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CABI plantwise

Changes in plant health system performance and responsiveness in Nepal: Stakeholder perceptions

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Photos

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Cover photos

Farmers receiving diagnosis and recommendations at a plant clinic in Biratnagar

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Acronyms

ADO	Agriculture Development Officer
ADS	Agricultural Development Strategy
AICC	Agricultural Information and Communication Centre
CABI	Centre for Agriculture and Biosciences International
CDD	Crop Development Directorate
DADO	District Agricultural Development Offices
DOA	Department of Agriculture
DoAE	Directorate of Agricultural Extension
FAO	Food and Agriculture Organisation of the United Nations
FAS	Farmer advisory services
FDD	Fruit Development Directorate
FFS	Farmer Field Schools
FGD	Focus group discussion
GAP	Good Agricultural Practices
GoN	Government of Nepal
HICAST	Himalayan College of Agricultural Sciences and Technology
INGO	International Non-Governmental Organisation
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
KII	Key informant interview
LI-BIRD	Local Initiatives for Biodiversity, Research, and Development
M&E	Monitoring & Evaluation
MOAD	Ministry of Agricultural Development
NARC	Nepal Agricultural Research Council
NGO	Non-Governmental Organisation
NITTR	National Institute of Technical Teacher Training & Research
NPPO	National Plant Protection Organization
NPR	Nepalese Rupee
NRO	National Responsible Organization
NSPM	National Standards for Phytosanitary Measures
PHS	Plant Health System
PMDGs	Pest Management Decision Guides
PMAMP	Prime Minister Agriculture Modernisation Project
POMS	Plantwise Online Management System
PPD	Plant Protection Directorate
PPO	Plant Protection Officer
RBPR	Rapid Bioassay of Pesticide Residue
RPPL	Regional Plant Protection Laboratories
SECARD	Society for Environment Conservation and Agricultural Research and Development
SL	Soluble Concentrate
SPS	Sanitary and phytosanitary systems
ToC	Theory of Change
WDG	Water Dispersible Granules
WHO	World Health Organisation

Executive summary

Introduction

This report presents the findings of a study on the effect of Plantwise on the performance and responsiveness of the plant health system (PHS) in Nepal. In September 2017 a one-day workshop with PHS stakeholders was followed by a two week period of interviews with PHS stakeholders as well as farmers, in six different districts in the Central, Western and Mid-western Regions of Nepal. The qualitative data collected were used to explore changes in the PHS since the start of the Plantwise programme in 2011, and the underlying drivers of those changes, including the effects of Plantwise. The PHS functions are defined as: 1. Farmer advisory services; 2. Plant health information management; 3. Diagnostic services; 4. Research and technology development; 5. Input supply; and 6. Policy, regulation and control. This report is structured according to these functions.

After initial plant clinic activities in 2008, and a pilot with mobile clinics in 2011, CABI and the Plant Protection Directorate (PPD) informally agreed to incorporate the plant clinic concept into the then prevailing agricultural extension activities. In 2013, they signed a formal partnership agreement. The Government of Nepal (GoN) also formally nominated the PPD as the national body responsible for providing plant protection services, which included the implementation of Plantwise activities.

The first years focused on strengthening farmer advisory services, plant health information management, and diagnostic services, with the PPD managing these services according to Plantwise principles. The time might now be ripe to strengthen and improve the links between the other PHS functions further: research, input supply, and regulation.

Farmer advisory services

The biggest change reported by PHS stakeholders was the increased knowledge and capacity of extension officers to provide plant health advice, which they attributed to Plantwise plant doctor training. The plant doctors valued their enhanced self-esteem and confidence in their new role, and farmers appreciated the increased access to advisory services, in terms of both quality and accessibility. However insufficient staff numbers in PPD has become a constraint to further scale up. One way to address this has been to train more Farmer Field School (FFS) farmer facilitators as plant doctors.

Plant health information management

PHS stakeholders felt that the changes in plant health information management had resulted in improved documentation of relevant data on plant health. The Plantwise programme contributed to increased access to and/or the development of quality reference materials, e.g. the Plantwise knowledge bank, fact and photo sheets, pest management decisions guides, etc. The management of plant clinic data in POMS was also considered to contribute to improved plant health information management, especially since the introduction of e-clinics, with direct data entry on to tablets. Clinic data validation has been a constraint but is now being tackled by teams comprising pathologists, entomologists and extension officers.

Diagnostic services

The major changes with regard to improved diagnostic services concern the speed and effectiveness of diagnosis due to a combination of improved knowledge and skills (plant doctor trainings) and faster communication tools (e-Clinics, mobile phones, Telegram messenger groups, Internet). This has resulted in improved coordination between diagnostic and advisory services.

Research and technology development

The link between extension and research, including institutes like the Nepal Agricultural Research Council (NARC), is improving. Plantwise modules have been included in the regular training programmes of the GoN as well as in the curriculum of the Himalayan College of Agricultural Sciences and Technology (HICAST). Both NARC and the Directorate of Agricultural Extension (DoAE), acknowledge the use of POMS data to support reporting, planning and surveillance. They also advise on the development of information and reference materials and diagnostic tools.

Input supply

PHS stakeholders considered the increased demand for and supply of safe pesticides, including bio-pesticides and botanicals, to be a key result of growing awareness about safe pest management. They also reported increased agricultural productivity but did not attribute this to safe pesticide use only, but also to other changes in agricultural input supply such as the provision of quality seed and fertiliser. There was a perception among farmers that better pest management resulted in both lower input costs and increased productivity.

Policy, regulation and control

Changes in plant health policy and regulation have accelerated since 2013, when plant health became an integral component of Nepal's agricultural extension system. Policies and structures are being revised and amended, and new policies drafted, to improve regulation and control. Although Plantwise is not the only driver of the changes in policy and regulation, it is seen as a major contributor to ongoing changes by feeding knowledge and information into the system.

PHS stakeholders consider all recent changes in plant health governance to be related to the formal enactment of the PPD as National Plant Protection Organization (NPPO) in 2013. In a country with 65% of the population engaged in farming, the GoN acknowledged it was necessary to invest more in extension to raise farmers' awareness and capacity to manage plant health. As plant protection had traditionally fallen under the PPD's mandate, the choice was readily made to partner with this directorate and make it responsible for the facilitation of the plant clinic approach, in addition to the regular agricultural extension services.

Challenges

Nepal encounters various infrastructural, institutional and contextual challenges which, to a greater or lesser extent, influence PHS functioning. The farmer advisory function is constrained by lack of trained staff to conduct plant clinics in remote districts. The Plantwise data management system sometimes suffers from connectivity or software problems which limit its effectiveness for plant health information management. Diagnostic services may not have capacity to identify new pests, or adequate laboratory facilities. Research and technology development could be better aligned with plant protection on the ground by incorporating more Plantwise modules in the curriculum of agricultural colleges, and by strengthening research infrastructure and coordination with advisory services. The supply of agricultural inputs could be improved by providing local input suppliers with equipment and training to enable them to offer safe pesticides. The open borders in Nepal allow easy transmission of pests and diseases, so strong SPS mechanisms need to be in place to address the risk of pest incursions.

The massive earthquake of 2015 not only impacted people's personal lives but also affected institutional functioning, including the operation of plant clinics in the affected areas.

PHS performance and responsiveness

This study identified drivers of change which had led to, or are leading to, improved PHS performance. These include changes at local level, such as improved, timely and easy access to farmer advisory services; and at national level such as the country incorporating the plant clinic approach in its budget for agricultural extension; the GoN making use of the plant clinic structure to reach farmers who were recently hit by the intense floods in the Terai region by financially supporting the clinics in this region; connecting plant clinics to the wider ambitious agricultural modernisation project established by the GoN in 2016; the deployment of farmers in extension activities; and strengthened and/or revived linkages between organisations and institutions working on crop protection.

Lessons learned

While the improved PHS performance is obviously the result of a combination of factors (high level political buy-in of GoN, opportune timing, changing agricultural production systems), the study suggests that the enhanced collaboration between the PPD and CABI Plantwise since 2011 has had a catalysing effect. A core team of both PPD and CABI staff was dedicated to implement Plantwise activities and bring advisory services closer to increasing numbers of farmers. Farmers feel that their awareness on the use of safe pest control has increased since they attended plant clinic sessions. It took a period of 4-5 years to establish and develop the plant clinic system, for which the financial management now lies mainly with the PPD. Despite a period of stagnation due to external setbacks (the 2015 earthquake and political blockade), recent developments (e-system, new laboratory infrastructure, policy amendments, creative and efficient staff deployment, strengthened institutional linkages) show the commitment of many stakeholders to improve the plant health system of Nepal. It is estimated that it will take another 7-8 years for increasing numbers of farmers within the entire country to benefit from improved pest management promoted through a strengthened plant health system.

1. Introduction

1.1 Background to the study: the Plantwise programme

Plantwise is a global programme led by CABI since 2011, which works to help farmers reduce crop losses related to plant health problems. The objective of Plantwise is to enable farmers around the world to lose less, produce more and improve the quality of what they grow. To achieve this objective, Plantwise focuses on strengthening systems for providing plant health advice to smallholder farmers through three core and inter-related interventions:

- **Plant clinic networks.** Working with existing extension providers to implement networks of plant clinics to support farmers in solving biotic (pests, diseases and weeds) and abiotic (e.g. nutrient deficiencies, drought) problems where there is the greatest need. Inclusive aspects such as equality and equity drive the efforts to support the delivery of services to farmers in an equitable manner: women and men, young and old, regardless of their social and ethnic background.
- **Systems for management and use of plant clinic data (POMS)** and **provision of plant health information (Knowledge Bank).** Supporting the establishment of appropriate systems and procedures for managing plant clinic data and providing plant health information which enable the proactive use of data and information for operational and strategic purposes at local and national levels.
- **A systems approach.** Working with key stakeholders to improve the capacity and responsiveness of national plant health systems by strengthening linkages between agricultural service providers, diagnostic services, plant health regulatory bodies, research and training institutes, input suppliers and private extension.

The Theory of Change (Fig. 1) reflects the systems approach upon which Plantwise is based. Plantwise as a change agent aims to strengthen the linkages between the different system components within the countries, leading to the following outcomes: (1) larger numbers of farmers having access to reliable plant health information; (2) rapid identification of new and emerging pests; and (3) increased accountability of organisations to farmers. All this is expected to strengthen national response systems to plant health threats, thus increasing agricultural productivity and ultimately achieving developmental impact through improved livelihoods and greater food security.

The aim of this study is to assess to what extent the Plantwise intervention has brought about change in the plant health system performance and responsiveness in Nepal, and to contribute towards the development of a generic plant health system assessment framework.

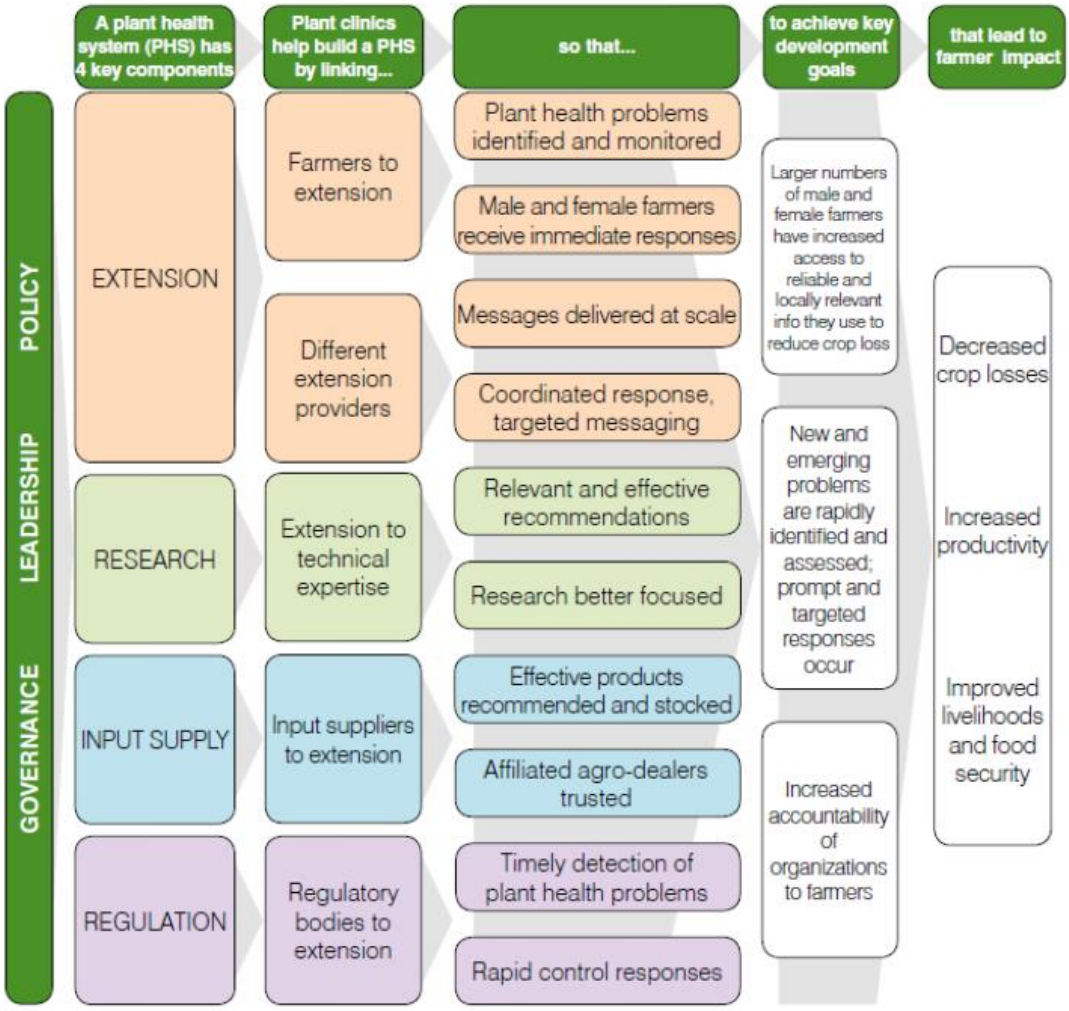

Figure 1. The Plantwise Theory of Change. Source: CABI Plantwise strategy 2015-2020

1.2 Agricultural development in Nepal

With 65% of the people in Nepal engaged in farming, and agriculture accounting for one third of the gross domestic product, agriculture is a major source of income. Population growth has led to decreasing average farm sizes as there is little scope for expanding the cultivation area. Agricultural productivity and returns remain low at USD 140 per capita (Plantwise, 2015). Hence, the Government of Nepal (GoN) highly prioritises agricultural development. Falling under the Ministry of Agricultural Development (MOAD), the Department of Agriculture (DOA) aims to achieve food security and poverty alleviation by transforming agriculture through diversification and commercialization (sources: interview notes and several web links: DOA Nepal; The Himalayan Times online; Government of Nepal, Office of the Investment Board; Prime Minister Agriculture Modernisation Project).

An ambitious effort in this respect is the Prime Minister Agriculture Modernisation Project (PMAMP) implemented in 2016-2017. It aims to enhance (commercial) domestic agricultural production through, among other things, support to smallholder farmers with the supply of agricultural inputs and agricultural extension services (interview notes; The Himalayan Times online).

1.3 Institutional background to the plant health system of Nepal

Agricultural extension has traditionally been dealt with by the Directorate of Agricultural Extension (DoAE), which is one of the twelve DOA directorates. DoAE uses several models and approaches for extension and technology transfer to farmers (DoAE, 2017).

The Plant Protection Directorate (PPD) has long been the DOA directorate responsible for all plant protection services (policies and implementation). Plant protection in Nepal is mainly guided by the regulations enshrined in the Plant Protection and the Pesticides Act, and by frameworks such as the National Standards for Phytosanitary Measures (NSPM), used by the PPD for pest risk analysis and other issues related to SPS. The Directorate operates the national plant quarantine programme, and is responsible for pesticide residue analysis, pesticide registration and for the recruitment and appointment of plant protection officers (PPOs). Since 1995, there has been least one PPO – also operating as the pesticide registrar - in each of the 75 districts of Nepal. Prior to the establishment of plant clinics through Plantwise, extension on plant protection was carried out by PPOs with a focus on IPM, for which advice and training were incorporated in Farmer Field Schools (FFS), with financial support from FAO.

Given the mandate of PPD and to comply with the International Plant Protection Convention (IPPC) requirements, GoN designated the PPD as the National Plant Protection Organization (NPPO) in 2013. The Directorate is responsible for the national plant quarantine programme, pesticide registration, and related issues.

1.4 Plantwise in Nepal

The first plant clinic activities in Nepal date back to 2008 when plant clinics were conducted under the former CABI Global Plant Clinic project, the precursor of the current Plantwise programme. NGOs were the implementers while CABI provided technical backstopping. It resulted in the establishment of the first mobile clinics on a pilot basis in Lamjung district. At that time the PPD was not involved.

The idea of bringing advisory services closer to farmers and increasing their outreach led to an informal agreement between CABI and the PPD to incorporate the plant clinic concept into the then prevailing agricultural extension activities in 2011. In 2012, more than 70 PPD staff were trained as plant doctors using the CABI training modules to establish a cadre of plant doctors. A toll free number for Farmer Advisory Services was also set up in 2012. Thirteen one-time well-received plant clinic sessions were held. The PPD and CABI considered this a successful “proof of concept” to continue to run plant clinics as part of the country’s plant health system.

The PPD is the main collaborating partner of Plantwise in Nepal, having signed an official agreement of collaboration with CABI in 2013. Since then the overall financial management for the operation of plant clinics lies mainly with the PPD, with CABI providing technical backstopping. The GoN has allocated a budget to the PPD to operate plant clinics based on the Plantwise model. By the end of 2014, 35 clinics were being held on a monthly basis in 34 districts, eleven of them funded by the GoN. In 2015, the total number of clinics increased to 41 in 40 districts. However, the massive earthquake that hit Nepal in 2015, followed by a political blockade by India, resulted in 70% of the clinics remaining inactive for much of the year. In the latter part of the year some but not all of the clinics re-started but 20-25% of

them were permanently discontinued. The aftermath of both the earthquake and the political instability was still felt in 2016. The PPD managed however to establish five new clinics in five new districts, bringing the total up to 45 (out of which 34 were supported by CABI). However, due to staff challenges, e.g. retirements or transfers, only 36 plant clinics in 32 districts were in regular operation in 2017.

2. Methodology

The conceptual framework and methodology for this study are described in the inception report (Posthumus and Sluijs, 2017). In this chapter, the specific methodology used in Nepal is described in brief.

2.1 Defining the plant health system

The study uses the following definition of a plant health system: “A plant health system consists of all organizations, people and actions whose primary intent is to promote, restore or maintain plant health” (Danielsen and Matsiko, 2016; after WHO, 2007). A plant health system performs the following functions (Table 1):

Table 1. Plant health system functions (Williams et al., 2015)

#	Function
1	**Farmer advisory services** Agricultural extension, advisory services incl. print and multimedia (radio, TV, helplines, ICTs); Training and extension approaches (plant clinics, on-farm demos, FFS, field days etc.);
2	**Plant health information management** Approaches and structures of providing plant health information to relevant actors at local and central levels; Resources, departments; pests lists, published information; Information management systems, including plant clinic data management and use, etc.
3	**Diagnostic services** Diagnostic facilities and expertise for diagnosing plant health problems incl. pests, diseases, soil health problems and nutrient deficiencies; Referral systems
4	**Research and technology development** Universities, research institutes and research stations that take part in technology development. Farmer participatory technology development and validation of indigenous practice. Private sector research e.g. breeding companies.
5	**Input supply** Supply of agricultural inputs (seed, pesticides, fertiliser, biocontrol products etc.); Public, NGO and private suppliers; Importers, breeders, distributers, local agro dealers and community schemes; Subsidy schemes for farmers on agriculture inputs.
6	**Policy, regulation and control** Crop protection; Quarantine and border control; Surveillance; Certification (e.g. seed, pesticides); Registration; Quality control of inputs, import and export; Policies supporting PHS functions.

The key actors within each function were previously identified during a stakeholder workshop held in 2016 (Plantwise, 2015). These are listed in Annex 4.

Well-operating PHS functions are supporting the system's **performance** and **responsiveness**. Health system performance and responsiveness are described in different ways in the literature. While there are similarities and overlaps, there are no commonly agreed assessment frameworks and criteria. Choices depend on purpose, perspective and what is feasible in a particular setting. Broadly speaking, performance measurements seek to monitor, evaluate and communicate the extent to which various aspects of the health system meet their key objectives (Smith et al., 2008), while responsiveness is how well the health system meets the legitimate expectations of the population (Derby et al., 2000). Challenges in particular parts can have ramifications in other parts of the system (Mutale et al., 2013).

The following indicators were used in this study to assess the performance and responsiveness of the PHS. These are from now on called key performance indicators (KPIs):

- **Timeliness** – is the service or good delivered in time (i.e. when required by user) without unnecessary delays?
- **Availability and accessibility** – is the service or good available and accessible to the users? Are certain groups excluded (because of gender, ethnicity, literacy level, status, distance, etc.)?
- **Affordability** – is the service or good affordable to the users? Do users perceive it is good value for money?
- **Acceptability** –is the service or good acceptable to the user? Is it relevant, effective and appropriate?
- **Coherence** – to what extent is the service or good aligned with goods and services in other PHS functions or other policies and practices?
- **Reach** – how many users does the good or service provide coverage for, and how many users access the good or service?

The respondents' narratives of change were used to assess the indicators qualitatively.

2.2 Research methods & tools

System change cannot be understood by looking at outputs (performance and responsiveness) only, but requires an understanding of the underlying structures, processes and functions of the system. In this study, system change was assessed based on stakeholders' narratives; where applicable, supporting evidence was also collected. The study explored the views of PHS stakeholders and beneficiaries (farmers) concerning major changes in each of the six PHS functions in recent years, how these changes came about and how that influenced the performance and responsiveness of the system. The methodology is embedded in qualitative and primarily inductive research, rather than testing theories through deductive methods.

2.2.1 Tracing the narrative of PHS change

The ways in which the Plantwise programme has influenced and effected change in the plant health system of Nepal was explored, firstly, through key informant interviews with CABI staff (e.g. country coordinator) and staff of the national implementing organisation(s) (or National Responsible Organisation – NRO) of the Plantwise programme. The areas explored were based on an M&E framework for human health systems described by Witter et al. (2013). Adapting this framework to this study resulted in the following domains that were considered when tracing PHS change from the perspective of Plantwise:

1. **Context:** What is the context and how does it influence the implementation of Plantwise?
2. **Policy formulation:** How was Plantwise introduced and rolled out?
3. **Design features:** How was Plantwise intended to affect the PHS in Nepal?
4. **Implementation:** How does the ToC compare with practice (de jure design vs de facto practice)?
5. **Plant Health System effects:** What are the effects of Plantwise on the PHS functions?

Next, a range of PHS stakeholders, as well as beneficiaries of the PHS (smallholder farmers) were asked to describe the major changes that had occurred in recent years. To trace changes in the PHS and the drivers and pressures that triggered the change, the study loosely followed the methodology of "outcome evidencing" which has been developed to evaluate programme interventions in complex systems (Paz-Ybarnegaray and Douthwaite, 2016). The method was adapted for the purpose of this study, as depicted in Annex 1.

The changes may have been triggered by various drivers and pressures including: 1) contextual changes; 2) changes in the social system (the constellation of stakeholders, their actions or interactions between them); and 3) changes in the system building blocks, including workforce, finance and governance/ leadership (adapted from WHO, 2007)

2.2.2 Qualitative data collection in Nepal

Over a period of two weeks the study collected qualitative data through a one-day workshop with PHS stakeholders, key informant interviews (KIIs), group interviews (of 2-4 respondents with similar roles), and focus group discussions (FGDs) (see Annex 2).

Stakeholder workshop

In a participatory workshop held on 12th September 2017, a group of 26 stakeholders representing the six different PHS functions identified PHS changes and placed these on a timeline covering the period of 2011-2017. They discussed the drivers/triggers behind these changes and assessed PHS performance and responsiveness against the KPIs mentioned in section 2.1. The result was a 'colourful snapshot´ which summarised the history of plant protection activities in Nepal at a glance. The year 2011 was chosen as a starting point for drawing the timeline as that was when Plantwise started activities and when plant clinics were incorporated in the agricultural extension programme in Nepal. The stakeholders' views

on PHS performance and responsiveness were triangulated with project documentation (e.g. annual reports, M&E data), anecdotal evidence, KIIs and the focus group discussions (see below).

This workshop could be considered a sequel to the stakeholder analysis workshop of July 2015 in which key stakeholders were identified for each of the six PHS functions (Plantwise, 2015). This time the same PHS stakeholders were invited to identify major changes in the PHS functions and assess the effects of these changes on the PHS. A description of the workshop process and an overview of the participants as by PHS function are given in Annex 3. The stakeholders that were considered as part of the system are given in Annex 4.

A first assessment of changes in the Plant Health System during the workshop was followed by two weeks of interviews and group discussions to discuss this more in-depth

Workshop participants discussing PHS changes.

Focus group discussions and key informant interviews

National level PHS stakeholders and farmers

At PPD Headquarters, in-depth individual interviews were held with:

- the PPD Programme Director, with overall responsibility for the Plantwise programme in Nepal
- a senior PPO, responsible for coordination and facilitation of Plantwise training modules; and data harmonisation and validation
- a PPO, responsible for facilitation of Plantwise training modules (1,2 and development of extension materials); and supporting data harmonisation and validation
- the CABI Plantwise country coordinator, responsible for implementation of the Plantwise programme in Nepal.

District level PHS stakeholders

At district level, the majority of respondents in FGDs and KIIs comprised PPOs at different levels (technician, junior and senior) who operate as plant doctors through District Agricultural Development Offices (DADO).

Also interviewed were farmer facilitators, who were trained in Plantwise modules 1 and 2, and who currently run some of the plant clinics, and farmers. All interviews were carried out face-to-face in a public setting, mostly at the locations where the plant clinics are normally held. In most districts the interviews with farmers were held in Nepali as the respondents were not conversant in English. An overview of the various PHS stakeholders in six different districts within central, western and mid-western regions can be found in Annex 8.

3. Findings

The findings are presented according to the six plant health system functions defined in Table 1. This chapter describes the **changes in the PHS, the drivers** behind these changes and the **key results** from 2011 to 2017 according to the views of Plantwise staff and PHS stakeholders. It also discusses challenges and opportunities relating to each function, and the linkages between them.

3.1 Farmer advisory services

Respondents observed a number of major changes related to farmer advisory services. A fundamental change is that plant health and safe pest management have become increasingly important in agricultural extension over the past 7-8 years. Plant health was formerly just one component of agricultural extension (alongside technology transfer, agronomic practices, and pesticides inspection). The haphazard use of chemical pesticides, an increased awareness of health hazards, and the acknowledgement that the piloted plant clinic operations led to increased farmers' awareness on safe pest management were said to be drivers for the Nepalese government to focus on the full integration of plant health in agricultural extension.

The individual scoring exercise (see Step 3, Annex 3) found that performance of farmer advisory services had improved from 2011 to 2017 with regard to all six KPIs (timeliness, availability, affordability, acceptability (quality/effectiveness), coherence (compatibility with farmers' practices) and reach). Key improvements are in the quality of service delivery to farmers (through well-trained plant doctors), and in outreach to farmers (data not shown).

A plant doctor at work, in Kavre, Nala.

Both farmers and other stakeholders reported more efficient and more effective pest management since the introduction of plant clinics. Farmers appreciate the regularity of clinic sessions (once a month and at a set time), as well as the immediate diagnosis and prescription that was received at the clinics (in 95% of cases). In cases where a sample has to be sent to a lab for diagnosis, recommendations are sent via SMS, as most farmers possess a mobile

telephone. The use of ICTs thus contributes to timeliness by enabling the farmer to start treatment as soon as a diagnosis is confirmed.

All farmers report that the plant clinics had increased the accessibility of advisory services. They appreciate this, and also report an increased awareness in safe and timely pest management since they have been attending plant clinics. They used to consult agro-vets at the moment that pest infestation became visible, but did not bring plant samples. This sometimes resulted in the random and combined application of pesticides and fungicides without proper diagnosis (FGDs in Kavre and Gothikel). Nowadays, farmers take plant samples to the clinics for proper diagnosis and the right pest management prescription, resulting in more cautious use of pesticides. They now know when (at which cropping stage) and how (with GAP, bio-control agents, bio-pesticides and fungicides) to manage pests, and value these prescriptions for proper treatment.

To gain access to advisory services outside official clinic sessions, farmers can also visit plant doctors during district office hours, or plant doctors visit farmers at home. In addition, an unknown number (due to an administrative delink between the national and district system) of mobile plant clinics are run by district level staff conversant with the Plantwise modules.

Availability of farmer advisory services relates to aspects of inclusiveness. Age, ethnicity and level of education do not exclude people from access to services (Box 1). Plant doctors in Kavre reported that in practice most customers visiting a clinic were aged 30-55, both men and women. Illiterate farmers were being briefed by their literate fellow-farmers. A PPO at PPD headquarters pointed out that availability of services had increased for those farmers who were able to attend plant clinics. In the districts in which plant clinics are non-existent or yet to be established the availability of services stayed the same as before. The ambition of GoN and the PPD as NPPO is however to increase this to cover the entire country over the coming years.

Box 1 A senior PPO at PPD headquarters referred to the inclusive approach applied by CABI/PPD with regard to the provision of advisory services**.** *"There is absolutely no restriction to anyone to attend plant clinics. And when you look at people who actually attend plant clinics you will notice a near-balance between female and male visitors. Very rarely it occurs that there will be more male than female persons attending a clinic, in places for instance where women are not so much outgoing for cultural and religious reasons".*

With regard to affordability, many stakeholders noted that free agricultural advisory and diagnostic services have always been provided. However both quantity and quality of services have increased (more clinics, and a greater variety of safe pesticides), delivering better value for money for farmers. Stakeholders perceived the increased awareness of farmers on safe pest management through plant clinics combined with the farmers' request to the government for more plant health services as a sign that the plant clinic approach was accepted. This led to an increase in investments in agricultural extension and the adoption of the plant clinic approach as an extension tool by the GoN.

The introduction of the e-plant clinic system in April 2017, in which the plant doctors enter data directly on to tablets, was considered another major change, further facilitating farmer advisory services and improving the timeliness of advice: if a plant doctor cannot make the diagnosis immediately, a picture is easily sent via the Telegram SMS system to consult fellow plant doctors. Other advantages of e-clinics which contribute to the timeliness of plant

health advice include easy access to plant health resources (Knowledge Bank fact sheets, web resources) and the simplification of plant health data collection and storage (see also Section 3.2).

The fact that GoN appreciates plant clinics as an efficient and effective approach to reach farmers is demonstrated by its decision to invest an extra one-off amount of ten million NPRs (USD 96,787) to enable the plant clinics to advise the farmers on crop protection in the Terai regions which suffered from the August 2017 floods.

3.1.1. Plant doctor training

Strengthening extension services also includes the training of plant doctors. Since the GoN is funding the PPD to facilitate and improve plant protection country-wide, the financial contribution that Plantwise makes to strengthen advisory services is restricted to the facilitation of technical support, i.e. training and capacity building. Since 2012, 300 PPD staff have been trained according to the Plantwise model, including 140 agricultural technicians and 160 PPOs (Table 2). In addition, due to staff shortages in PPD and to further scale up the reach of the plant clinic model, 38 farmer field school (FFS) facilitators were trained to run 120 plant clinic sessions during 2016-17 in four districts.

Table 2. Training of plant doctors

People trained	2012	2013	2014	2015	2016	2017
Agricultural technicians (PPD)		20	20	25	50	25
Plant Protection Officers (PPD)	15	25	50	25	25	20
FFS farmer facilitators					18	20
Total	**15**	**45**	**70**	**50**	**93**	**65**

Source: workshop 12th September 2017

Plant doctor training has contributed to increased quality of farmer advisory services. The availability of Internet, the existence of the Plantwise knowledge bank, the existence of information management systems, access to POMS, and enhanced data validation, have all helped plant doctors to deliver reliable plant health information. Plant doctors also feel increased self-esteem and confidence and appreciate their role as being the first contact for farmers to inform them about safe pest management. They are ambitious in reaching more farmers which they see currently being inhibited due to the lack of clinics at ward level. They would further prefer to receive more, and more regular, Plantwise trainings to be able to deliver the full package of plant clinic services (including data management). It is not only the PPD improving farmer advisory services on plant health through plant clinics: NGOs such as SECARD and Caritas also provide (mobile) clinic services making use of the Plantwise modules.

3.1.2 Related advisory services

Other ways in which Plantwise has encouraged an expansion in the advisory services offered to farmers include: the provision of a toll free number for technical advice in 2012 so that farmers can obtain free-of-charge advice; the establishment of laboratory services at community level in 2013; the introduction of “no-pesticides-week”, and the emphasis on

good agricultural practice (GAP) in 2014. An increased use of smartphones by farmers led to the development of mobile applications in 2015, to further facilitate access to technical advice. The same year saw the start of pest and disease forecasting through bulletins issued by the AICC for dissemination to farmers, started.

Farmers in Kavre asked whether there was not an app which they could use themselves to send pictures of their infested crops to be diagnosed by plant doctors “online”.

Plant doctors in Kaski (Pokhara) double checking their diagnosis.

3.2 Plant health information management

An integral element of the Plantwise model is the provision, management and use of information tools. The main positive change for this function has been the improvement in the documentation and distribution of plant health information. On the one hand, the quality of the information has improved through training of plant doctors and ICT developments facilitating the management of plant health data. On the other hand, there has been increasing attention to dissemination of plant heath information to farmers through a range of new and improved information materials such as pest management decision guides.

The stakeholders’ individual scoring exercise, in the workshop, found that plant health information management had improved from 2011 to 2017 with regard to all six KPIs, particularly with regard to reach. A major improvement has been in management and documentation of plant health data (data not shown).

3.2.1 Data management

With the introduction of the plant clinics in 2012 the way in which plant health information was managed and disseminated changed. Plant health information is now channelled in an increasingly focused manner. Plant clinic data is uploaded monthly to POMS, facilitating the monitoring of regular pests and forecasting emerging pests in the localities in which plant clinics are held. Initially, plant doctors used to manually enter their records or were supported by cluster coordinators in cases where they did not have access to a computer.

In 2017 the management of plant clinic data was streamlined by the launch of the e-clinic system (see Section 3.1.1), which eased data entry and uploading to POMS. The tablets both facilitate quick processing of normal clinic activities and the processing of farmer queries outside of clinic days. However, the new system has some (infant stage) problems as well, e.g. the improper functioning of tablets and crashing software while uploading data to POMS, because of Internet connectivity problems. To prevent the loss of data, plant doctors still make use of the paper-based prescription forms which costs extra time. In due course however, the e-clinic system is expected to contribute to the further consolidation of plant health information management.

The growing numbers of plant clinics also mean that more and more data needs to be validated and analysed. Although the value of data validation is acknowledged, it is not always prioritised as it is very time consuming, and the few staff who are able to do it already have heavy workloads due to their many other plant protection duties. In August 2017, a practical solution was proposed in forming teams of two to three professionals, comprising an entomologist, a pathologist and an extension officer. Each team is randomly allocated data to be validated, against a target of ten entries per month. The teams have been trained in data harmonisation and validation by the officer in charge of data management at PPD headquarters. This is currently being tested.

3.2.2 Data for surveillance

Continuous data collection through plant clinics enables the PPD to keep trying to improve plant disease control, tailored to the different farming contexts within the country. The Nepal Agricultural Research Council (NARC) and DoAE are increasingly aware that POMS data are useful for pest surveillance, reporting and informed policy planning and decision making (Plantwise Nepal Annual Report 2016, p.7).

3.2.3 Dissemination to farmers

The increased focus on dissemination of plant health information started with the establishment of one information centre (AICC) by MOAD in 2011. The AICC is responsible for the collection and dissemination of all plant health related information via various channels such as regional and national pest maps, general publications, leaflets, posters, and via FM radio.

The plant clinics give farmers direct access to high quality plant health information. They also benefit increasingly from ICT developments, like the Telegram SMS system, through which they receive information on pest diagnosis and recommendations from plant doctors,

and social media, such as a special Facebook page "Plant doctors from Nepal" on which they can find "verified plant health information".

In addition, a variety of reference materials have been either developed or improved through Plantwise, in some cases by making use of clinic data. These (new) materials include fact sheets, pest management decision guides (PMDGs), books and manuals about diagnostic services, and a 'ready reckoner' developed by a special team of experts within the PPD. The ready reckoner is a manual which by means of coloured images shows the various pests and diseases occurring in crops in Nepal.

The introduction in 2017 of a farmers' SMS system is thought to have further improved access to plant health information at local level. Both farmers and plant doctors can use this system. In practice, it is mainly used by plant doctors to send recommendations to farmers.

3.3. Diagnostic services

The primary change observed by stakeholders with regard to pest and disease diagnosis is the strengthened capacity of the workforce. MOAD, through the PPD-Plantwise programme, invested in upgrading the plant protection services by building the capacity of agricultural extension staff to add diagnostic services to their tasks (Table 2). Plant protection officers, FFS farmer facilitators as well as students from HICAST have enhanced their diagnostic skills owing to the use of Plantwise modules in plant doctor trainings (PPOs and farmer facilitators) and in the curriculum of HICAST (since 2014).

The establishment of e-clinics in 2017 was considered by PHS stakeholders to have simplified diagnostic services. The tablets allow plant doctors to easily take pictures of infested crop samples to send for further study, in case a proper diagnosis cannot be made on the spot.

Another change mentioned was the increasing recognition by GoN that laboratory strengthening is essential for improved diagnostic services. In 2015 an MoU between NITTR and PPD was signed to establish a reference laboratory. However, lack of public funds hampers government investments. Therefore linkages with FAO and NGOs, like SECARD and Caritas, have been reinforced in 2016 to access additional funding for this purpose. In 2017 the PPD was provided with new laboratory facilities. In addition Caritas has started to fund mobile clinic services following the Plantwise model. Further, an MOU with the National Institute of Technical Teacher Training & Research (NITTR) to establish a reference laboratory was also signed.

Lab strengthening is currently receiving increased attention with support from FAO and the World Bank. Although the first signs of improving laboratory services have become visible lately they are still considered to be far from optimal. To combat the continuous threat of emerging (new) pests, careful attention is required to improve diagnostic services, including the provision of more sophisticated laboratory equipment.

The stakeholders' individual scoring exercise found that diagnostic services had improved from 2011 to 2017 with regard to all six KPIs: Scores for reach, timeliness and availability were all low for this function in 2011, which some workshop participants explained as being due to insufficient financial support at that time. By 2017 the scores had become positive for all the indicators. Improvements over this period included improved coordination of diagnostic (and extension) services, as well as slightly improved lab services (data not shown).

3.4 Research and technology development

Although Plantwise does not participate directly in research, it does have connections with agricultural research institutes dealing with plant protection and as such exerts an indirect influence. For instance, the Himalayan College of Agricultural Sciences and Technology (HICAST) trains its student-researchers on the basis of Plantwise modules. Plantwise module 1 has been incorporated as a compulsory subject in its curriculum. HICAST staff and students would like to extend the number of Plantwise modules.

PHS stakeholders mentioned minor changes in research and technology development but emphasised that the mandates of agricultural research institutes have not changed. Plantwise has inspired NARC to shift focus to the development of agronomic and biological treatment of pests in collaboration with farmers, e.g. the establishment of farmer laboratories producing bio-control agents. Research stakeholders noted a significant reduction in pest losses in tomato in 2017 as compared to the 80% loss experienced in 2015 due to *Tuta* infestation (workshop outcomes). Further, a NARC representative at the workshop observed improved coherence between research and practice in general. Nowadays, problem identification for research is increasingly in compliance with the local challenges that farmers face. PHS stakeholders acknowledged that the research function complements the other PHS functions. They agreed though that in practice the connection with research was underexposed in the time span under consideration (2011-2017).

The stakeholders' individual scoring exercise found that research and technology development had improved from 2011 to 2017 with regard to five of the six KPIs (reach was not included) (data not shown). The exercise identified specific improvements in the areas of pest and disease identification, and technology generation. However, the linkages between PHS stakeholders at implementation are still weak and require attention. For instance, despite everyone agreeing that inter-institutional cooperation is essential, in practice, NARC still seems to be operating somewhat in isolation. However, it was found to be more responsive to farmers' practices nowadays with problem identification based on the local challenges that farmers are facing.

3.5 Input supply

Respondents reported changes in the supply of seed, fertilisers and pesticides over the period 2011-2017 time span. Hybrid seed supply increased after 2011, when it comprised 80% of total seed supply, and farmers mentioned easy access to rice and vegetable seed through their links with LI-BIRD (Local Initiatives for Biodiversity, Research, and Development) and the UN. The provision and use of fertiliser has also changed. Prior to 2011, available fertilisers included diammonium phosphate (DAP), urea, potash and some micro-nutrients. Currently, the supply and application of bio-fertiliser has increased while the supply and use of chemical fertilisers has declined. Simultaneously, a substantial increase in availability and use of safe pesticides has been observed over the past years. The import of safe chemical pesticides - mainly WDG/SL pesticides (CCOHS, 2017) - as well bio-pesticides and bio control agents has increased. Before 2011 only neem-based pesticides were available whereas nowadays agro-vet shops provide a variety of bio-pesticides including hormone traps, pheromone tools, botanicals, and nematodes to control *Trichoderma* and *Tuta absoluta*. Farmers also confirmed that bio-pesticides and botanicals are increasingly available, as well as protective gear to use with chemical pesticides; and

that they are increasingly using both (farmer interviews, Shankharapur, Sankhu, Kathmandu). However, one of the plant doctors indicated that although pheromone tools are easily accepted by farmers, this was less so in the case of bio-pesticides.

Box 2 Safe pest management in Nepal

In accordance with Plantwise principles safe pest management in Nepal includes the promotion of IPM and GAP: promoting the use of bio-pesticides and biocontrol agents as much as possible and the use of chemical pesticides as last resort. In this respect, farmers are referred to only use green and yellow-labelled pesticides. Red-labelled highly toxic pesticides are increasingly being banned – the latest ban of 16 of such pesticides (including endosulfan and phorate) in Nepal dates from 2016.

The respondents from the Plantwise programme said that Plantwise Nepal encourages plant doctors to advise farmers on the dangers of misuse of chemical pesticides and to promote the use of safe (bio-) pesticides and bio-control agents. This was borne out by the observation of other PHS stakeholders that the Plantwise focus on safe pesticides triggered the change in input supplies. Its emphasis on safe pest management (e.g. GAP/IPM/biocontrol/yellow and green pesticides list) (Box 2), has influenced the provision of a greater variety of safe pesticides. The GoN banned 16 highly toxic chemicals in 2016 (see Box 3) and is regulating pesticide use through protocols and policy documents as well as by increasingly encouraging organic inputs. The formulation of a new Pesticides Act is in its final stage. This Act gives power to PPOs at DADO level to intensify the monitoring of pesticides, which includes the monitoring of the supply stocks of agro-vets (interview with Director General, DOA). However, stakeholders also expressed concern of overburdening PPOs as extension staff already struggle to fulfil all their responsibilities.

Box 3 List of banned pesticides in Nepal

1. Chlordane; 2 D.D.T; 3. Dieldrin;4. Endrin; 5. Aldrin; 6. Heptachlor;7. Mirex; 8. Toxaphne; 9. Lindane; 10. B.H.C.; 11. Phosphamidon; 12. Organomercury chloride; 13. Methyl Parathion; 14. Monocrotophos; 15. Endosulfan; 16. Phorate

The stakeholders' individual scoring exercise found that input supply had improved from 2011 to 2017 with regard to five of the six KPIs (reach was not included) (data not shown). Improved coherence in input supply was explained by one workshop stakeholder, involved in the overall management of a district agri-programme, by the fact that 'many inputs are related to local materials' (*sic*). With regard to affordability, the main improvements mentioned by farmers relate to savings on costs for pesticides. Formerly, they used to buy, combine and haphazardly apply pesticides, fungicides and insecticides without knowing the root causes of pest problems. Now they know when to opt for cultural practices to manage pests, or to reduce pesticide use. The farmers appreciate their increased knowledge about safe pest management, and the use of safe pesticides and bio-control agents.

Important outputs identified included increased demand for safe pesticides (green and yellow lists), which aligns with farmers' comments (see above). PHS stakeholders further reported (though cautiously) increased agricultural productivity thanks to changes in agricultural input supply within the past decade. They considered this mainly due to a combination of increased use of quality seed and safe pest management. This view was reflected by farmers' own experiences. Farmers in Sankhu reported that better pest management contributed to increased crop yields. All farmers indicated an increased variety

and quantity of safe (bio-) pesticides available at the agro-vet shops, which is in line with the extension on GAPs and safe pest management they receive at plant clinics. They further perceive a positive change in agro-dealers' knowledge and attitude towards the use of safe pesticides. For some crops, e.g. tomatoes, potatoes and vegetables, farmers have shifted to (jointly operated) commercial cultivation systems, which simplify pest management and so saves labour, cost and time.

Some farmers reported plant clinics having positive effects on their livelihoods. A farmer in Kavre said for example: "Improved pest management helps to increase our crop production which ultimately fetches good prices resulting in improved living standards". A farmer in Biratnagar (Terai plains) explained better pest management allowed him to go into commercial farming. He used to work in the Gulf countries to make a living. Now he has started to commercially cultivate vegetables such as broad leaf mustard farming, allowing him sufficient income. Farmers in Pokhara region are growing tomatoes and vegetables commercially which increased their living standards. They are sending their children to boarding schools, have constructed houses and were able to buy land.

In the future, continued Plantwise support could further improve input supply, for example by providing agro-vets with equipment to keep bio-pesticides in a controlled environment to enhance shelf-life. In addition, training and awareness raising activities could be included to improve engagement with input suppliers in the PHS.

3.6 Policy, regulation and control

This study has identified ways in which Plantwise has influenced both agriculture extension policy and plant health policy in Nepal, as well as plant health system governance. Compared to a decade ago, PPD representatives perceived an improved coordination between DOA directorates, in particular with regard to policy making. An example of this is the development and approval process for pest management guidelines. Although guidelines have long existed, prior to 1990, and amendments of these are continually required, nowadays they are only approved after extensive consultation. A three-tier consultation process has been in existence for the last 4-5 years, with consultations at stakeholder, departmental and ministerial levels. These include public consultations via a website, as well as workshops, e.g. on pest analysis at an IPM resource centre. Farmers' opinions are also taken into account. Only after all the three levels have been consulted, guidelines are approved and subsequently published on the PPD website (http://ppdnepal.gov.np). This website was established in 2012 to ease the provision of information and improve communication.

3.6.1 Agricultural extension policy

Since 2013, the plant clinics have become an official instrument in Nepal's agricultural extension services, and this has been a major factor in integrating plant health into the national extension system. For instance in the fiscal year 2016-2017 the Prime Minister Agriculture Modernisation Project (PMAMP) was initiated (see Section 1.2). The DADO team in Lalitpur decided to integrate plant clinics in the PMAMP vegetable block programme in order to better reach farmers.

Despite their overall optimism about integrating plant health into agricultural extension, some PPD staff expressed concerns about implementation. They thought the current transition to a federal system was particularly challenging. Under the new constitution the local government has to manage agricultural extension and it appears to expect to accommodate all plant health related activities to the current numbers of extension staff. At DOA level, solutions are being considered on how to integrate the Plantwise programme into the decentralised government system, e.g. allocating the local government a budget to implement the plant clinic programme. In addition, more farmer facilitators could be trained as plant doctors. Further, connections may be made with a special DOA programme which has been established to engage more youth in agriculture (interview 22nd Sep).

3.6.2 Plant health policy

Plant health policy formulation in Nepal is prompted by several factors. These include the permanent existence and emergence of (new) pests, the misuse of chemical pesticides, and international obligations (e.g. WTO rules on SPS measures; and the Rotterdam, Basel, Stockholm Conventions which aim to protect human health and the environment from hazardous chemicals and wastes) (Unitar and WTO websites, 2017).

The formal partnership agreement between PPD and CABI Plantwise in 2013 coincides with a period of amendments of plant protection directives and pesticide guidelines developed by the PPD. These had hitherto been guided by the Plant Protection and Pesticides Acts, with their latest amendments dating back to 2007 and 1991 respectively. Since 2013, the political commitment to strengthen the PHS in Nepal is high. PPD has been involved in drafting updated and/or new plant protection policies, directives and guidelines in areas such as pest surveillance, safe pest management including organic and bio-pesticide directives, policies to encourage organic agriculture and IPM, and the formulation of MoUs with regard to laboratory strengthening. Examples include the IPM Village Directive, the Campaign Plant Protection Directive, the Pest Surveillance Directive and pesticide guidelines in 2013. Further, protocols for the surveillance of fruit fly, citrus greening, citrus canker and citrus psylla were developed in 2014, and RBPR guidelines were also formulated. In 2015 a policy document was drafted to encourage organic agriculture and the PPD was formally appointed to act as NPPO. Currently, PPD, DOA and MOAD have discussed and prepared further plant health policy documents and guidelines, some of which are awaiting formal approval. These include an IPM policy, a directive for an IPM Resource Centre, the formulation of a new Pesticide Act, and the Organic and Bio-pesticide Directive. This aligns with the aim of GoN to boost agricultural development in general.

3.6.3 PHS governance

Plantwise design includes the strengthening of PHS governance. The PPD was endorsed as NPPO in 2013 through its work with Plantwise: a key development in plant health policy, regulation and control. Since 2017 the PPD has also become the focal point for the Asian chapter of the International Plant Protection Convention (IPPC).

A national forum was established in 2013 in which high-level policy makers meet twice a year to discuss plant health management issue, based on crop pest data obtained through

plant clinics. These meetings contribute to increased coherence in plant health related policies.

In their pursuit of a sustainable agricultural system the 12 DOA directorates are increasingly working together and strive for joint coherent solutions, in close consultation with GoN. On their agenda is another pest management related challenge: the fact that Nepal has only 12 plant quarantine check points and over 1000 kms of open borders through which pests could enter into the country.

3.6.4 Future policy directions

A DOA representative who played a key role in the establishment of the Plantwise-PPD collaboration suggested that the time might now be ripe to shift attention to strengthening other PHS functions in Nepal. The first years focused on strengthening farmer advisory services, plant health information management, and diagnostic services. This resulted in the PPD now being in charge of managing these services according to Plantwise principles. PPD staff are now capable of training new staff. Insufficient staff numbers however currently challenge further up-scaling (hence the idea to involve more farmer facilitators and train them to become plant doctors). Continued Plantwise support is still required to strengthen other PHS functions, such as reinforcing input supply by providing facilities for agro-vets to keep bio-pesticides in a controlled environment to enhance shelf-life. In addition, provision of equipment, training and awareness raising activities could be included to better engage with input suppliers and further stimulate the alignment of all agricultural inputs (seed, pesticides, fertilizers).

Plant health protection has always been a public service in Nepal and will remain to be so at least in the foreseeable future. This does not imply, however, that strengthening linkages with the private sector should be neglected. Improved collaboration with the input supply sector is definitely strived for, e.g. to enhance the numbers of agro-dealers offering safe inputs.

4. Conclusions

Based on the evidence presented in this report, Plantwise has contributed to important changes to the PHS in Nepal, with regard to all six of the PHS functions (summarized in Table 3). The major driver of these changes has been the strong collaboration between PPD and CABI Plantwise.

4.1 Farmer advisory services

Plantwise has contributed to mainstreaming plant health within the national extension system of Nepal. The drivers of this change have included increased awareness of the haphazard and uncontrolled use of chemical pesticides, and the associated health hazards; and the proven effectiveness of plant clinics in increasing farmers' awareness and use of safer pest management practices. Through establishment of plant clinics (in 40 districts), training of extension workers as plant doctors, and provision of improved plant health

A farmer in Kaski (Pokhara) showing a trap for biological pest control.

information and reference material, plant health has become part of the portfolio of extension workers. Farmers now receive prompt and relevant advice on pest problems, including information on GAP, IPM and safe pesticide use. This results in reduced crop losses, hence increased crop yields, which “ultimately helps to improve our living standards”, as farmers in Sankhu reported.

Some influence of Plantwise on other extension providers (NGOs and other agencies) is being observed. Caritas organises plant clinics using the Plantwise modules, and information is shared with PPD extension officers. Plant doctors further engage with LI-BIRD (Local Initiatives for Biodiversity, Research, and Development) and the UN on rice and vegetable seed production respectively.

4.2 Plant health information management

Plant clinic data is being more effectively captured on POMS through e-clinics, and is perceived by national agencies (NARC, DoAE) as a valuable surveillance tool. Farmers are getting better access to plant health information, not only directly from the clinics but through new and improved reference materials, ICT innovations such as the use of messenger (Telegram) groups, and the recent introduction of an SMS system for farmers.

4.3 Diagnostic services

Field-level diagnosis has improved as MOAD has invested in training more plant doctors, including FFS facilitators as well as extension officers, in pest and disease diagnosis. PPOs and students from HICAST have also been trained using the Plantwise training modules. The use of messenger apps (Telegram) has made it easier for plant doctors to seek diagnostic advice. The need for stronger in-country diagnostic capacity is well understood but resourcing issues have resulted in only limited progress in this area, although some new laboratory facilities were installed at PPD headquarters in 2017. FAO and the World Bank are now also investing in the strengthening of diagnostic lab facilities.

4.4. Research and technology development

The link between extension and research is incrementally improving. Plantwise has established connections with some (educational) research institutes, such as HICAST and NARC. NARC (as well as DoAE) is acknowledging the use of POMS data to serve reporting, planning and surveillance. Research experts, (pathologists and entomologists), take part in the data validation teams, validating POMS data. They further play advisory roles in the

development of information and reference materials and diagnostic tools (e.g. the ready reckoner). Researchers during the workshop reported improved plant health research now compared to prior to 2011. Currently, NARC deals with almost all plant health related research issues and only transfers research technologies after consulting farmers on its relevance. However NARC is looking at setting up farmer-managed labs to produce bio-control agents.

4.5. Input supply

Plantwise indirectly affected input supply. At local (district) level plant doctors engage with agro-dealers to discuss the supply of certified and effective agro-chemical inputs as well as the provision of bio-pesticides and other bio-control agents, such as pheromone lures. PPOs – acting as plant doctors in Nepal- are also entitled to do pesticide registration and thanks to the amended Pesticide Act which mandated DADO to monitor agro-vets, PPOs can order them to cease their business in case banned pesticides are detected. Since 2011, farmers have better access to improved seed, bio-fertilisers, bio-pesticides and bio-control agents. Agro-vet shops now provide a variety of bio-pesticides including hormone traps, pheromone tools, botanicals, and nematodes. Plant doctors promote the use of bio-pesticides and other bio-control agents and this is perceived to have increased their availability from input suppliers.

4.6 Policy, regulation and control

Plantwise came at an opportune time and formed an ideal and natural partnership with the PPD to collaborate on plant health issues. Since the formal partnership agreement in 2013, the GoN has designated PPD as the national body responsible providing for plant protection services (NPPO) which includes the implementation of Plantwise activities (Plantwise NRO). There is now a strong political commitment to plant protection in Nepal. Plant health policies and structures are being revised and amended and new policies being drafted to improve regulation and control. Although Plantwise is not the only driver of the changes in policy and regulation, it seems a major contributor to ongoing changes by feeding knowledge and information into the system.

Plantwise has also been influential in integrating plant health into agricultural extension, as plant clinics have become an official instrument in Nepal's agricultural extension services. In Latitpur District, plant clinics have also been integrated into the PMAMP for vegetable growers.

Table 3. Summary of changes, drivers and challenges/opportunities within the PHS of Nepal during 2011-2017

PHS function	Changes	Drivers	Challenges / Opportunities
1 Farmer advisory services	• Increased access to FAS (in the districts which operate plant clinics) thanks to regularly held plant clinic sessions (previously no direct FAS: farmers went to agro-vets and occasional to DADO and ASC) • Increased quality of service delivery to farmers (thanks to well-trained plant doctors) • Appreciation of information on GAP, IPM and safe pesticide use (both plant doctors and farmers) • E-plant clinic system appreciated • Increased timeliness thanks to frequency of plant clinics and the increased use of smartphones by farmers to receive immediate technical advice • Enhanced involvement and coordination with (I)NGOs, like Caritas, with regard to plant health	• Proven concept of plant clinics increasing farmers' awareness on safe pest management • Haphazard use of pesticides • Increased demand for bio-pesticides • Increased use of mobile devices • Acknowledgement and adoption of plant clinics as mainstream extension tool by GoN	• Lack of plant clinics at ward level • Conduction of training to plant doctors & farmer-facilitators should be done at regular time intervals
2 Plant health information management	• Increased access of plant doctors to quality reference material (fact sheets, KB, books, photo sheets, PMDGs, etc.) • Improved knowledge (insight) and skills with regard to pest lists and banned pesticides • Facilitation of relevant data documentation on plant health • E-system is appreciated for PHIM	• Institutional support (CABI, PPD, DOA, MOAD) • Policy guidelines (ADS) and periodic plans • Science & Technology generation (ICT, agricultural research findings) • Farmers' needs & interests	• At times, improper functioning of tablets – e.g. crashing of software while uploading data to POMS. To prevent the loss of data: plant doctors still make use of the paper-based prescription forms (and write the recommendations to farmers on paper instead of SMS on phone)
3 Diagnostic services	• Improved coordination of diagnostic (and extension) services • Improved identification of pests and diseases • Establishment of laboratory to diagnose plant health problems, e.g. in Hariharbhawan (PPD) • Slightly improved lab services	• Low levels of diagnostic expertise • Financial resources (large investments) • Institutional support (CABI; GoN; (I)NGOs)	• Emergence of new pests

PHS function	Changes	Drivers	Challenges / Opportunities
4 Research and technology development	• HICAST has incorporated Plant Clinics in their curriculum (syllabus) • NARC more responsive to farmer research needs	• Government policy to support lab strengthening	• No plant doctor training to HICAST students
5 Input supply	• Increased demand for safe pesticides (green and yellow lists), biocontrol and IPM • Increased supply of agricultural inputs, through subsidy schemes to communities, including quality seed, safe pesticides, fertiliser and bio-pesticides	• Increased awareness on safe pesticides, incl. bio-pesticides • Changing protocols and policies • Commercial farming	• High demand and low supply of agricultural inputs • Import of agricultural inputs is high
6 Policy, regulation and control	• Changing plant health policies • The formal enactment of the PPD as NPPO (providing plant protection services). • Plant clinic extension services included in PPD budget • Prime Minister Agriculture Modernisation Project – Government – e.g. DADO team Lalitpur decided to integrate PCs in the vegetable block programme • Increased awareness on plant quarantine measures • Increased awareness on certified seed, quality inputs	• Government policy to endorse plant clinics in its regular extension programme • Emergence of (new) pests • Prior to 2011: outbreak of brown plant hopper in 1995 induced GoN to amend plant health policies • Misuse of chemical pesticides • International obligations (WTO, Rotterdam, Basel, Stockholm) • Agreement to collaborate with CABI Plantwise	• Open borders • The transition to a federal system requires associated changes in (plant protection) acts

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Web links

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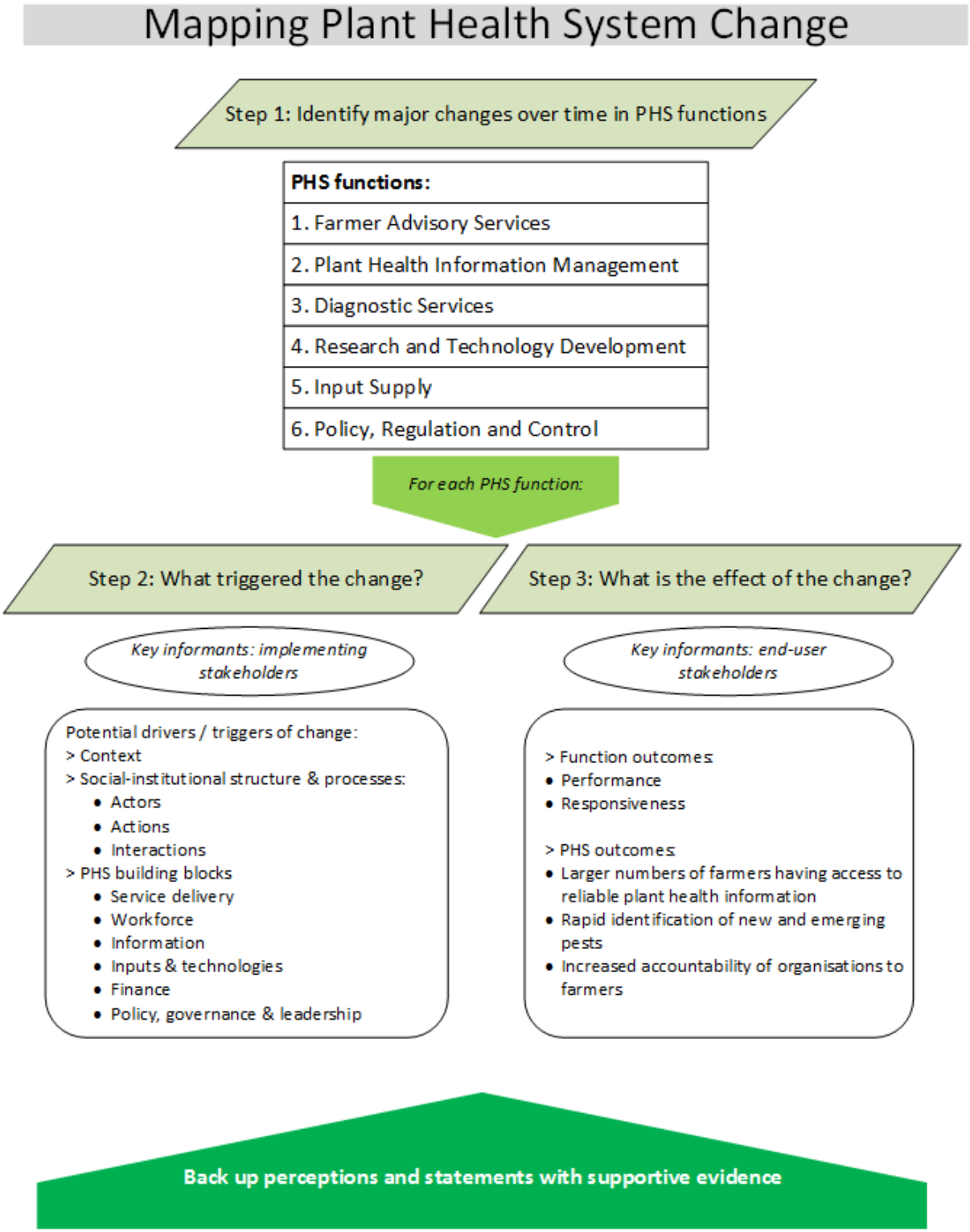
Annexes

Annex 1 Methodological steps to reconstruct the PHS narrative on system change



Annex 2 Interviews and FGDs

Stakeholder	Duty station	Function / activities
CABI country coordinator	CABI New Delhi	
National coordinator Plantwise	PPD Kathmandu	Programme Director PPD
National data manager Plantwise	PPD Kathmandu	Senior PPO
M&E officer Plantwise Nepal	PPD Kathmandu	PPO
Senior ADO (pest management at district level	DADO, Dhulikhel, Kavre	Senior Agriculture Development Officer
Farmer facilitator (IPM/ plant doctor)	Kavre, Nala	Farmer
Farmer facilitator (IPM/ plant doctor)	Kavre, Nala	Farmer
Farmers	Kavre, Nala	Note: some 6-7 other farmers joined the FGD
Farmer facilitator (IPM/ plant doctor)	Shankharapur, Sankhu, Kathmandu. Note: this PC is located in a village that was hit severely by the 2015 earthquake	IPM Trainer and agro-vet shop owner.
Plant doctor trainer; PMDG development; member PW national data validation team		Senior PPO
Farmers	Shankharapur, Sankhu, Kathmandu	
Senior PPO, conducting and M&E of PCs, training PDS, coordination & supervision regional PPD activities & laboratories	Bahunne, Biratnagar, Morang	
Farmer facilitator: IPM and plant clinics		
Farmers		
Senior PPO	Hemja, Kaski, Pokhara	Plant pesticide inspector; agricultural extension (plant protection)
PPO, DADO Kaski		
Senior PPO		
Farmers		
Agricultural Technician, DADO	Leknath, Pokhara	Monitoring extension activities
Farmers		Farming
Plant Doctor	Gothikel, Mahankal Rural Municipality	Agricultural technician (DADO) / Diagnosis pest and diseases; seed provision; monitoring agricultural activities; raising awareness to farmers on pesticide use
Plant doctor		PPO, DADO Lalitpur / Plant protection; technical backstopping (IPM/FFS); pesticide inspection
Farmers		Farming
Former national coordinator Plantwise (until mid-2017)	MOAD-DOA	DG DoA

Annex 3 Description of the workshop process

Workshop objectives
The aim of the workshop was to obtain information on PHS changes in Nepal since the introduction of Plantwise in the country. A group of stakeholders having a crucial role in one or more of the six functions that altogether form the PHS in Nepal was invited to:

- identify the major changes regarding PHS functions over time
- discuss the major drivers/triggers of these changes and,
- to assess the effects of these changes on the performance and responsiveness of the PHS functions

The group was divided into six sub-groups of 4-5 people with, to the extent possible, equal numbers of people representing the six different PHS functions. This meant that in practice for those functions that only had two people present, who would 'officially' qualify to represent a certain function, people from other function-groups were added. For instance, the two people from the Pesticide Association representing *function 5 input supply* got support from DADO representatives (drawing from their practical knowledge and experience on the topic). These six groups stayed the same throughout the day and were to follow all workshop steps together.

Step one – identify key PHS changes within 2011-2017 & relate these PHS building blocks
Part one -For the identification of PHS changes the groups were to discuss and write down the key changes for the functions they represented and place these on a timeline covering the period 2011-2017. Each group received a stack of coloured cards corresponding to the respective functions. For example, with regard to function 1, farmer advisory services, the questions to be answered were: (1) what would you identify as a major change within the past seven years? (2) could you define these changes as specific as possible time-wise? of the changes could include, for example: new systems, services, or financial mechanisms; changes in existing services or systems, etc.; or, the establishment of new organizations. Thus, if group one, representing function one (farmer advisory service) found that extension services to farmers had clearly increased in 2009 because of the fact that there were new NGOs providing extension services at that time (or NGO's changing their mandates towards enhancing extension services) – it was to indicate this as a change on the timeline. Similarly for the other PHS functions.

Part two – In order to be able to categorise changes in the relation to PHS building blocks, it was first explained what these are. Analogous to those of human health systems (WHO, 2007) the six PHS building blocks are: (1) services delivery; (2) workforce; (3) information; (4) inputs, technologies, infrastructure; (5) finance; and, (6) policy, governance, leadership. Each of the six PHS functions consists of these six building blocks.

Participants were given stickers of six different colours corresponding with each building block. These stickers were used to indicate which building blocks relate to the function change. In addition, participants were to indicate whether the change was positive or negative by drawing a + or – symbol on the stickers. For example: suppose, that in part one of the exercise group one (function 1 advisory services), indicated that IPM had become standard advice in extension then this could relate to (a change in) building block 3: "information" but/and maybe also in building block 2: "workforce" (increased knowledge workforce).
At the end of the session, a representative of each group was asked to present in five minutes the summarised findings of his/her sub-group to the plenary group. This allowed discussion to indicate any overlap and/or additions. Thereafter, in plenary, the changes per PHS function were discussed to commonly agree on and define the eventual output of these changes.

Step two - drivers of change
The aim here was to gain insight into drivers/triggers of change. Sub-groups had to stay together and discuss the drivers/triggers of the changes they had identified earlier. Thus, group one would discuss the drivers of change with regard to Farmer advisory services, group two for plant health information management, etc. These drivers had to be written on cards and stuck to the respective changes on the timeline.

Step 3 - scoring PHS function outputs using performance indicators

The function outputs were now to be assessed individually to allow for as much objectivity as possible. Each participant received a score form on which they had to assess each function against a number of predefined performance indicators (see section 2.1).For example, when with regard to PHS function one (farmer advisory services) the commonly agreed outputs were: “quality of service delivery to farmers” and “outreach to farmers” then the individual participant had to score this on this set of given indicators. For instance, performance indicator “availability” in relation to farmer advisory services (FAS) concerns whether FAS are available to all types of farmers, despite differences in gender, education, wealth, ethnicity or location. On the other hand, performance indicator “reach” with respect to FAS is about numbers of farmers being reached, that is scale.

Workshop participants as per their PHS functions

Stakeholder	**#**	**Level**	**Role in Plantwise**	**PHS function**
Plant protection Directorate (PPD) (NPPO / NPQP program)	5	National Regional District	National Responsible Organisation (NRO)	1. Farmer Advisory Services 2. Plant Health Information Management 3. Diagnostic services (regional level) 4. Research & technology development 6. Policy, regulation & control – NB: RBPR
Department of Agriculture (DOA)	2	National		6. Policy, regulation and control
Crop Development Directorate CDD	1	Regional District		
Fruit Development Directorate FDD	1			
Nepal Agricultural Research Council (NARC) Including NARC soil lab	2	National Regional		1. Farmer Advisory Services 2. Plant Health Information Management 3. Diagnostic services 4. Research & technology development 5. Input Supply
Himalayan College of Agricultural Sciences and Technology (HICAST)	1	National Regional	Plant Clinics incorporated in HICAST curriculum	4. Research & technology development
Regional Plant Protection Laboratories (RPPL) (labs)	3	Regional	Local Implementing Organisation (LIO)	3. Diagnostic services 4. Research & technology development 6. Policy, regulation & control
District Agricultural Development Offices (DADOs)	5	District	Local Implementing Organisation (LIO)	1. Farmer Advisory Services 2. Plant Health Information Management 6. Policy, regulation and control 3. Diagnostic services – NB: some DADO’s maintain basic laboratories 6. Policy, regulation and control
Pesticide Association (Nepal)	2			5. Input Supply
CARITAS	1			1. Farmer Advisory Services
Farmer facilitators / resources lab	1			1. Farmer Advisory Services
CABI	1		Financial and Technical support	2. Plant Health Information Management
Total # PHS participants	**26**			

Annex 4 Overview of PHS stakeholders in Nepal

PHS stakeholders in Nepal (based on Plantwise, 2015)

Stakeholder	Level	Mandate	Role in Plantwise	PHS function
Plant protection Directorate (PPD) (NPPO NPQP program)	National Regional District		National Responsible Organisation (NRO)	1. Farmer Advisory Services 2. Plant Health Information Management 3. Diagnostic services (regional level) 4. Research & technology development 6. Policy, regulation & control – NB: RBPR
Ministry of Agricultural Development (MOAD)	National	Public sector extension services	National forum members guiding PW implementation programme in-country	6. Policy, regulation and control
Department of Agriculture (DOA)	National	Public sector extension services Policy, Planning, Monitoring and Evaluation (PPME) Technical guidance		6. Policy, regulation and control
Directorate of Agricultural Extension (DoAE)		Policy, Planning, Monitoring and Evaluation (PPME) Technical guidance Provision of needs based extension services		3. Diagnostic services – NB: NARC providing technicians 4. Research & technology development 6. Policy, regulation & control – NB: DoAE
Concerned Directorate				1. Farmer Advisory Services
PMRD offices				6. Policy, regulation & control
SQCC				6. Policy, regulation & control
DFTQC	National			6. Policy, regulation & control
Nepal Agricultural Research Council (NARC) Including NARC soil lab	National Regional			1. Farmer Advisory Services 2. Plant Health Information Management 3. Diagnostic services 4. Research & technology development 5. Input Supply
CABI			Financial and Technical support	2. Plant Health Information Management
Soil lab	Central, regional			3. Diagnostic services
Researchers				2. Plant Health Information Management 3. Diagnostic services
Universities				2. Plant Health Information Management 4. Research & technology development
LIBIRD				4. Research & technology development
AICL	National	Procurement and distribution subsidised fertilisers across the country		5. Input Supply
Regional Plant Protection Laboratories (RPPL) (labs)	Regional		Local Implementing Organisation (LIO)	3. Diagnostic services 4. Research & technology development 6. Policy, regulation & control
CBD				4. Research & technology development
IAAS				4. Research & technology development
SMD				4. Research & technology development
PHMD				4. Research & technology development
AFU				4. Research & technology development
National Seed company Ltd	National			5. Input Supply
Agricultural Information and Communication Centre (AICC)	National			1. Farmer Advisory Services

Stakeholder	Level	Mandate	Role in Plantwise	PHS function
Mass media, e.g. TV and FM radio stations	National			1. Farmer Advisory Services
NGOs/INGOs	National District			1. Farmer Advisory Services 2. Plant Health Information Management
Community Based Organisations (CBOs)	District Community			2. Plant Health Information Management
Check posts				6. Policy, regulation & control
Training Centres				1. Farmer Advisory Services
Regional Plant Protection Laboratories			Local Implementing Organisation (LIO)	1. Farmer Advisory Services 2. Plant Health Information Management 5. Input Supply
Regional labs				5. Input Supply
Agricultural Service Centres (ASCs)	District	Extension services to agricultural producers		2. Plant Health Information Management 3. Diagnostic services
District Agricultural Development Offices (DADOs)	District		Local Implementing Organisation (LIO)	1. Farmer Advisory Services 2. Plant Health Information Management 6. Policy, regulation and control 3. Diagnostic services – NB: some DADO's maintain basic laboratories 6. Policy, regulation and control
Grass root level extension officers		Diagnostic support for common plant health problems		
Training Centres				1. Farmer Advisory Services
Finance and Banking institutions				5. Input Supply
Community Seed Bank	District			5. Input Supply
Cooperatives				1. Farmer Advisory Services 3. Diagnostic services 5. Input supply
Farmers' groups				1. Farmer Advisory Services 3. Diagnostic services 5. Input supply
(Community) Resource Centres				5. Input Supply
Agro-vets				3. Diagnostic services 5. Input Supply
Formulators and private companies				5. Input Supply
Private manufacturers				5. Input Supply
Private dealers and distributors				5. Input Supply
Black Smiths				5. Input Supply
Welfare fund of farmers group				5. Input Supply
Farmers				2. Plant Health Information Management 3. Diagnostic services
Consultants				2. Plant Health Information Management
Web designer				2. Plant Health Information Management

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