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Chapter 22 from *One Health: the theory and practice of integrated health approaches*

Better Together: identifying the benefits of a closer integration between plant health, one health and agriculture

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The health problems that bind us: Napier grass (e.g. napier grass stunt disease) in the foreground feeds the cattle (e.g. foot and mouth, internal parasites) which produce the milk and meat which farmers (e.g. malaria) sell to buy food for their family (e.g. *malnutrion*)

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Better together: identifying the benefits of a closer integration between plant health, agriculture and one health

Eric Boa[1], Solveig Danielsen[2] and Sophie Haesen[3]

1 Introduction

There is a long association between human and animal health. After all, humans, livestock, horses, cats and dogs – to name a few in regular contact with people – are all mammals, linked by biology and behaviours and affected by the same diseases. Medical and veterinary procedures and processes have naturally evolved to deal with these shared threats, but there has also been further reflection and sharing of lessons learned on how best to organise services and train health professionals.

The increasing confluence of human and animal health has been prompted by a surge in importance of zoonotic diseases and is reflected in terms such as 'one medicine' and now 'one health'. One Health (OH) has stimulated new ideas about a wider vision of health that encompasses society at large, livelihoods and the natural world, as in the 'EcoHealth' movement. Broader, integrated thinking has encouraged trans-disciplinary research that examines the complexity of interactions between people, animals and their surroundings.

Despite the burgeoning of movements and initiatives on 'health' in its widest sense, plant health is frequently missing or only briefly mentioned. The purpose of this chapter is to redress this imbalance and discuss the reasons why more attention should be given to plant health. We hope that a broad definition and exploration of plant health will suggest and stimulate new links and joint actions across the different health sectors, ones that will improve human lives and help sustain the natural environment.

The launch of the One Health Initiative, which 'seeks to promote, improve and defend the health and well-being of all species'[i] is an important recognition of how linking human and animal health has prompted new ideas and actions. Surprisingly, plant health is not explicitly addressed by the initiative although lack of food and malnutrition makes people ill and more prone to infections (Rice *et al.*, 2000). Despite the importance of crop production and agriculture to poor people, with an estimated 400 million small farms (less than 2 ha) worldwide (Nagayets, 2005), plant health is a marginal if not invisible topic within the wider debate about OH. This needs to change.

We review past and recent work in plant health, to show how new approaches and ideas from plant health clinics (Boa, 2009a), for example, could strengthen OH and improve health outcomes for all. We consider the strategic and practical role of plant health in OH through three areas: joint service delivery, cross-sectoral coordination and cross-sectoral learning. Our target audience includes the broad community of actors brought together through the OH movement as well as the people and organisations active in plant health and related aspects of agriculture. We also hope that this chapter will be of general interest to people working in development and human and animal health.

Service delivery in plant, human and animal health has many common features. What works in one sector could work in another. Joint service delivery for human and animal health saves money (Zinsstag *et al.*, 2005). Opportunities exist for combining plant health services with human or animal health. Good coordination between human health and agriculture has identified solutions to malnutrition (Stern *et al.*, 2007) and could be used to manage the threat of mycotoxins more effectively. Research on human health systems has provided new ideas and tools for plant health systems (Danielsen *et al.*, 2012). But it is also true that lessons from running plant clinics are relevant to other health sectors.

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We compare the current view of plants as part of OH and related movements and the meaning of plant health more generally (it is more than crop protection or integrated pest management). Recent developments in service delivery and health systems are reviewed for plants, people and animals. Lastly, we propose a tripartite approach to plant, human and animal health and how this could help stimulate and shape cross-sectoral actions.

This is a timely moment to consider plant health. The millennium development goals will be superseded by new sustainable development goals[ii] in 2015, ones that specifically address agriculture. The strong emphasis on human health remains. The importance of including plant health in broader movements such as OH and EcoHealth has never been greater.

2 An overview of three major health 'movements' and their relation to plant health

Human and animal health are closely connected to plants for at least four reasons: *food and feed security* – enough food and feed at the right time to sustain people and animals; *food and feed safety* – plant products free from mycotoxins, pesticide residues and human and animal disease contaminants; *livelihoods* – agriculture is the world's most important enterprise, fundamental to economic growth in developing countries; *medicinal plants* –the origin of pharmaceutical sciences and a continuing source of novel compounds for drugs used in human and animal health.

Three strong 'movements' have emerged over the last decade or so: One Health, Agriculture and health (AH), and ecosystem approaches to health (EcoHealth). All stress the importance of multidisciplinary approaches and wide collaborations to improve health outcomes. OH and AH have substantial overlap in content and rhetoric yet have different origins and emphases. OH has a long history rooted in One Medicine (Zinsstag *et al.*, 2011) and zoonotic diseases. OH has largely been driven by the scientific community in the developed world, its agenda influenced by pandemics such as avian flu and SARS, and perceived bio-terrorism threats. EcoHealth strives for sustainable health of people, animals and ecosystems, using knowledge drawn from natural, social and health sciences and the humanities (Charron, 2012; Zinsstag, 2012).

Zoonotic diseases remain a strong focus of OH, though its aims have broadened to address improvements to the health and well-being of people, animals and the environment. The aims may have broadened yet change is slow to arrive. Although the United States Department of Agriculture (USDA) is part of the OH initiative there is little mention of agriculture or integrated responses to hunger, inadequate diet and poor quality food and feed.

Enthusiasm and interest in OH is growing, particularly in developed countries, where public concern about zoonoses is most clearly articulated. The One Health Global Network[iii] says that OH began as 'a concept that became an approach and then a movement'. The network's aim is to 'improve health and well-being through the prevention of risks and the mitigation of effects of crises that originate at the interface between humans, animals and their various environments'.

The OH movement has gained wide official approval through the joint endorsement by WHO, FAO and OIE and a 'tripartite global framework to address health risks at the human-animal-ecosystems interface' (FAO-OIE-WHO, 2010). OH has spawned many new ideas, yet few include suggestions for linking to plant health. One possible exception is the potential for joint service delivery (e.g. Schelling *et al.*, 2007) to include plant health, which is considered later in this chapter.

The agriculture and health (AH) 'movement' is more diffuse, though nutrition is a big part of its agenda. AH is driven by a 'South agenda' defined around the MDGs with the International Food and Policy Research Institute (IFPRI) taking a leading role since 2005. The World Bank annual report for 2008 on agriculture for development was a significant milestone in revitalising donor and government interest in agriculture (World Bank, 2007). AH was further bolstered by an international assessment of agricultural knowledge, science and technology and its role in development (McIntyre *et al.*, 2009).

The close links between agriculture and human health are clearly illustrated by HIV/AIDS, a disease which has had disastrous effects on agricultural production. Get sick and you can't farm. If you can't farm then families suffer. An increase in widow-and-orphan-headed households in Uganda led to a 'downward spiral of livelihood degradation for vulnerable households' (Parker *et al.*, 2009). Good nutrition, also part of AH, is an important for managing the long term health outcomes of HIV positive people and improving their quality of life.

Two programmes under the AH movement stress the importance of cross-sectoral approaches. The CGIAR collaborative research programme on Agriculture for Nutrition and Health (A4NH)[iv] includes partner centres active in agriculture, agroforestry, development policy, livestock and fish. The Leverhulme Centre for Integrative Research on Agriculture and Health (LCIRAH)[v] is a coalition of researchers from diverse disciplines, including human health.

These programmes have overlapping research themes that range from diet and non-communicable diseases in development and biofortification to 'agri-health' and 'enhanced nutrition'. There is little mention of plant health. One reason may be the limited contact between scientific researchers studying plant pests and diseases and their medical and veterinary counterparts, perhaps because, with rare exceptions, plant pathogens do not infect humans or animals. Few professional societies foster interdisciplinary engagement that might build bridges between the different health sectors.

A stronger connection between nutrition and agriculture offers new ways to link plants to people (see von Braun *et al.*, 2012). The United Nations Standing Committee on Nutrition produced ten key recommendations for improving nutrition through agriculture which included incorporating 'explicit nutrition objectives' in programmes. The Tata-Cornell Agriculture and Nutrition Initiative is promoting links through a 'research, development and education program'. These are steps in the right direction, but there are still more policy briefs and recommendations than direct actions.

Disciplinary isolation is a major obstacle to bringing human and veterinary medicine, agriculture, livestock and nutrition closer together. Weak ties within and between ministries, local government, service providers, regulatory agencies and education further limit cross-sectoral coordination, integrated actions and coordinated responses (Schelling *et al.*, 2007; von Braun *et al.*, 2012).

Human, animal and plant diseases are all covered by ProMed-mail[vi], an internet-based reporting system for "rapid global dissemination of information on outbreaks of infectious diseases and acute exposures to toxins that affect human health, including those in animals and in plants grown for food or animal feed". Run by the Society for Infectious Diseases, alerts are issued on diseases affecting people, animal and plants. The Foresight Programme reviewed threats to human, animal and plant health for the UK and Sub-Saharan Africa (Foresight, 2007), and attempted to place plant health in a wider context, an encouraging sign of cross-sectoral thinking.

The Emerging Pathogens Institute (EPI)[vii] is part of the University of Florida and studies human, animal and plant diseases (albeit the smallest of all programmes). EPI draws on scientific expertise in medicine, veterinary medicine and agricultural and life sciences. In 2011 the Southern African Centre for Infectious Disease Surveillance (SACIDS) initially included plants in their OH framework but they are missing from a 2013 mission statement[viii]. The reason is unclear but it may have been difficult to define concrete actions that addressed broader health outcomes.

Fletcher *et al.* (2009) argued for broadening OH to include plant health. The authors highlighted the importance of plant health to nutrition, food security and food safety. They proposed improvements in scientific cooperation and technology development but did not discuss delivery mechanisms or extension and advisory services. These topics will be considered in detail later in this chapter.

3 Understanding plant health

Plant health in practice has a limited scope, usually restricted to pests and diseases and their management. A broader definition is needed to consider all the possible links to human and animal health, one that would consider the overall vigour and health of plants. Expanding the scope of plant health will not be easy given the weak visibility of services. The 'plant health workforce'

consists mainly of general extension workers who have a broad range of responsibilities. Plant health specialists such as plant pathologists are more visible, but most are based in research, with often ill-defined roles in extension.

In the context of OH, the scope of plant health should be consistent with achieving improved health outcomes for people, animals and the environment. Browning, a leading US plant pathologist, proposed a national plant health system comprising research, training, education and extension (Browning, 1998). His definition of plant health included biotic and abiotic stresses and therefore covered soil fertility as well as pests and diseases and crop protection.

Browning worked in integrated pest management (IPM) for many years before developing his vision of 'holistic plant health'. IPM promotes non-chemical methods, including biological control, and has many definitions (Pinstrup-Anderson, 2001), making it difficult to agree on its scope. The System -wide Program for IPM (SP-IPM) talks of 'improving established methods and developing new practices of pest and disease control' (Anon, 2010). Integrated Soil Fertility Management (ISFM) also embraces plant health (Vanlauwe and Zingore, 2011).

The SP-IPM has little advice to offer on how improve service delivery beyond encouraging others : "Policymakers need to provide incentives to encourage the adoption and adaptation of IPM to local conditions through a strengthening of knowledge transfer to upgraded extension services"(Anon, 2010). An independent review of the impact of IPM extension confirmed the need pay more attention to delivery mechanisms (Bentley, 2009), a recognized priority in human health : 'Biomedical discoveries cannot improve people's health without research to find out how to apply them specifically within different health systems, population groups, and diverse political and social contexts' (WHO, 2004).

Plant health services are only one part of general extension efforts. Diagnostic laboratories are more visible, but difficult for farmers to access (Smith *et al.*, 2008). Extension has 'subject matter specialists' in crop protection, but they are few and spread too thinly. Support from 'plant health specialists', such as plant pathologists, entomologists, is often dependent on project funding for specific problems. Plant health service delivery does not receive the attention it clearly needs.

Browning's proposal of a 'national plant health system' was never consciously adopted, though the creation of a National Plant Diagnostic Network (Stack *et al.*, 2006) and the continuation of joint research-extension appointments at land grant universities are positive signs. The political commitment to agriculture at all levels goes back to the creation of the United States Department of Agriculture in 1862 (Campbell *et al.*, 1999). Continuing support has done much to sustain a strong and effective plant health delivery system with more than a passing resemblance to a national plant health system.

A less encouraging picture emerges from developing countries, where extension-agriculture links are generally weak (Davis, 2007). When emerging diseases cause major damage or pose major threats (Anderson *et al.*, 2004) plant health gains a temporary fillip, but this may not be sustained. Diagnostic services continue to suffer from weak technical capacity and uncertain funding, even where major plant diseases cause widespread damage, such as in Uganda (Miller *et al.*, 2009).

Browning's ideas have helped to establish a postgraduate qualification for Doctor of Plant Medicine (Agrios, 2001). The idea of plant doctors is not new (Large, 1940) and has gained wider attention through courses begun by the Global Plant Clinic (GPC) in 2003 (Boa, 2009a). The Plantwise programme of CABI[ix] has expanded this training since 2011 to over 30 countries. Numbers trained are still small compared to community-based animal health workers in Africa and Asia (Scoones and Woolmer, 2006).

Plant health is closely associated with phytosanitary regulations and the International Plant Protection Committee (IPPC). Each Ministry of Agriculture nominates a national plant protection organisation (NPPOs), usually the government body responsible for crop protection. Their main responsibility is to monitor pests and diseases and work closely with extension services. The IPPC is much smaller than the World Health Organisation (WHO) or World Organisation for Animal Health (OIE), and has a narrower mandate: 'to protect the world's cultivated and natural plant resources from the spread and introduction of pests of plants'.

Extension and research in plant health often struggle to work together. In Uganda, Government agencies have overlapping mandates and sometimes competing interests in food safety, nutrition and agriculture, with poor coordination between nationally-organised research and locally-delivered extension (Danielsen *et al.*, 2012). Internationally, opportunities for consolidating activities in plant health could be better exploited. The IPPC is hosted by the Food and Agricultural Organisation of the United Nations (FAO), with wide interests in crop protection and extension, and overlapping interests in nutrition and food safety with the WHO.

Wider agreement is needed on the importance of plant health. The most widely quoted source estimated up to 40% losses due to pests and diseases (Oerke, 2006), but individual instances can be much higher (e.g. cassava mosaic disease: see Anon 1997). Up to date and comprehensive data are however hard to obtain and difficult to assess.

More accurate data are available on losses due to mycotoxins, an important part of plant health, with lost export earnings from Africa of around $400 million each year (Anon, 2012). The well-documented consequences of plant pests and diseases on livelihoods, human welfare and natural resources have often failed to translate into support for research (Lenné, 2000).

The Global Forum for Rural Advisory Services (GFRAS) offers new opportunities for encouraging a move towards 'robust rural services' rather than ad hoc, crop-specific, technology-driven projects (Tripp *et al.*, 2005). Projects on crop pests and diseases are an unreliable way to sustain service delivery, the key to improving plant health and providing consistent help to farmers.

4 Improving health outcomes through joint responses

This section explores the basis and outcomes of cross-sectoral actions and the scope for stronger involvement of plant health, where joint responses to health issues have been weakest.

In Chad, combined health interventions ensured that vaccination of the children of nomadic pastoralists, which was optional, took place at the same time as compulsory vaccination of cattle. Delivery of human health services, organised around static health centres, piggy-backed on animal health campaigns designed for mobile populations (Schelling *et al.*, 2005; also see Chapter C7).

Prior to this approach, studies had failed to find one fully immunised nomadic child. Savings of 15% were identified compared to separate campaigns to vaccinate animals and people. Pastoralists understood the concept of vaccination for their animals but not for themselves or their families. Researchers used this knowledge to encourage vaccination of 'the most neglected populations in remote rural areas'.

The potential for improved health outcomes from closer cooperation between animal and human sectors is already recognized (Zinsstag *et al.* 2005). Managing zoonotic diseases is a constant incentive for joint actions. There are also compelling reasons for including plant health in joint actions but for different reasons, for example in reducing contamination of food and feed. Results so far have been uneven. A comprehensive review by GFRAS on the integration of nutrition into extension and advisory services noted the restricted ability of extension agents in Nigeria to improve agricultural practices and reduce mycotoxins in crops (Franzo *et al.*, 2013). The extension agents 'lack(ed) a clear agenda on mycotoxins, limiting their ability to provide good messages that improve food safety'.

Nutrition is already part of agricultural extension in some countries through efforts to change what people grow and eat. World Neighbours, an international Non-Governmental Organisation, has led efforts to 'bring agriculture and health workers together' in the Philippines, Indonesia and Ecuador (Stern *et al.*, 2007). They found that many women had a lot of practical knowledge of food but were unaware which crops were most nutritious. The project team included people with backgrounds in nutrition, agriculture and the social sciences and it took some time to design a multidisciplinary approach on how to encourage women to plant nutrient-rich crops and address changes in diets. As the scope of projects widens so disciplinary biases need to be recognized and managed.

Joint actions on the diagnosis of plant, human and animal diseases would appear to be more straightforward. Similar methods are used to identify human, animal and plant pathogens (see Fletcher *et al.*, 2009 for in-depth review). Diagnostic techniques and tools are often developed first by medical scientists before being adapted to plant and animal pathogens. Rapid diagnostic testing of human, animal and plant pathogens use similar technologies, such as lateral flow devices.

Yet there is little contact between plant diagnostic services and other health sectors. Human and animal pathology services already collaborate in confirming zoonotic diseases though there is more scope for sharing facilities (Zinsstag *et al.*, 2005). Molecular and immunological diagnostic tools are being increasingly used to identify fungi, bacteria and viruses, for example, but few plant diagnostic laboratories are able to perform such tests (Smith *et al.*, 2008). It is unclear how many human and animal laboratories might accept samples from plants, though few efforts have been made to our knowledge to explore such possibilities.

The World Animal Health Organisation (OIE) and the World Health Organisation (WHO) have designated reference laboratories for specific diseases which help to coordinate responses to new diseases. International cooperation in diagnosing new and emerging plant diseases is much weaker despite calls to improve networking and coordination (Smith *et al.*, 2008, Miller *et al.*, 2009). CABI is in unusual in providing specialist diagnostic services for plant diseases to developing countries (Aitchinson and Hawksworth, 1993). More than 50 new plant disease records were published by the Global Plant Clinic from 2002 – 2011 (Boa and Reeder, 2009). Although the Plantwise Diagnostic and Advisory service continues to receive samples from around the world there is still considerable scope for strengthening international cooperation in plant diagnostics, while more could be done to link plant diagnostic services in developed countries. The National Plant Diagnostic Network (NPDN) coordinates US laboratories but has only done so since 2002 (Stack *et al.*, 2006). The NPDN is a potential focal point for expanding links to human and animal health given the international reach of the US Centres for Disease Control.

A multidisciplinary research strategy to address contamination of food with human pathogens has recently been proposed (Fletcher *et al.*, 2013). But there are few signs that cross-sectoral approaches are being used in developing countries, where the use of 'night soil' to fertilize crops and unsanitary conditions pose considerable public health threats (Nguyen-Viet *et al.*, 2008; Pham-Duc *et al.*, 2013; and see Chapter B5).

Plant and human health closely intersect where pesticides are widely used. The effects of pesticides on human health was comprehensively studied in Carchi province, Ecuador (Yanggen *et al.*, 2004), a major potato producing area with highly damaging plant health problems such as the Andean weevil and late blight. Carchi has the highest incidence of pesticide poisoning in the world and researchers used an 'ecohealth approach' to limit pesticide use (see Zinsstag *et al.*, 2011). The researchers were disappointed in their ability to bring about 'substantial changes in current practices', yet even though the health outcomes were less than expected the study confirms the validity of cross-sectoral approaches. The study also provides important lessons for others attempting similar approaches concerning other aspects of plant and human health.

Two FAO studies in Africa looked at emerging and re-emerging diseases of agricultural importance in all three health sectors, one on the border of Tanzania and Uganda (Rugalema and Mathieson, 2009), the other between Malawi and Moçambique (Bentley *et al.*, 2012). They considered the combined impact of plant, human and animal diseases from a broad livelihoods perspective. A separate paper from the larger Tanzania/Uganda study looked at local perceptions of diseases and why recommended control measures and strategies were often ignored (Rugalema *et al.*, 2009).

One of the overall conclusions was that a lack of professional collaboration between health professionals undermined attempts to limit the knock-on effect of diseases in other sectors. Most residents in the border region between Malawi and Moçambique crossed frequently and were 'rarely empty-handed, often taking plants and animals'. The studies said that it was better to share information about diseases occurring on both sides of the border rather than attempt to limit travel and hinder trade that depended on plants and animals (Bentley *et al.*, 2012). These initial insights confirm the need to continue using a cross-sectoral approach to understand and minimize the human, animal and plant health risks associated with movement of people across borders.

Many Non-Governmental Organisations (NGOs) already use cross-sectoral approaches to work with rural communities. They are less restricted by the 'disciplinary silos' of formal approaches. The Village Vocations Program, a Kenyan NGO, works in all three health sectors, though only recently in plant health. One of the reasons was because they recognized that efforts to help families affected by HIV/AIDS should also include support for agriculture.

In summary, there are encouraging examples of joint responses and cross-sectoral coordination involving plant health, but they are still small scale. Further thought needs to be given on designing interventions and testing their effectiveness.

5 A unified approach to plant healthcare

Attempts to broaden the focus of plant health beyond specific interventions on particular crops and pests and diseases include a proliferation of 'integrated' approaches, such as Integrated Pest Management and Integrated Soil Fertility Management. Their separate achievements stop some way short short, however, of a unified approach to plant healthcare. Taking inspiration from broad-based approaches to human and animal health, and their emphasis on service delivery and health systems(see Tollman *et al.*, 2006 and Catley *et al.*, 2001), this section discusses a plant health system approach and a model for analysing links, dependencies and interactions between human, animal and plant health.

Plant clinics began with the intention of providing regular support to farmers, filling major gaps in service delivery for plant health (Boa, 2009a). The aim was to work with existing organisations already active in extension, building on local knowledge to streamline advisory services. Plant health clinics began in Bolivia in 2003 (Bentley *et al.*, 2009) but made their biggest steps forward in Nicaragua from 2005 onwards (Danielsen and Fernandez, 2008).

Plant clinics are run mainly by extension workers, often known as 'plant doctors'. By 2009 there were eight countries running 80 clinics with the support of the Global Plant Clinic (Boa, 2009a), now the expanded Plantwise programme of CABI (Romney *et al.*, 2013). Training modules for plant doctors were developed in Nicaragua (Danielsen and Fernandez, 2008) and have been an important tool in establishing networks of plant clinics and creating new partnerships (Boa, 2009b).

Local innovations in plant clinics and service delivery flourished as more countries and new partners took part. In Bangladesh plant clinics promoted safe use of pesticides. Plant doctors requested training in diagnosing pesticide poisoning (Kelly *et al.*, 2008). Some plant clinics in Nicaragua included qualified vets hired by local cooperatives, who accepted queries about animal health. Many of the early innovations were in location and timing of plant clinics, as local staff found what worked best. In DR Congo and Kenya mobile plant clinics alternated between sites to increase coverage and improve access. SOFRI, a fruit research institute in Vietnam, stayed overnight at remoter locations to run several plant clinics in quick succession. They visited different areas two or three times a year in response to local requests.

A university diagnostic laboratory in Butembo, North Kivu analyses plant specimens and human samples (though safety procedures are lax). Plant clinics in Nepal organised by SECARD, an agricultural NGO (Adhikari *et al.*, 2013), mobilised female farmers linked to a partner NGO working in livestock. The Nepali clinics carried out simple soil tests while SECARD integrated plant clinics into its programmes on organic farming.

Concerns have been raised about the knowledge and qualification of extension workers to deal with 'any crop, any problem'). Similar concerns are expressed about primary healthcare in rural locations (Tollman *et al.*, 2006). In Nicaragua the plant doctors – local extension officers – asked for more diagnostic support. Discussions led to ideas about a 'plant health system', where extension, diagnostic services, research and input supply were better connected and worked more closely together (Danielsen *et al.*, 2013). The Plantwise programme of CABI is now taking forward the plant health system approach by strengthening service delivery, plant health information systems (Leach and Hobbs, 2013) and linkages between key actors in developing countries (Romney *et al.*, 2013).

The shift from services to system thinking was a natural consequence of thinking about plant health from a wider perspective. With the expansion in numbers of organisations and countries running plant clinics[x], it became increasingly necessary to consider the wider policy, institutional and organisational implications of providing primary plant health services, and to identify tools and methods to measure outcomes and provide guidance on future interventions.

The WHO health systems framework from 2007 was adapted to plant health (Fig 1) and used in Uganda for measuring performance of plant clinics (Danielsen *et al.*, 2012). The resulting Plant Health Systems (PHS) framework is a work in progress and needs wider testing and validation as well as agreement on ultimate (plant health) outcomes.

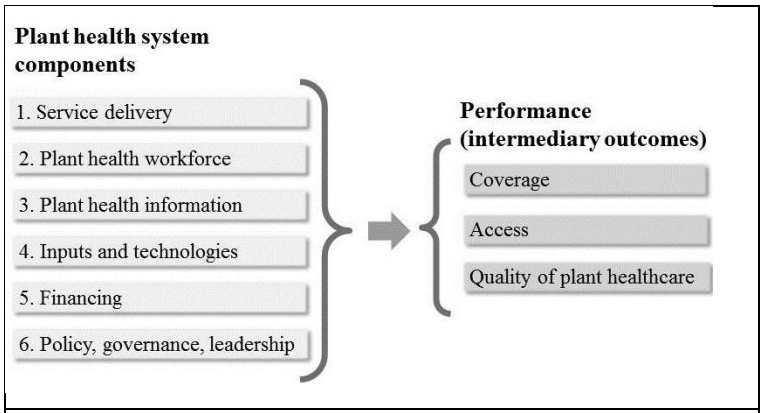

Fig 1 Plant health system framework (Danielsen *et al.*, 2012)

The PHS framework is a good example of cross-sectoral learning, sharing ideas and insights gained from human health. The framework emphasises the importance of service delivery as well as policies, governance and financing, three topics which would normally receive little attention in crop protection.

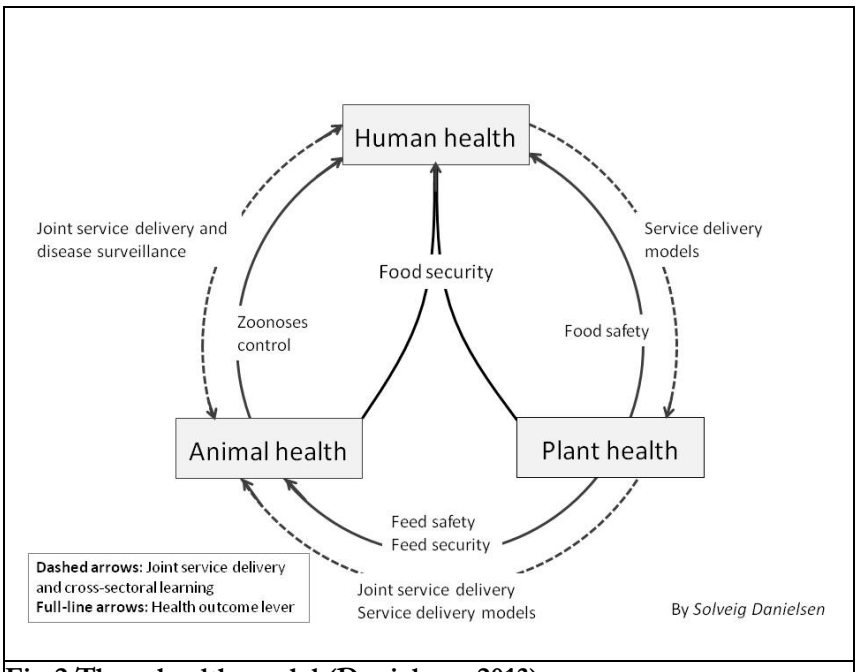

Fig 2 Three health model (Danielsen, 2013)

The PHS framework has been used to develop a three health model (3H) for plants, people and animals shown in Fig 2 (Danielsen, 2013). In its simplest reading, the 3H model is a way of showing links, dependencies and interactions between the different health sectors. It highlights important influences on food security (animal and plant health), for example, and the overall role of plant

health in determining human health. The model has other potential uses, for example highlighting the need to coordinate disease surveillance across all health sectors, as well as the potential benefits of joint service delivery.

The 3h model emphases service delivery and exposes gaps in thinking about how to manage plant diseases at field level and organise extension services. One of the most important conclusions, however, is to show the inter-relatedness of different health sectors and to emphasise the need to expand cross-sectoral actions.

6 A tripartite approach to plant, human and animal health

Plant health is already part of general debates on human health, animal health, agriculture, nutrition, ecosystem health and so on but there is little evidence of active engagement with other sectors. Practical suggestions on how to implement a tripartite approach that includes plant health are scarce and new ideas need testing.

A decade's work on plant clinics in more than 30 countries is helping to strengthen links and widen partnerships through a plant health system approach. A better understanding of how extension is organised and institutions function has identified opportunities to link different groups of people with shared interests but who often struggle to work together. This helps to pave the way for tripartite approaches to health.

The MDGs have raised aspirations to 'alleviate poverty' and increased the importance for cross-sectoral actions. Complex problems demand complex responses, and, as this chapter has attempted to show, plant health has an important contribution to make in addressing big issues. But first there must be better integration within plant health, with closer working ties between pre- and post-harvest control of pests and diseases and soil fertility and crop protection, for example. This is an essential pre-condition for embedding plant health more clearly in OH and in preparation for new development goals for agriculture and human health (Independent Research Forum, 2013).

Plant clinics have articulated farmer and extension demand and stimulated new actions and partnerships which give greater coherence to plant health. Human health systems thinking has helped to develop a framework for measuring performance of plant clinics and understanding better how to strengthen plant health systems. Plant clinics have an important contribution to make in catalysing actions, stimulating partnerships, understanding the weaknesses and strengths of extension, improving surveillance, linking to diagnostic services and input supply.

The PHS framework noted in the previous section still lacks long-term outcomes and indicators of success. These are important to assess the high expectations of the Plantwise programme (Romney *et al.*, 2013), for accountability as well as learning and improvement. Learning from human health systems has been critical in the transition from services (plant clinics) to systems, paying more attention to the delivery of primary plant healthcare. Ideas from agricultural extension on seeking 'best fit' rather than 'best practice' also need to be considered (Birner *et al.*, 2005) also need to be considered. All this is a long way from IPM and crop protection, but without a wider focus and perspective on plant health little will change in how extension operates or impact on farmers and beyond.

Plant clinics have a wider role to play in general agriculture and human health, as noted previously: example include diagnosis of pesticide poisoning and giving advice on safe use of pesticides, as well as planting nutritious crops. Advice on plant and animal health could been given at the same location. More plant samples could be diagnosed by medical and veterinary services. Adding new services and features to plant clinics will, however, require careful planning, additional training and better backstopping (Franzo *et al.*, 2013).

SIDAI is a donor-funded attempt[xi] to improve the quality of advice on animal health through an agrodealer franchise operation in Kenya. The same agrodealers sell fertilisers and pesticides, which constitute 40% of their business. Although there is concern that agrodealers give biased advice on

plant health problems to promote sale of pesticides, work in Bangladesh has shown it is possible to create effective partnerships with plant clinics (Kelly *et al*., 2008).

Another suggestion is to run plant clinics in parallel with maternity clinics. Many women are important producers and would benefit from advice on crops that would improve nutrition (von Braun *et al*., 2012). Village meetings or training events are opportunities to hold plant clinics. Plant clinics could play a stronger role in giving advice on post-harvest problems to reduce accumulation of mycotoxins. All these ideas need to be tested to see if they work and how they are best adapted to different places and contexts.

Unpublished research in Uganda (Haesen, pers. comm.) compares service delivery through village health teams and plant clinics. There are similar challenges in paying staff and ensuring that the most serious illnesses and unknown problems are referred on to a reliable source, but there are also clear opportunities for human health and plant health to work more closely together.

A concise summary of (human) health systems (Mills, 2007) illustrates the challenges, opportunities and above all contributions made by effective primary healthcare. The opening paragraph could just as easily apply to plant health:

> "The term 'health system' is a shorthand way of referring to all the organisations, institutions and resources that are primarily concerned with improving health in a particular country. They ensure the provision of preventive, rehabilitative, curative, and other public health services, as well as the generation of the financial, physical, and human resources needed for service provision. Most importantly, health systems also encompass the management and governance arrangements that help ensure efficiency and equity in provision of service, responsiveness to patient needs, and accountability to communities and the broader society."

There are other opportunities for joint service delivery involving plant clinics, reducing costs, increasing coverage and access to advice on crop protection as well as other topics. The farmer 'demand' for advice on mycotoxins is weak – to the best of our knowledge no queries have been received by plant clinics – yet the fundamental solutions to this human health liability lie in agricultural practice. A doctor will treat the symptoms of mycotoxin and other plant-related poisonings, but will not give advice on how to treat the root cause.

There have been other suggestions to promote tripartite approaches (Fletcher *et al*., 2009) and there are existing links between the health sectors. But much more could and should be done to establish a stronger role for plant health in OH, and exploiting new opportunities to improve health outcomes for all.

A unified vision of health and healthcare is a powerful concept for tackling the complex challenges implicit in the MDGs and the new sustainable development goals. The 3H model is an important starting point for integrating plant health into OH. But it will require careful testing of assumptions about creating cross-sectoral collaborations, as well as new methods for assessing jointly agreed outcomes if the model is to bring about demonstrable and measurable change.

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