policy makers. ASHC's online library of practical ISFM materials includes books, cartoons and posters. A related project, *Optimising Fertiliser Recommendations in Africa* (OFRA), aims to contribute to improved efficiency and profitability of fertiliser use within the context of ISFM practices. This helps collect and analyse data to develop practical decision-making tools, including fertiliser optimisation tools, providing advice on how much fertiliser a farmer should use to maximise their profits, tailored to their individual situation.

Women play a central role in feeding families and communities. According to the World Food Program (WFP), if women farmers have the same access to resources that male farmers do, the number of hungry people in the world may be reduced by up to 150 million (WFP, 2015). We also need to reduce, and ideally reverse, the migration of next-generation farmers into cities. Both ASHC and OFRA have experimented with different types of communication to overcome the challenge of how we best reach women and youth, to help them deliver their potential in agriculture.

Plantwise is a global programme, launched by CABI in 2011, to increase food security and improve rural livelihoods by sustainably reducing crop losses, with the goal of reaching 30 million farmers with plant health information by 2020. So far, the programme has reached nearly two million farmers across 34 implementation countries. *Plantwise's* motto is 'any crop, any problem,' including fruits and vegetables from home gardens, which can improve family nutrition but which are often neglected by traditional cash crop extension. *Plantwise* helps over 200 national partners to run plant clinics worldwide. Linkages are the hallmark of *Plantwise*: communications between farmers, extension services, research and regulatory bodies have substantially improved as they work together to run and backstop plant clinics.

The clinics work like those for human health where farmers bring in sick crop samples and trained plant doctors provide diagnosis and recommendations. Plant clinics, often run regularly in local marketplaces, attract more farmers than traditional door-to-door extension, increasing cost and resource efficiency for national partners. Countries see the value. Many have integrated permanent plant clinic departments and terms of references into government roles, and increase budget year-on-year to help ensure sustainability.

The networks of plant clinics are backed by the *Plantwise* knowledge bank: a database with over 20,000 fact sheets and resources covering diagnostic guides and science-based plant health advice on best practice in biological and chemical control. In addition, the prescription forms filled out at the clinic for each farmer visit provide a rich source for countries to data mine: they can track farmer needs and respond quickly to new or re-emerging pests (Figure 3). Over 110,000 records from plant clinic visits have been uploaded and analysed in a new *Plantwise* Online Management System. Already this is throwing up intriguing researchable questions about the spread of pests and diseases in response to soil type, climate change, trade and population movements.

The *Plantwise Factsheet Library* app, the *Serious* training game, and use of SMS and voicemail advisory services demonstrate how *Plantwise* can use information and communications technology (ICT) to expand the quality and reach of plant doctor advice, marking a new chapter of agricultural extension. Pilots in the use of tablets by plant doctors have shown a 75 percent increase in the speed of uploading data, as well as improvements in quality, capturing of pictures and promotion of networking among plant doctors and their customers.

As has been documented in many sources, access to mobile phones, and increasingly to smartphones, is growing at an incredible rate in the developing world. For the rural population they are not just a communication device but also, by giving wireless internet access, a source of information and entertainment. This combination makes the mobile phone a powerful tool for an increasing array of agricultural advisory services. Although the relative importance of and demand for different types of information varies in different situations,

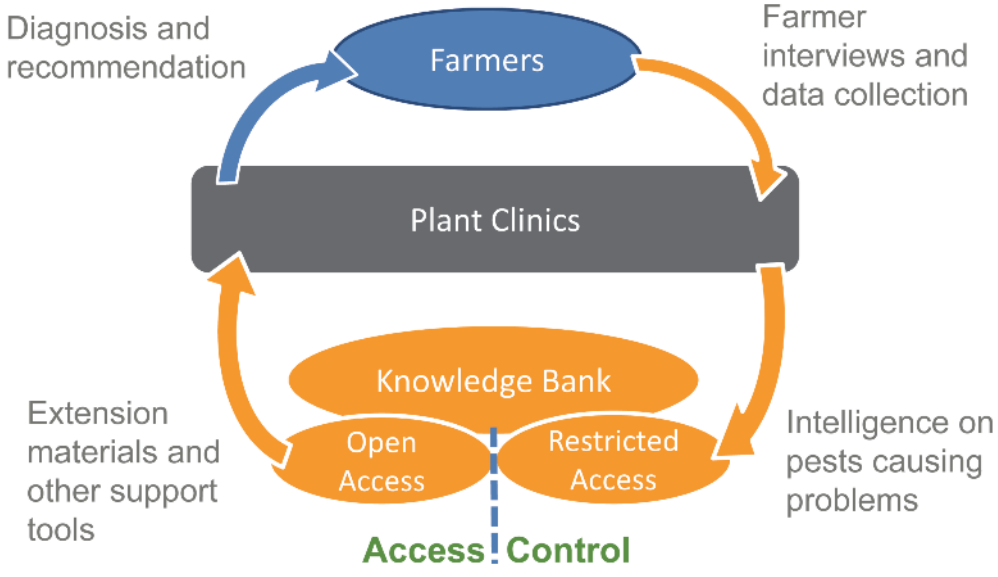

Figure 3. Information flows in *Plantwise*

there is a consistent demand for information on new varieties, pests and diseases, use of pesticides and fertiliser, as well as weather, credit and markets (Benard *et al*, 2014).

CABI has been involved in this revolution since 2009, beginning in India through a partnership with Airtel and the India Farmer's Fertilizer Cooperative, which reached over four million farming households. This stimulated our *Direct2Farm* initiative to build a database of short messages - deliverable via text or voice - which are specific to a location, the crops grown there and key points in time during the crop calendar. The information given via mobile services can include, for example, information on integrated approaches to manage soils, crop health, pests and diseases. It can also include information about nutrition. The Mobile for Development Foundation of the GSM Association (GSMA) recently appointed a CABI-led consortium to support the *mNutrition* initiative, which helps beneficiaries to access nutrition-based agricultural and health information using mobile technology. In all of our work with mobile services we have found the key factors for success to be:

- Multiple touch points with the farming family and the community within which they live;
- Easy adoption - accessibility over multiple media via robust standard technology offering plug-and-play capability;
- Hyper-localisation and synchronisation with the local agricultural system (economy and ecology); and
- Facilitation of peer-to-peer interaction and community building so as to build trust and viral adoption through word-of-mouth.

Conclusions

For impact, information and knowledge need to be put into use. Whichever mix of communication tools are used, the target information needs to be delivered to farmers in ways that are shown in Table 2. In particular, they must be:

- Appropriate, relevant and affordable;
- Timely and understandable;
- User-centric and pragmatic;
- Holistic - cover all farm activities, not just one or two crops; and
- Market related - to enable farmers to realise the value they create.

While these factors are necessary, they are not sufficient to ensure long term success. Donor funding is often essential to get projects off the ground but all too often interest and enthusiasm wanes just as the effort is at a critical point and about to deliver benefits. For long term sustainability, the original sponsor needs to think about bringing in private sector partners, investment and entrepreneurial skills to create a self-sustaining business to business (B2B) or business to consumer (B2C) activity.

Finally, when considering how to boost farming output, it is important to keep an eye on the bigger picture, understanding that agricultural production systems interact in many ways and at many levels of scale, from plot to farm, and from farm to landscape. Challenges can arise when trade-offs must be made between different land use objectives, for example, agricultural intensification versus environmental protection, and we need to think about the framework of the whole landscape. The members of the Association of International Research and Development Centers for Agriculture (AIRCA) are committed to tackling these problems at the landscape level. The 'landscape' approach to sustainable agriculture requires the creation of solutions that take into account the diversity of interactions among people and the environment, agricultural and non-agricultural systems, and other factors that represent the entire context of agriculture (Figure 4). This approach also takes into account the trans-national aspects of landscapes where they cross national boundaries, making concerted efforts to find solutions to sustainable agriculture more pressing (Nicholls *et al*, 2013).

For these efforts to be successful authoritative science-based information sources must be available, providing a true 'one health' coverage of human, animal, plant, soil, seed and environmental health - perhaps better termed an 'all health'

Table 2. Key success factors for ICT in agriculture

Engagement	Uptake	Scalability
Multiple Touch Points	Hyper-localisation	Robust technology standards
More benefit per cost	In sync with agrarian ecosystem	Plug-and-play modularity
Facilitating community building	Peer to peer interactivity	Easy adoption (viral)
Accessible over multiple media	User interactive	Trust & Word of mouth

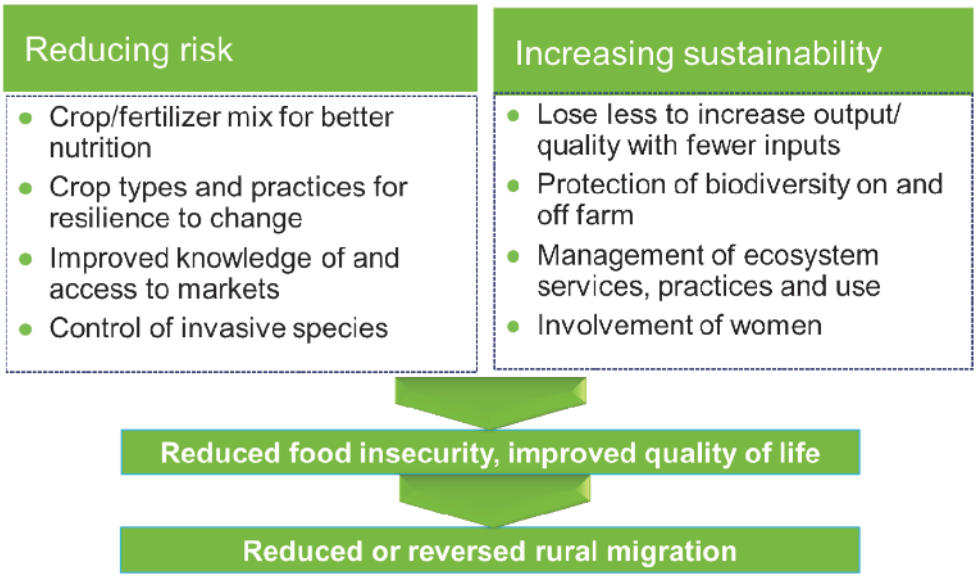

Figure 4. Healthy landscapes - making rural communities more viable

database. This needs to make information available in formats supporting a variety of end-users from academic research, through public and private organisations to extension workers and farmers. It also needs to be able to help users search, integrate and correlate findings from different disciplines and subject areas - particularly by drawing together the physical and social sciences - so as to promote approaches which are sustainable, climate-smart and gender sensitive. This is a very challenging objective but also an exciting one as the revolution in information technology makes it increasingly feasible.

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