Plantwise: Putting innovation systems principles into practice

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1. Introduction

Successful smallholder farmers must be masters of innovation, using knowledge to improve the economic and social benefits they derive from farming. Growing healthy and productive crops requires continuous innovation, so farmers need timely access to new and existing knowledge on plant health. Crop losses to pests are already estimated at around 30-40% (Oerke, 2006), and intensified production, climate change and globalisation are causing new problems to emerge at an increasing rate. Wheat rust (Ug99), banana bacterial wilt and oriental fruit fly are recent examples in Africa.

Rather than addressing each new problem with a piecemeal approach, developing capacity to prevent or respond rapidly to new problems as they arise is likely to be more efficient. Such capacity is an emergent property of the actions and interactions of the different organisations generating, sharing and using new knowledge – an innovation system. Rural and agricultural development lends itself to "systems thinking", yet finding ways to put such thinking into practice can be a challenge (Hirvonen, 2008).

In this paper we describe Plantwise, an initiative that seeks to improve the productivity of agricultural crops by strengthening the capacity of national plant health systems. We illustrate, with examples from the initiative, what eight features of innovation systems approaches mean at a practical level.

2. Plantwise

Plantwise aims to strengthen plant health systems, using provision of advice to farmers through community-based plant clinics as an entry point. Plant clinics are run by trained "plant doctors", normally extension officers with knowledge of crop agronomy/crop protection, who are taught field diagnosis and approaches to giving pragmatic advice. Cliics are typically run 1 day per week or fortnight in a marketplace or other location readily accessible to smallholder farmers, so being a plant doctor is only a part of an extension officer's work.

Farmers can present any crop health problem they encounter, and are encouraged to bring samples of their sick plants to the clinic. Details of symptoms (both observed and from consultation with the client) are recorded, along with the diagnosis and recommendation, a copy of which the farmer takes away with them.

Clinic records provide information that can be used in various ways, including quality assurance and give a snapshot of the problems farmers face in an area around clinics.

The Plantwise knowledge bank (www.plantwise/knowledgebank.org) provides online resources that support plant doctors, including a diagnosis tool, treatment advice, a mechanism to share knowledge between clinics and countries, and a means to collate and analyse the information collected at clinics via secure national plant health portals.

Clinics are thus a cornerstone of Plantwise, but they serve to forge and strengthen links between various actors in plant health systems, including other
extension providers (public and private sector), research, diagnostic services, input providers and regulators (Figure 1).

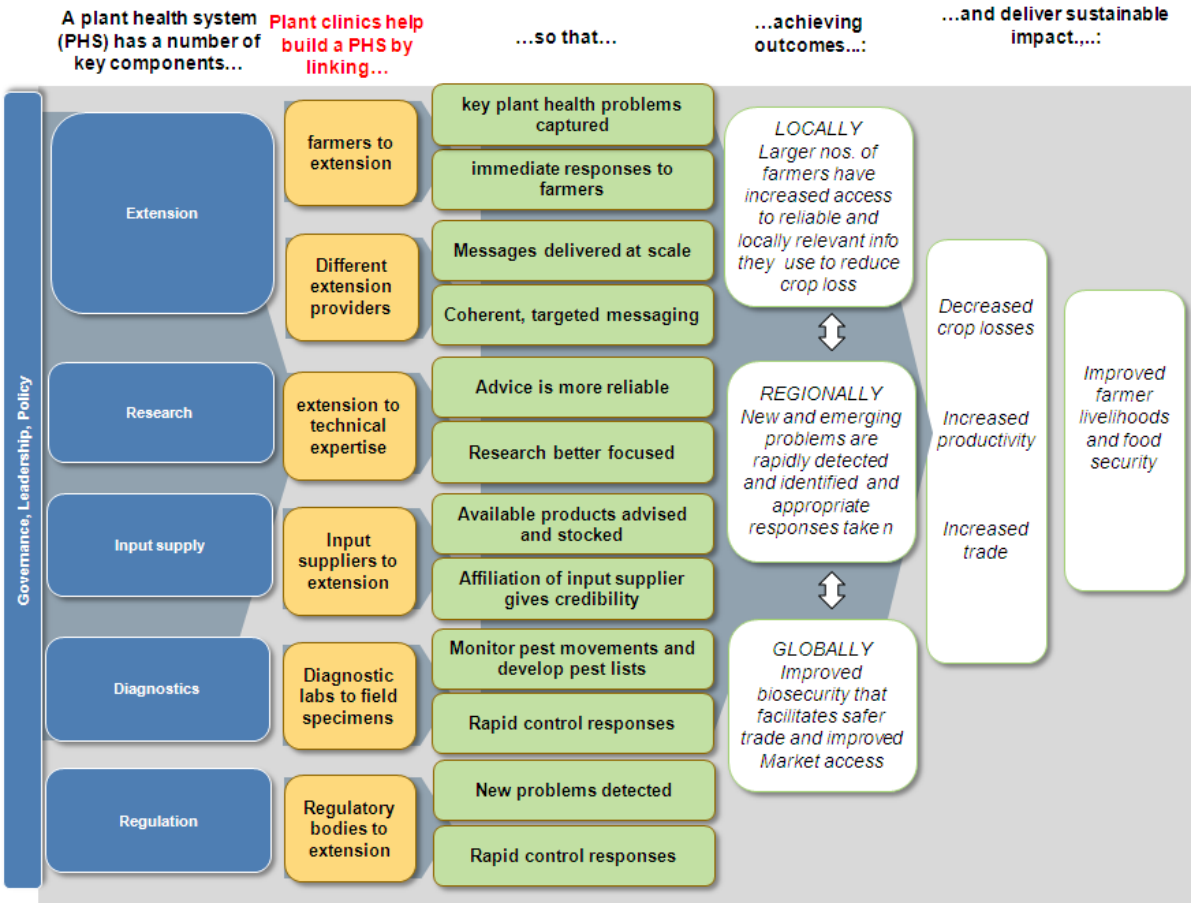

Figure 1. Plantwise theory of change (E.Boa, R.Day, R.Reeder, D.Romney); *Source Plantwise strategy*

3. Practical approaches

One focus of innovation systems discourse concerns what aspects or characteristics of a system promote innovation, and the following 8 generic features have been adapted from A Barnett (RIU 2009, Personal communication) and Jones et al. (2009). We do not aim to assess the importance of each, but we illustrate each feature with practical examples from Plantwise that, in 2012 operated in 24 countries across Africa, Asia and Latin America.

*1. Using **system diagnosis** to understand the different actors, their interactions and power relations, and to determine constraints and identify opportunities*.

When a country joins Plantwise and begins piloting plant clinics, we start by talking to the various key actors, particularly in agricultural extension and plant protection, to develop an understanding of their organizational mandates, structures, capacities and activities. Table 1 lists some of the key public sector functions in the system, which are organized in different ways in different countries.

Table 1. Public sector responsibilities for some functions in plant health systems in Kenya, Uganda and Afghanistan

Function	Kenya	Uganda	Afghanistan
Public provision of plant health advice to farmers	Department of Extension Services and Training, Ministry of Agriculture Extension. (Extension will be decentralised under the new constitution)	Local government; National Agricultural Advisory Services (NAADS), an agency under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)	Extension and Agriculture Development Directorate, under the Ministry of Agriculture, Irrigation and Livestock (MAIL)
Controlling outbreaks of migrant pests (eg locusts)	Plant Protection Services Branch, Ministry of Agriculture	Department of Crop Protection (DCP), MAAIF	Plant Protection and Quarantine Directorate (PPQD), under MAIL
Regulation of pesticides	Pest Control Products Board (PCPB)	DCP, MAAIF	PPQD, MAIL
Regulation of seeds, fertilisers	Kenya Plant health Inspectorate Services (KEPHIS); a semi-autonomous agency	DCP, MAAIF	Fertilizer by PPQD, MAIL Seed by Department of Seed, MAIL
Responding to new pest outbreaks	No individual organization has responsibility	National Agricultural Research Organisation (NARO); DCP, MAAIF	PPQD, MAIL
Pest surveillance	KEPHIS; Ministry of Agriculture; Kenya Agricultural Research Institute (KARI)	DCP, MAAIF; NARO; Universities	PPQD, MAIL

Source: W. Otieno and E.Tumuboine (Personal Communication); Z. Faizi (Personal communication)

Table 1 illustrates differences between countries that need to be taken into account if the overall plant health system is to be improved. Key challenges include

- Local provision of plant health advice may be under a different ministry from national extension policy
- Responsibility for plant health may be dispersed between various agencies and ministries
- Mandates for specific functions may not be well defined

*2. Recognising that the **institutional context** (local policy, culture, ways of working and social values) strongly influences behaviour and therefore innovation.*

Institutional environment has a big effect on success of the Plantwise approach. In Nicaragua, Danielsen *et al.* (2011) describe the difficulties of moving to a systems approach and cooperation amongst actor networks when innovation capabilities are weak. In Kenya the existence of the information desk initiative

where extension workers already went to market places to deliver advice created fertile ground for introduction of plant clinics (Negussie et al. 2011). Culture and social norms in relation to gender can have a profound effect on agricultural innovation. Table 2 shows the proportion of men and women attending clinics in different countries. Women in Pakistan do not attend clinics and in Afghanistan rarely, while in Africa and the Caribbean differences are much smaller. In DRC the large numbers of men reflect the fact that the clinics were associated with the collection points of a cacao export company and that men manage these cash crops

Table 2: Proportion of men and women attending clinics in different countries

Country	Women (%)	Men (%)
Democratic Republic of Congo	12.6	87.4
Pakistan	0.0	100.0
Sierra Leone	40.3	59.7
Trinidad and Tobago	41.9	58.1
Kenya	38.0	62.0
Afghanistan	0.7	99.3

Depending on who is making and implementing plant health decisions in the farm, such data can indicate the need to change the way plant clinics are run. In Bangladesh, for example, women previously elected as local ward representatives were trained as plant doctors, and ran clinics in the village rather than in market places and these clinics were more used by women. We continue to gather information on the gender dimensions of the relationship between plant doctors and their clients, as well as on how siting of plant clinics may interact with local cultural and social values.

*3. Facilitating **networks and linkages** between actors to provide channels for flow of information.*
Linkages between actors can take various forms, but two-way information flow is critical. Different actors in plant health systems see clinics as providing a mechanism for both receiving and disseminating information (Table 3).

Table 3. Actor groups' expectations of clinics as channels for improved information flow (summarized from various workshops)

Actor group	Clinics as a source of information	Clinics as a dissemination route
Extension	Understand crop pest and disease distribution in the country to drive extension campaigns	Deliver new extension messages
Research and training	Identify areas of research/training required on new or re-emerging plant health problems	Promote uptake of new technologies, research outputs
Regulation	Surveillance of pests; feedback on problems with inputs	Increase awareness and implementation of regulations
Agro-inputs	Confirm what problems farmers have; know what advice is being given and what products recommended	Promote correct use of quality products

Digitising, validating, analysing and communicating information from plant clinics is a significant undertaking requiring activities by, and linkages between a range of actors. In many countries we are only just getting to the stage at which these linkages are functional.

*4. Balancing the power relations between the **supply push** of the research community and the **demand pull** of the users of new knowledge.*

Improving research-extension linkages, and making agricultural research more demand-led have been elusive goals over several decades, and one component of the quest is mechanisms for expressing or assessing demand. Clinic records give an indication of the problems farmers face (e.g. Table 4). Data from Uganda and Kenya show that because clinic clients "self-select" they are different to the general population, but that differences are small.

Table 4. Apple problems presented at clinics in different parts of Afghanistan

Apple problem	% of all apple queries in each area			
	Bamyan centre	Kahmard	Shiber	Surkh-e-Parsa
Nutrient deficiency	21.5		14.0	-
Woolly apple aphid	24.0	29.7	14.0	19.6
Caterpillars	24.0		8.0	
Green aphid		8.1		
Sooty blotch		8.1		
Codling moth				13.0
Blight				13.0

A corollary of supply-led research is that advice and advisory services are supply led, and many "projects" focus on a particular crop or even plant health problem; in contrast, advice given at plant clinics is clearly demand led.

*5. Strengthening **intermediaries** between the suppliers and users of new knowledge.*

Intermediaries are not only passive channels for information flow; they need to find out what their clients (farmers) need, and search through existing and new knowledge to find options that best meet those needs. Plant doctors are intermediaries, and during training are encouraged to become "searchers" of information. When setting up clinics, relevant local information is collated from various sources, but access to information is also provided through the Knowledge Bank. Plantwise also builds capacity to create problem-specific fact sheets, 1-page illustrated documents that describe in simple terms a plant health problem and ways it can be addressed. Dissemination materials are often written by researchers in language suitable only for other researchers, so validation by farmers is included in the process (Bentley and Boa et al. 2013).

Our theory of change also envisages strengthening the capacity of other intermediaries in the provision of plant health advice to farmers. Knowledge Bank resources are freely available to all users, and include information from many sources. Information from the plant clinics should also strengthen the ability of intermediaries to provide relevant information at the right time. A sudden upsurge in enquiries about a particular problem could indicate the need for a complementary extension campaign reaching large numbers of farmers quickly with key messages.

*6. Creating **incentives** that motivate people and organisations to play their role in the innovation process.*

The Plantwise approach appears to motivate plant doctors in several ways. Being able to provide better advice to farmers is satisfying, particularly when farmers provide positive feedback. Where extensionists have target numbers of contacts with farmers, plant clinics provide the mechanism and verification. At

organizational level, Plantwise supports extension services with tools and approaches that assist them to deliver on their mandates.

We also recognize the importance of organizational and individual incentives. At an individual level, this may involve including the running or supervision of plant clinics in job descriptions and performance contracts. Different ministry departments often compete for funds. As the capacity to analyse and use information from plant clinics develops, we anticipate there may be a need to formalize the different responsibilities among the different organisations involved.

*7. Using both **tacit knowledge** and **codified knowledge***

The Plantwise approach supports the use of tacit as well as codified knowledge. When training plant doctors, one emphasis is on enabling them to use the knowledge they already have. Much of this may be tacit, gained from years of experience, so the training helps them reflect on and evaluate such knowledge in making diagnoses of problems, and in providing recommendations to farmers. Through the collaborative development of factsheets by extensionists and farmers as well as scientists, codification of tacit knowledge is encouraged.

*8. **Experimenting** and investing in **learning**, so that individuals and organisations improve their performance through an evolutionary process.*

Experimentation and learning is very much part of the Plantwise approach. Usually a few clinics are started to begin with, so that experience can be gained and reviewed by the various actors involved. Regular meetings of plant doctors from clusters of clinics are held, where they are assisted to critically reflect on how clinic services can be improved, including individual performances. Analysis of clinic registers contributes to this learning, particularly in determining the extent to which doctors make good diagnoses and provide appropriate advice (Danielsen et al. 2012). National stakeholder forums provide for wider reflection, learning and decision making on implementation. In some countries committees established from across the actor groups serve some of the functions of innovation platforms.

The Plantwise initiative itself is a product of experimentation and learning by CABI and its partners in the Global Plant Clinic (GPC). The GPC evolved out of a long-standing diagnostic and advisory service (Boa, 2009). Countries sent pest specimens, and received a diagnostic report with information on what to do about the problem. But it was realized that to increase the value of the service, the diagnosis and advice needed to be taken much closer to farmers. If there are clinics for sick people and sick animals, why not clinics for sick plants? Experiments with plant clinics in various countries found that not only were they a popular way of providing advice; they could also trigger wider changes in the way plant health services were delivered (Danielsen *et at*. 2011)

Plant Doctors Z. Mohsini, Sharifa & Shagul, giving advice to farmers at a plant health clinic at Dokani village, in Bamyan District and Province, Afghanistan

Thus Plantwise now has much wider system-level objectives than when plant clinics were first started. We have learnt a lot about how to set up and run plant clinics, we still have much to learn about how they can stimulate and catalyse the whole system. Perspectives from innovation systems approaches, and

working through what these mean at a very practical level, is helping us in the journey. We continue to experiment, evaluate and apply what is learned.

Acknowledgements
Plantwise works in partnership with public and private sector organisations in the countries where it works, particularly with national governments. Donor support is provided from many donors, particularly the UK's Department for International Development (DFID), the Swiss Agency for Development and Cooperation (SDC); the European Commission - EuropeAid; International Fund for Agricultural Development (IFAD); Australian Centre for International Agricultural Research (ACIAR); IrishAid and Ministry of Foreign Affairs of the Netherlands (DGIS)

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