Plant clinic data management

An assessment of the use, management and functioning of the Myanmar Plantwise Data Management System

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Cover photo
Plant Clinic at Pyun Tan Zar, Bago, infested leaves on prescription form. *Photo:* Jacqueline Sluijs

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Abbreviations

AED	Agricultural Extension Division
CABI	Centre for Agriculture and Biosciences International
DAR	Department of Agricultural Research
DMS	Data Management System
DOA	Department of Agriculture
FEO	Farmer Extension Officers
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
HQ	Head of Quarantine
ICT	Information and communication technology
IPM	Integrated Pest Management
JICA	Japan International Cooperation Agency
KM	Knowledge Management
KOICA	Korean International Cooperation Agency
LIO	Local Implementing Organisation
M&E	Monitoring & Evaluation
MoALI	Ministry of Agriculture Livestock & Irrigation
NDM	National Data Manager
NRO	National Responsible Organisation
NSC	National Steering Committee
PC(s)	Plant Clinic(s)
PD(s)	Plant Doctor(s)
PHE	Plant Health Extension
PHEO	Plant Health Extension Officer
PHIS	Plant Health Information System
POMS	Plantwise Online Management System
PPD	Plant Protection Division
PRB	Pesticides Registration Board
PW	Plantwise
PW-M	Plantwise Myanmar
SEA	South East Asia
SPS	Sanitary and Phytosanitary
YAU	Yezin Agricultural University
VFM	Value for Money

Summary

This report presents the findings of a study carried out in Myanmar in order to: 1. understand how plant clinic data are managed, perceived and used by partners; 2. identify key challenges and opportunities for improving systems for plant clinic data management and use; and 3. identify key criteria and variables for future assessments of data management systems. The report is part of a larger study covering two countries: Kenya (where the first CABI supported plant clinics started operations in 2010) and Myanmar (first CABI supported plant clinics started in 2014).

In a period of two weeks in December 2016, the research team spoke with about 50 people, who are either technically or organisationally engaged in the Plantwise Myanmar (PW-M) data management system (DMS). Through in-depth interviews and focus group discussions (FGDs) their perceptions, motivations and incentives were discussed with regard to their institutional mandates in general, and their role in the Plantwise DMS in particular. They were also asked about their views on the benefits and challenges of the DMS. The qualitative data were complemented with quantitative data retrieved from the Plantwise Online Management System (POMS).

In order to obtain a complete picture of the factors that influence the effective use and management of plant clinic data, ideally the views and perceptions of actors engaged in all DMS stages – data collection, processing and sharing/use – should be assessed. In this study, the majority of respondents were actors involved in the first stage. This was purposefully done, to gain detailed insight in the data collection stage, as Plantwise activities in Myanmar had been rolled out relatively recently with a focus on the establishment of plant clinics and training of plant doctors. In practice this meant that we mainly spoke with plant doctors and the people coordinating and managing extension work at regional levels.

DMS developments move fast in Myanmar. Since the field work took place late 2016, there may be elements of subsequent progress that are not captured in this reports.

The idea of a plant clinic data management system

Within a period of less than three years PW-M, through the leadership of the Plant Protection Division (PPD), has established 23 plant clinics and trained 30 plant doctors (by July 2016). In essence, the Plantwise method serves demand-driven extension with information directly collected from farmers and stored in a repository to assist evidence-based/ tailored research and extension. The aim of a DMS as part of a wider plant health information system is embraced by all stakeholders interviewed. They see the need for an up-to-date information system in order to address new and emerging pests and diseases in a dynamic agricultural context, to foster collaboration with other plant health stakeholders and to contribute to improving quality of advisory services and decision making at various levels.

The PW-M team consists of people who are eager, dedicated and ambitious in their aim to further develop and contribute to a DMS containing up-to-date and accurate plant clinic data. Although a full-functioning DMS is not yet in place, at institutional level people feel incentivised to support the development of such system. They agree that this will contribute to Plantwise's overall aim to lose less and grow more, also in Myanmar.

Data collection

PW-M operates a paper-based data management system which means that plant clinic data are collected on printed forms which are later digitised and uploaded to the POMS. POMS data downloaded in October 2016 showed that, at that time, 13 clinics had a total of 1,154 queries recorded in the system (from Oct 2015 to Oct 2016). The data was of high quality in terms of percentage harmonisation (almost 100%) and completeness.

Data processing

In five out of the eight regions operating plant clinics, the plant doctors are also working as regional data managers and therefore involved with digitising the clinic data. The data of the other three regions are collected and entered by PPD staff at the Yangon headquarters where data harmonisation also takes place. The use of English in the POMS is sometimes challenging for data managers working with prescription forms written in the local language.

The paper-based data collection process is perceived as time-consuming. There is a significant lag time from data recording until processed data is available in POMS. The observed lag time is likely to be caused by a combination of transfer time, insufficient computers, staff, staff skills as well as language complications. Plant doctors and data managers are eager to shift to a tablet-based system (e-plant clinics). This would smooth data collection, entry into POMS and harmonisation. Seeking collaboration with Pestpoint, another global programme using ICT to improve pest identification, might create useful synergies.

At the time of the study, the National Data Manager (NDM) was the only person skilled to do data validation, apart from the PW-M Project Coordinator, who did not have time for this due to other responsibilities. A national validation team was yet to be established. Due to the limited experience with data validation in Myanmar, it is too early to assess the feasibility of the Plantwise validation protocol. Formalisation of data validation procedures should also include discussions about what data quality standards are required by whom and for what? What quality management scheme is feasible and relevant in a Myanmar context?

Data use

The use of POMS by partners is still very limited in Myanmar. Of the four individuals who have been given access to POMS in Myanmar, two have activated their account (by mid-June 2017). Of these, only one person, the NDM entered the system in 2016, with a total of 41 login sessions spread over most of the year. The regional data managers indicated that they do not feel comfortable and experienced enough to do data analysis despite the training they received (data validation and analysis). In addition, they have to compete for access to the few available computers. The NDM analyses and uses clinic data to generate statistics and reports on pests and diseases, crops, diagnoses and pest management. Analysed data are shared with the PW-M Project Coordinator with a copy to the National Coordinator.

Future developments

PW-M is facing challenges with regard to establishing a well-functioning DMS. These include budgetary limitations, lack of investment in ICT equipment and lack of sufficient qualified personnel to ensure smooth processes. Securing staff and making computers available are therefore high on PW-M's agenda for 2017 and onwards, especially in light of the plans to further expand the plant clinic network. CABI's key priority is to continue building data management capacity at the various levels, and to assist Myanmar partners with the establishment of effective systems and procedures for manging and using the data.

Currently, all PDs are recruited from the PPD which seems to be understaffed already. Engaging with the extension apparatus of MOALI is of particular importance in order to secure sufficient staff, strengthen the synergies between extension and plant protection and to enhance the resilience of the system.

The assessment framework

Based on the results from Kenya and Myanmar and further discussions and analysis of POMS data, a generic assessment framework has been developed wherein each of the DMS phases – data collection, processing and sharing/use – are assessed against the key indicators: *efficiency, feasibility and quality* (Posthumus et al., 2017).

1. Introduction

Plantwise is a global programme led by CABI, which works to help farmers lose less of what they grow to plant health problems. Working closely with national agricultural advisory services the programme supports the establishment of networks of plant clinics, run by trained plant doctors, where farmers can find practical plant health advice. To control pests and diseases, Plantwise focuses on disseminating good agricultural practices (GAP) and Integrated Pest Management (IPM) through targeted plant doctor training and development of locally relevant green and yellow lists[1].

To achieve its goal, Plantwise uses a system approach which focuses on three core and inter-related areas:

- **Plant clinic networks**, at the core, by working with existing extension providers;

- Systems for **management and use of plant clinic data (POMS)** and **provision of plant health information (Knowledge Bank)**;

- **A systems approach**, improving the capacity and responsiveness of (national) plant health systems.

Building effective systems for management and use of plant clinic data is thus a core element of the Plantwise intervention strategy. A fundamental assumption is that good use of the data can help strengthen plant health systems making them more responsive to existing and emerging plant health threats in addition to contributing to improving quality of advisory services and decision making at various levels.

Similarly, the importance of strong *health information systems* in human health has been highlighted by many, for example Teklegiorgis (2016): "A health information system is a system that integrates data collection, processing, reporting, and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services. Maintaining a good health information system is an essential part in strengthening a health system".

> **Box 1. Data vs. information**
>
> It is important to make a distinction between data and information; data are bits of information, facts and figures. When data is processed, interpreted, organized, or presented to make it meaningful and useful, one obtains information. In the case of the Plantwise DMS, data is thus collected from plant clinics, processed, organized and interpreted within POMS in order to create and share information on plant health amongst stakeholders.

The Plantwise Knowledge Bank plays a key role in the programme's effort to strengthen plant health information systems (PHIS) nationally and globally. In addition to providing a comprehensive open access online resource developed according to user needs for pest diagnosis and distribution, as well as plant health management, the Knowledge Bank supports the plant clinics by providing secure data and information tools for managing and analysing clinic data, and by working with them to learn to handle data (Finegold et al., 2014). These two parts of the Knowledge Bank are illustrated in Figure 1.

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[1] Green and yellow lists, a concept first developed by the Commission on 'Guidelines for Integrated Production' of the International Organization for Biological Control's (IOBC) West Palearctic Regional Section (WPRS) to provide indirect and direct pest control options. It has been adopted and expanded through Plantwise (source: http://www.iobc-global.org/news_20160121_Plantwise.html, latest access on 6th February 2017).

This study focuses on the closed access part of the Plantwise data management system (DMS) (left part of the figure). The DMS is set up to enable systematic real-time collection, processing and analysis of plant clinic data.
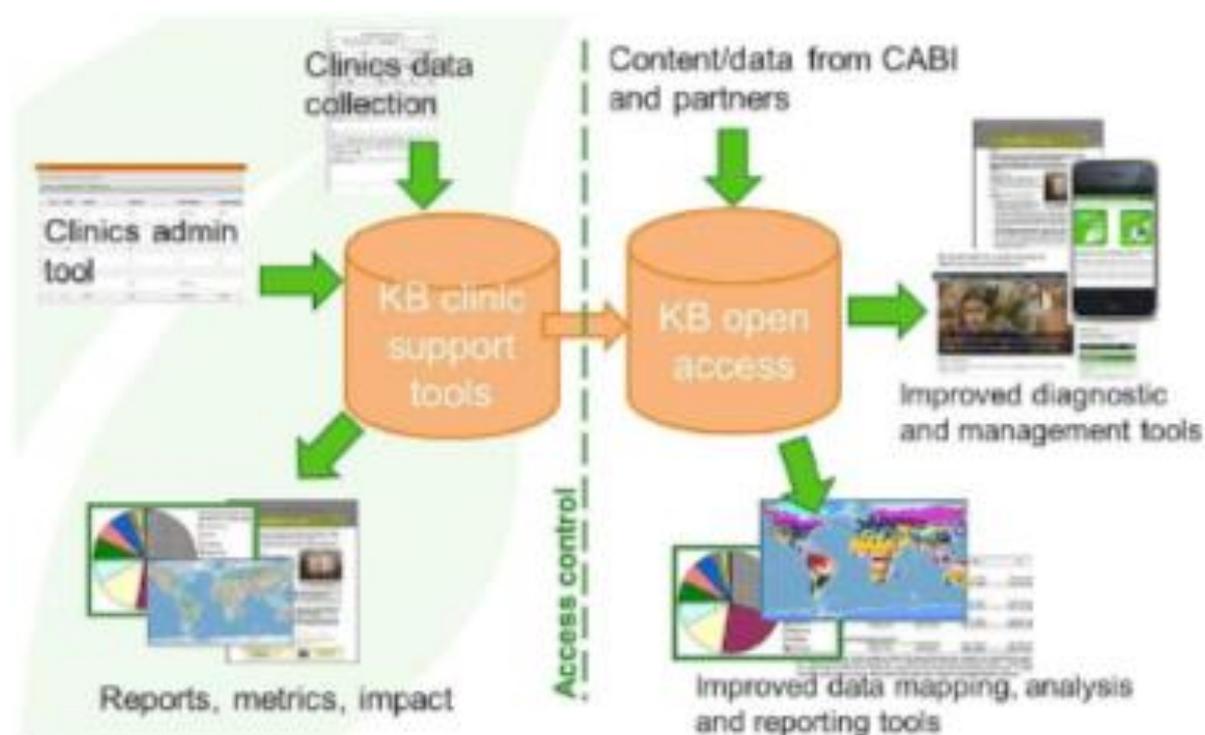
Figure 1. Schematic diagram of access controlled and open access sections of the Plantwise Knowledge Bank (Finegold et al., 2014)

The purpose of the DMS is to provide data that can **a)** inform actions (decisions) by plant health system (PHS) stakeholders, and **b)** be used for M&E by the program and partners. Among the possible uses of plant clinic data, the following are mentioned in the Plantwise training materials[2]:

- Identify *farmers' plant health problems* and their *distribution* (snapshot of pests causing farmers problems)
- Provide *early warning*, i.e. identify new and emerging pests (pests vigilance)
- Shape *priorities for extension* (identify topics for campaigns and other actions)
- Identify needs for *further research* (technology development)
- Identify need for *plant doctor training* and *backstopping*
- Assess plant *clinic performance* (regularity, attendance, coverage, quality)

Experiences from a number of Plantwise countries have indeed shown that plant clinic data can be used to strengthen performance monitoring of plant doctors, inform research about demands for new technologies, target extension activities and to support early warning

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[2] Trainings on e.g. *Data Management, Data into Use* and *Monitoring Plant Clinic Performance*

systems and their responses. Yet, for this potential to be fully exploited, a number of basic conditions need to be in place.

Establishing new ways of managing, sharing and using data involve substantial organisational change, within and between organisations. Lessons from human health indicate that establishing effective health information/data systems in low-income settings is complex and highly context specific (Braa et al., 2007). Among the factors that influence the functioning of health information systems are: Organisational mandates, procedures, resources and capacity, governance and management structures, incentive systems and attitudes towards data use and sharing (Lippeveld and Sapirie, 2001; Danielsen and Matsiko, 2016; Teklegiorgis et al., 2017).

The establishment of effective systems for plant clinic data management and use requires thorough knowledge of the people (both users and suppliers) and processes involved, available information/ knowledge systems/ tools, and how country partners perceive the Plantwise intervention.

The study

In order to assess the functioning of the Plantwise data management system and gain insight into the factors influencing the effective management and use of plant clinic data, a study was carried out in two countries, Kenya and Myanmar.

Specifically, the study aimed to:

1. Understand how plant clinic data are managed, perceived and used by partners at different levels (local, county, national). This includes looking at processes for managing, capturing, processing, sharing and using data; roles, perceptions, motivation and incentives along the data management chain; compatibility with existing data/information management systems as well as effects of the context.
2. Identify key challenges and opportunities for improving systems for plant clinic data management and use.
3. Identify key criteria and variables for future assessments of plant clinic data management systems (e.g. efficiency, feasibility, quality).

The two countries represent different stages of development of the DMS, with Kenya operating a tablet-based DMS and Myanmar a paper-based DMS.

This country report mainly describes the findings from Myanmar with regard to the first two points. The third point will be dealt with in the general report in which a generic assessment framework will be presented based on the results from both countries. It was initially the aim also to assess the value for money (VFM) aspects, which was however not feasible in the time frame given and may require a follow-up study.

2. Plantwise Myanmar

Plantwise Myanmar (PW-M) began with CABI's partnership with the Ministry of Agriculture, Livestock and Irrigation (MoALI) through the Plant Protection Division (PPD), Department of Agriculture (DOA) based in Yangon. PW-M started with an inception workshop in March 2014 after which a pilot phase commenced lasting from June 2014-June 2016.

Plantwise key partners in Myanmar include:

- Plant Protection Division (PPD), Department of Agriculture, Ministry of Agriculture, Livestock and Irrigation (MoALI) – NRO & LIO
- Yezin Agricultural University – Provides technical support
- Department of Agricultural Research (DAR) – Provides technical support

The DOA has separate divisions which deal with plant protection: the PPD which is responsible for e.g. IPM, entomology, plant quarantine, pesticide analyses and agri-produce quality, and the Agricultural Extension Division (AED) dealing with general agricultural extension issues.

The PPD acts both as the National Responsible Organisation (NRO) for Plantwise leading and coordinating PW-M, and the Local Implementing Organisation (LIO), responsible for running the plant clinics. It has regional representations in the major regions of the country. Plant doctors from regional stations are responsible for running plant clinics under the direction and guidance of the National Coordinator. The PPD provides logistical support, human resources, planning and organisation for all Plantwise activities (Plantwise Annual Report Myanmar, 2016). The Plantwise functions of PPD staff are listed in Table 1.

Table 1. Roles of PPD staff in Plantwise Myanmar.

Plantwise role	Formal position in PPD	Based in
Plant doctors	PPD staff officers (working as agricultural extension officers e.g., in IPM and/or Biocontrol and after being trained by Plantwise currently acting as plant doctors as well)	Eight PPD regions
National Coordinator	Director Plant Protection Department	PPD HQ, Yangon
National Data Manager	Deputy Staff Officer IPM & Bio-control Laboratory	PPD HQ, Yangon
Regional Data Managers	PPD staff officers	Six PPD regions
Plantwise Project Coordinator	Deputy Director, Head of IPM Section	PPD HQ, Yangon

Within the pilot period, 30 plant doctors were trained and eight plant clinics established in three divisions: Yangon, Ayeyarwady and Bago. By July 2016, there were 23 plant clinics (PCs) in eight divisions (Table 2). The target for 2017 is to open another 20 PCs. The aim for PW-M is to have 300 PCs operating and 600 PDs involved in plant health extension activities by 2020 (Plantwise Annual Report Myanmar, 2015).

Table 2: Overview of plant clinics (PCs) in Myanmar by July 2016.

Division	# PCs	District(s)	Starting date
Yangon	2	Hlegu and Taik Kyi	2014, June
Ayeyarwady	3	Pathein, Kyaung Kone, Pyapon	2014, June
Bago	3	Nyaung Lay Bin, Taung Oo, Thar Yar waddy	2014, June
Nay Pyi Taw	5	Dak Khina Thiri, Boba thiri, Zayarthiri, Pyinmana	2015, March
Mon	1	Mudon	2016, July
Sagaing	2	Monywa, Shwebo	2016, July
Mandalay	4	Mandalay, Meikhtila, Yamethin, Pyin Oo Lwin	2016, July
Shan	3	Nyaung Shwe, Shwe Nyaung, Taunggyi	2016, July
Total # PCs	**23**		

3. Approach and methodology

When assessing the functioning and use of the Plantwise DMS, the human factor is central. Even when data are automatically stored in a system, it will be people using the data and managing the system. Therefore, the direct interaction with the Myanmar DMS actors was considered important to gain insight into how the people who make the DMS work perceive the functioning of the system they are part of. To obtain as much relevant information as possible in a short time period, KIT considered qualitative methods (in-depth interviews and focus group discussions) the most suitable.

To understand how the processes for capturing, processing, sharing and using data work in practice, a mapping exercise was carried out with "information chain" actors, as well as interviews and Focus Group Discussions (FGDs) with selected informants. A preliminary evaluation matrix was used wherein each of the DMS phases were assessed against the key indicators: *efficiency, feasibility* and *quality*.

For the mapping exercise and the interviews/FGD we prepared questions aimed to gain insight into the roles, perceptions, motivation and incentives of the different information chain actors. Besides these socio-organisational aspects of the functioning of the DMS, contextual/ infrastructural facets were incorporated as well, e.g. the compatibility with existing data/ information management systems, challenges and opportunities. A description of these exercises and tools are included in the generic assessment framework (Posthumus et al., 2017).

Interviews and FGDs were held in the local language and translated by the local consultant. This allowed the respondents to express their opinions in their mother tongue, but some of the information and meaning may have been lost in the translation. Where possible, the international and local consultants divided the individual interviews among each other to obtain as much as information as possible from more respondents.

The following list summarises the methods applied in Myanmar:

- Meeting CABI Plantwise Myanmar staff
- Validation exercise of the current DMS flow
- Workshop / mapping exercises

- FGD with data managers and plant doctors
- 2 field visits
- Interviews with other stakeholders (not directly involved in Plantwise but institutionally and/or content related)
- SWOT analysis
- Analysis of POMS data

Table 3 presents a gender-disaggregated overview of all stakeholders interviewed, including numbers of total people present when discussions or meetings involved more than an individual respondent.

Table 3. Plantwise Myanmar (PW-M) overview of stakeholders met /interviewed.

Stakeholder	Method	# Respondents
Plant Doctors / Plant Health Extension Officer	Individual interviews	3
	FGDs	F: 2 + M: 4
Regional Data Managers Plant Protection Division IPM staff	FGDs	IPM staff– F: 22 Data Managers F: 4 + M: 2
National Data Manager	Individual interview	1
PW-M Coordinator	Individual interview	1
Other PPD staff	Individual interviews	4
Regional MoALI staff: • Regional Agriculture, Livestock and Irrigation Minister • Regional Deputy Director • District extension officer • Regional Director Pathein, Ayeyarwaddy region	Individual interviews	4
Plantwise international staff: • CABI SEA • CABI UK/ NL • CABI board member	Meetings	2 meetings

F: Female; M: Male; Pax: # of persons

To complement the qualitative study component, quantitative data were acquired by examining plant clinic data and POMS login statistics during one year. Data summaries included: # farmer queries per month by clinic, POMS login user statistics, % harmonized and validated data, and % frequency each field in the prescription form had been filled.

The quantitative data are obviously key to providing information about the functioning and use of the DMS. They can also be used to prompt deeper discussions with different stakeholders and to triangulate with the information collected from the informants. However, in this first step of the study the main focus was on the qualitative aspects. Due to a very tight interview and FGD schedule in Myanmar, we lacked sufficient time to discuss, validate and further develop the assessment matrix, in particular with regard to defining the indicators and key variables (for more details see Posthumus et al., 2017).

4. Results and discussion

This chapter describes the main findings of the study. First, an explanation is given of how the DMS currently works and who is involved at the different stages. Then, a description of POMS is provided with examples of analyses of Myanmar clinic data. Thereafter a more detailed description of stakeholders' perceptions of the different processes for managing and using data is given, including the challenges and opportunities for improving systems for plant clinic data management and use. The chapter ends with a SWOT analysis taking both the DMS and the general Plantwise programme in Myanmar into consideration.

4.1 The Plantwise data management system in Myanmar

The Plantwise DMS in Myanmar works with paper-based prescription forms. The national Plantwise data manager (see Table 1) at PPD headquarters in Yangon is responsible for the coordination and analysis of all data from all regions. As the number of plant clinics in Myanmar is gradually expanding, PW-M is exploring how to organize data entry into POMS in the most efficient way.

The Myanmar DMS is depicted in figures 2 (focus on the organisational process) and 3 (focus on the various data processing steps). In the paper-based system practical preparations (referred to as groundwork in figure 2) have to be made prior to the actual data collection and processing. These consist of the printing of prescription forms and distribution to the plant doctors operating clinics for which the National Data Manager (NDM), assisted by two junior PPD staff (recent MSc Agriculture graduates), is responsible. The forms are either sent by courier or manually delivered to the regional PPD offices, from where they are taken to the sub-PPD offices and subsequently to the PDs.
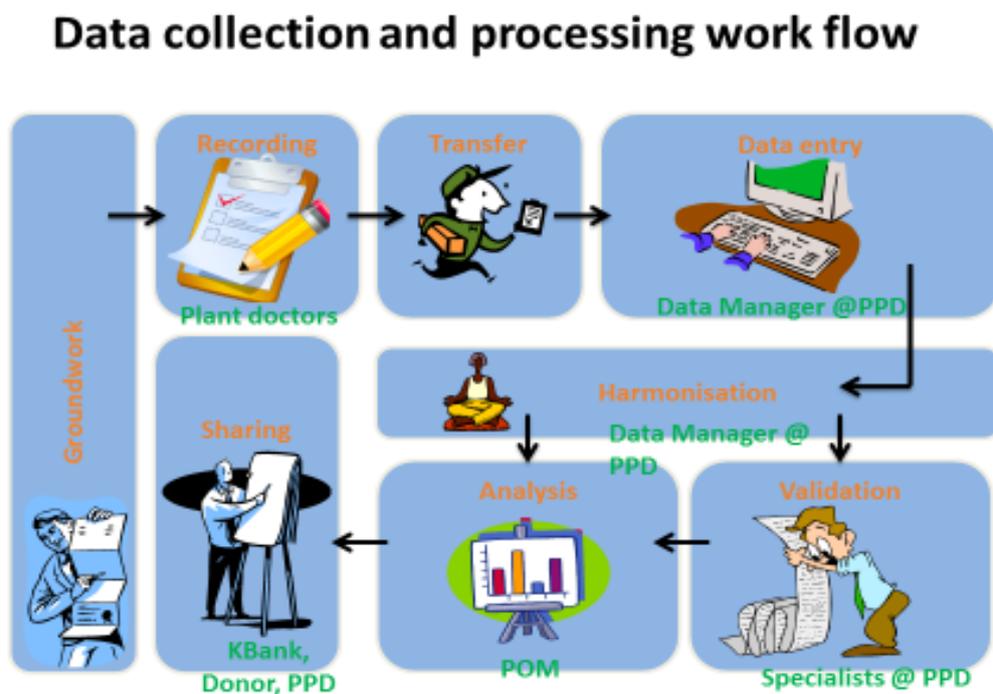

Figure 2: Data collection and organisational work flow for Plantwise Myanmar
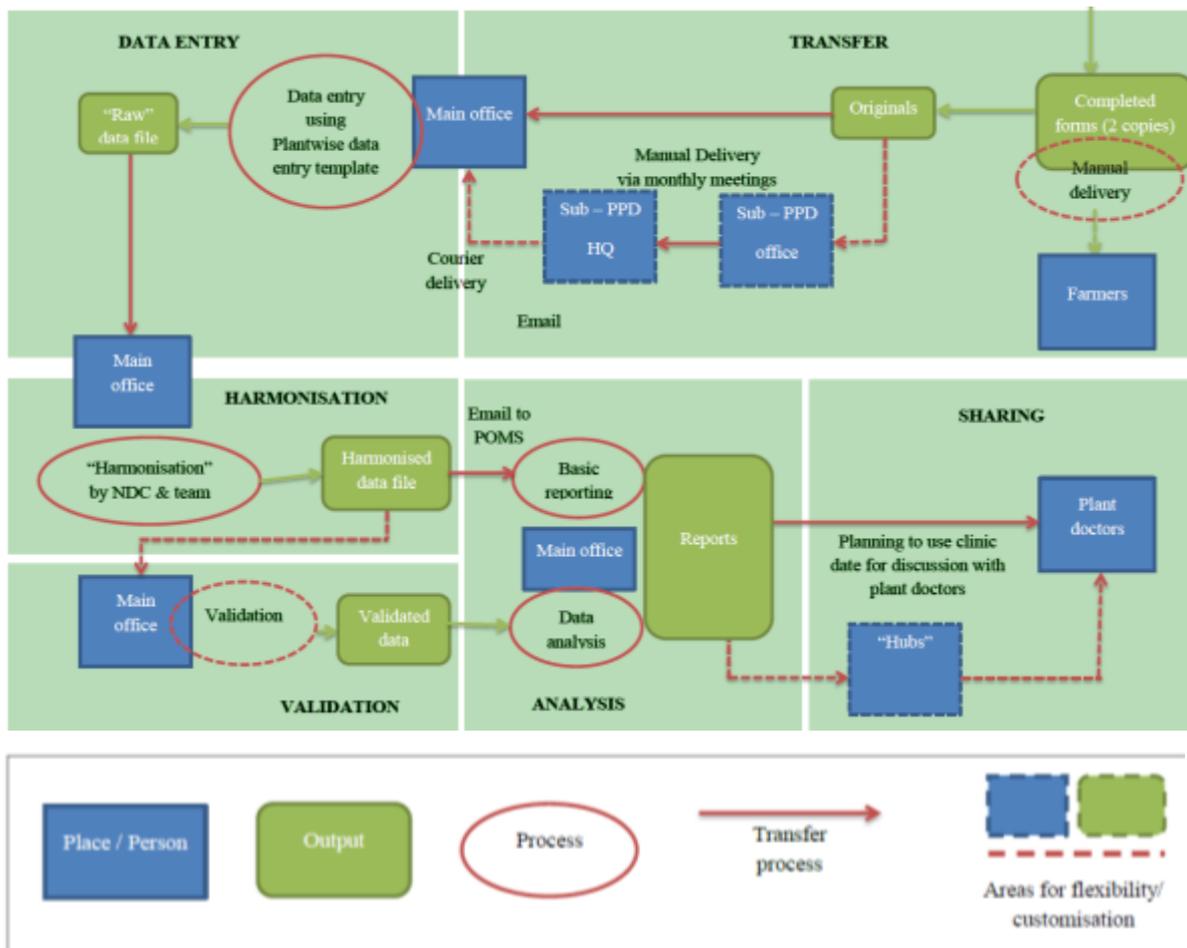
Figure 3 Plant clinic data processing flow diagram for Plantwise Myanmar

Data collection

Data recording and transfer. During plant clinic sessions, plant doctors record farmers'
queries in the prescription form, including clinic administrative details, contact details of the
farmer, symptoms of the infested crop and management recommendations. Completed clinic
forms are collected and transferred through mail or courier to a central hub, e.g. a regional
PPD office. Plant doctors also provide the farmers with a copy of the form.

Data processing

Data entry, harmonisation and validation. In five out of the eight regions operating PCs the
plant doctors are also working as data managers and are as such involved with data entry
into the digital system. The data of the other three regions are collected and entered by PPD
staff at the Yangon headquarters. Plant clinic data are transferred to an Excel data entry
template. The data are cleaned, standardised and harmonised to enable analysis and
reporting. At the time of the study, these steps were being dealt with by the NDM supported
by the two junior PPD staff referred to above.

After data harmonisation, the diagnoses and recommendations should in principle be
validated by in-country experts verifying whether diagnoses match the symptoms and
whether the recommendations given are effective, safe, and practical. However, at the time
of the study (December 2016) a data validation team for PW-M was non-existent. The formal

establishment of such team has however been put high on the agenda for 2017. As an interim solution, the NDM is responsible for data validation with support from CABI Plantwise SEA. The latter has been supporting the Myanmar programme since the beginning with the intention to gradually phase out once the DMS fully equipped to operate independently. The uploading of validated data to POMS was said to be taking place every 3-4 months. However, information from POMS could not confirm this (see Section 4.2 for more details).

Data use

Analysis and sharing. The NDM analyses and uses clinic data to generate statistics and reports on pests and diseases, crops, diagnoses and pest management. Analysed data are shared with the Plantwise Myanmar Project Coordinator (PPD Deputy Director, Head of IPM Section) with a copy to the National Coordinator (Director Plant Protection Department). The Plantwise Myanmar Project Coordinator will formally report the data with a narrative explanation to the National Coordinator.

Table 4 Key actors in the Myanmar Plantwise DMS process.

		Actors involved
DMS category	**DMS step**	**Paper-based**
Data collection	1. Recording	PDs/ regional data managers on prescription forms (paper-based)
	2. Transfer	PDs/ regional data managers via data entry hubs, e.g. regional PPD offices
	3. Data entry	Regional data managers; PDD Yangon office assisted by junior PPD staff
Data processing	4. Harmonisation	Data managers; assisted by junior PPD staff (recently graduated MSc Agric. students). Plantwise national Project Coordinator (checks and corrects data).
	5. Validation	NDM, CABI Southeast Asia and CABI UK. Formal national validation team non-existent at the time of study.
Data use	6. Analysis	NDM and national Project Coordinator
	7. Sharing	Regional data managers; NDM; PW-M coordinator; National coordinator Plantwise Myanmar (Director PPD)

Table 4 summarises the actors involved in the eight steps of the Plantwise DMS process identified through a mapping exercise. The key actors are: plant doctors-cum-regional data managers, the NDM and the Project Coordinator. Limited financial resources impeded the development of a full-functioning DMS. Data managers had to share two computers located at one of the regional PPD offices and the PPD headquarters in Yangon, respectively. Further, sufficient funding was lacking to recruit and train qualified personnel that could contribute to the DMS. Since the focus of Plantwise during the first two years has been on the set-up and operationalisation of plant clinics, less time and resources have been dedicated to establish a full-functioning DMS. Securing staff and equipment to accommodate the management and use of the DMS is high on the agenda for 2017.

4.2 Plantwise Online Management System (POMS)

POMS functions as a global repository of plant clinic data from Plantwise countries. Due to the sensitivity of plant health data, access to POMS is secured and restricted to certain users requiring a password to enter the system. The Knowledge Bank Development Manager, responsible for POMS, explained that POMS is used for the stages of harmonization, analysis and sharing. It also holds information necessary for the maintenance and analysis of clean data i.e. a people form including plant doctor name and clinic code. POMS is on the interface between data entry and harmonization: partners use the upload page in the POMS to upload their data.

The plant clinic data kept in POMS can be used and analysed in different ways. Firstly, there is an option to create an automated report in PDF with simple analyses (e.g. # plant clinic sessions held, farmer queries by gender, crops and diagnoses) for a selected period (see Figure 4). Secondly, it is possible to download a data set that works with an offline data analysis tool, downloadable from the POMS, allowing for more in-depth analyses. Thirdly, the data can also be downloaded as an Excel file, either the whole dataset or parts of it, for individual tailor-made analyses.

In 2016, POMS underwent a major overhaul to make it more user-friendly. There are now 5 options for downloading data, one of which concatenates field outcomes from the prescription form into fewer columns (from ca. 130 columns to 40) for 'viewing or analysing', compared with a download that allows users to reharmonise data and thus requires all field outcomes to be in separate columns. The user interface has been improved and the dashboard is more informative.

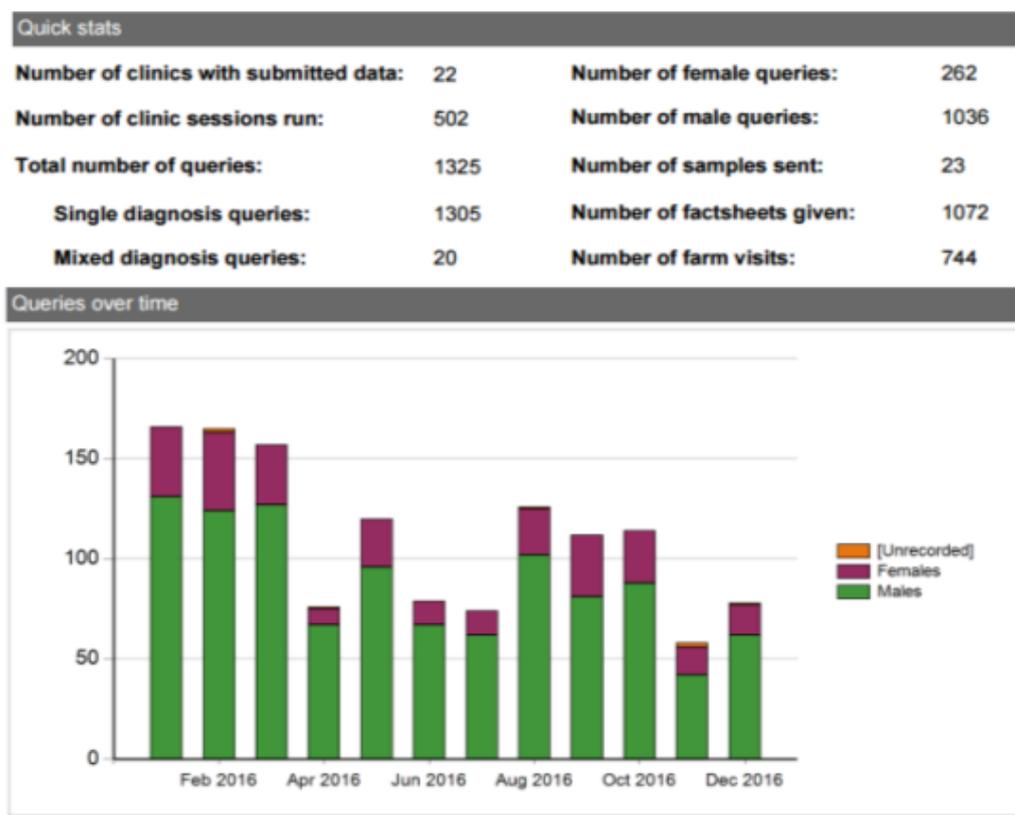| Quick stats			
Number of clinics with submitted data:	22	Number of female queries:	262
Number of clinic sessions run:	502	Number of male queries:	1036
Total number of queries:	1325	Number of samples sent:	23
Single diagnosis queries:	1305	Number of factsheets given:	1072
Mixed diagnosis queries:	20	Number of farm visits:	744

Figure 4. Excerpt from automated report created in POMS based on Myanmar data from 2016 (data downloaded June 2017)

The following shows a few additional examples of POMS data analyses to illustrate how the data can contribute to assessing the functioning of both the plant clinics and the DMS itself. These data summaries were made after the visit to Myanmar. It was therefore not possible to include them in the discussions with stakeholders referred to in the section 4.3. For future DMS assessments the data analyses should be made first so that they can be used to enrich the discussions with partners.

Plant clinic activity and speed of data uploading

Plant clinic data covering the period Oct 2015 to Oct 2016 were downloaded on 19th Oct 2016. The dataset consisted of 1,154 queries from 13 clinics (Table 5). In summary, the data show that over a one-year period:

- Thirteen (13) clinics out of 25 had submitted data to POMS
- Five (5) clinics had more than 100 queries/ year
- Three (3) clinics had less than 50 queries
- Eleven (11) clinics had no queries recorded from June 2016
- November – December appears to be a peak period

From April 2016 a declining trend in number of queries is observed. The 10 new plant clinics established in July 2016 (see Table 1) did not have any queries recorded in POMS as of October 2016. This does not mean that plant clinic data have not been collected but rather that there is a certain lag time from the data is collected until they are processed and made available in POMS. Part of the explanation is the aforementioned lack of sufficient computer equipment and shortage of staff familiar with data processing in POMS.

Table 5. #queries recorded in POMS Oct 2015 – Oct 2016 (downloaded 19.10.2016).

Plant clinic	2015			2016							Total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Total
MMAY01	9	22	24	11	12	9	4				91
MMAY02	2	22	24	12	9	10	4				83
MMAY03	5	32	32	18	16	20	9				132
MMBG01	15	21	9	6	7	9	10				77
MMBG02		12	6	5	7	5	5				40
MMBG03		1	7	5	5	3					21
MMNP01	8	8	15	10	11	8	2	5			67
MMNP02	19	32	26	30	28	14	6	11			166
MMNP03	10	14	19	18	16	20	8	19			124
MMNP04	8	12	16	14	17	16	11	14			108
MMNP05	4	12	18	20	20	27	8	10			119
MMYG01		12	14	12	12	10	4	1	9	10	84
MMYG02	2		4	5	5	5	5	5	5	6	42
Total	**82**	**200**	**214**	**166**	**165**	**156**	**76**	**65**	**14**	**16**	**1,154**

The effect of the lag time can be seen in Table 6 where data from the same period were downloaded 5 and 7.5 months later. There is almost a 40% difference in the query numbers between the last and the first date.

Table 6. Plant clinic data covering the period 19 Oct 2015 to 19 Oct 2016, downloaded from POMS on three different dates.

Variable	Date of download from POMS		
	19 Oct 2016	27 March 2017	7 June 2017
# plant clinics	13	17	22
# queries	1,154	1,349	1,641

The data patterns displayed in Tables 5 and 6 raise a number of questions that should be addressed by the relevant authorities (programme/data/extension managers) as part of the regular monitoring procedures:

Do the data give an accurate picture of clinic regularity and queries attended?

🌿 **If yes**, how do they reflect on plant clinic performance?

- o What influences the observed patterns (low vs. high attendance)? E.g. clinic placement and timing, plant doctor availability, funds, commitment, seasonality, degree of crop problems
- o What management decisions are required to improve (if any)?

🌿 **If no,** how inaccurate are the data?

- o What are the causes of the inaccuracies? Are there any issues with the DMS itself? E.g. procedures, capacity, resources and infrastructure, incentives, motivation, management, policy environment etc.
- o What management decisions are required to improve?

Data quality

Data quality was not analysed in great depth in this study. This section addresses a few aspects: proportion of harmonised and validated data and completeness in form filling.

The proportion of harmonised crop names in POMS has been high since 2015, with more than 98% harmonised (Table 7. *Note*: a different data set was used here to compare the trend over a longer period). A quick look at the data also indicates a high degree of harmonised diagnoses (not shown). Clean and harmonised data are a key prerequisite for making accurate data summaries and analyses.

The table also demonstrates that no validated data were recorded in POMS for Myanmar. The study did not look further into this aspect, so we cannot say whether it is because no data were validated in the period, or that they have not been recorded in POMS. A KB Content Developer explained that: *"The Excel tool used to validate the records was an older version which is no longer compatible with POMS. We are currently in the process of migrating the records to the current version. Once this process is completed, validated records will be uploaded onto POMS."*

Table 7. Percentage harmonised and validated plant clinic data from Myanmar from different periods as recorded in POMS

Processing step	1st half 2015 (n=1,466)	2nd half 2015 (n=1,222)	1st half 2016 (n=745)	2nd half 2016 (n=560)	1st half 2017 (n=109)
%harmonised (crop names)*	98.4%	98.7%	98.5%	98.8%	100%
%validated	0%	0%	0%	0%	0%

* Entries that are spelled according to the agreed terms (picklist)

Table 8 summarises the use of the different fields in the prescription form, comparing before and after March 2015. Overall the completeness is high and has even increased over time for all fields, except symptom type. The Myanmar DMS assessment did not go deeply into discussions on design and use of the prescription form data fields, yet future DMS assessments should include questions such as: What information is collected? Who uses it, how, and for what?

Table 8. Myanmar POMS data: Frequencies of selected data fields filled before and after 18/03/2015.

*How frequently are each of the fields below **used** in the form?*

*How frequently has the plant doctor **not ticked**/ filled the field below?*

Data field	Pre 18/03/2015	Post 18/03/2015		Data field	Pre 18/03/2015	Post 18/03/2015
Day	100%	100%		Farmer Gender	0%	0%
Month	100%	100%		Sample Brought	1%	0%
Year	100%	100%		Area Planted (unit)	0%	0%
ClinicCode	100%	100%		Crop Affected (%)	19%	6%
PlantDoctor	100%	100%		Lab Sample Sent	10%	1%
FarmerName	100%	100%		Factsheet Given	10%	1%
FarmerCounty	100%	100%		Field Visit Arranged	11%	2%
FarmerLocation	100%	100%		Development Stage	3%	0%
FarmerVillage	100%	100%		Part Affected	9%	2%
FarmerTelephone	8%	27%		Symptom Type	5%	30%
Crop	100%	100%		Distribution (in field)	2%	1%
Variety	96%	98%		Diagnosis (Biotic/Abiotic)	0%	1%
YearFirstSeen	98%	100%		Recommendation Type	2%	1%
AreaPlanted	99%	100%				
YieldLoss	61%	94%				
ProblemDescribed	100%	99%				
PestDiseaseWeed	100%	100%				
PracticesUsed	100%	100%				
Recommendations	100%	98%				

Source: Compiled by Tim Beale, March 2017

Use of POMS by partners

The use of POMS by partners for managing and analysing the clinic data is still very limited in Myanmar. Of the four individuals who have been given access to POMS in Myanmar, two have activated their account (by mid-June 2017). Of these, only one person, the NDM entered the system in 2016, with a total of 41 login sessions spread over most of the year (Table 9).

Table 9. Number of POMS user logins by month in 2016, Plantwise Myanmar.

User	J	F	M	A	M	J	J	A	S	O	N	D	Total
National Data Manager	2		6	5	6		11		2	3	3	3	41

4.3 Stakeholder views on the Data Management System functioning

This section presents the views, perceptions, motivation and incentives of the actors involved in the DMS process flow with regard to the execution of their tasks. Further, the benefits and values that actors allocate to the Plantwise DMS are described as well as the challenges and opportunities they face. To this end, the eight different steps of the DMS steps are grouped into three categories: **(1) data collection**, covering steps 1 groundwork, 2 recording, and 3 transfer; **(2) data processing** comprising steps 4 data entry, 5 harmonisation and 6 validation; and, **(3) data use** covering steps 7 analysis and 8 sharing.

As the DMS is a component of the wider Plantwise programme respondents not only mentioned their perceptions of the DMS *per se* but also expressed their feelings about the wider plant health system's functioning, including challenges and opportunities. The responses are summarized in the Annex.

4.3.1 Data collection: groundwork; recording and transfer

Data collection: Plant Doctors views

As mentioned earlier, plant doctors from five out of the eight regional PCs perform a dual function and are data managers as well. These plant doctors have all obtained their BSc in Agricultural Science. They are officially employed by the PPD and received training by Plantwise to become plant doctors and data managers.

The PDs told that it takes about 20-30 minutes to fill a prescription form. They are aware of their colleagues in other Plantwise countries who were introduced to the e-based system making use of tablets and consider that such system would greatly ease their work. They do not only see the advantages of using tablets for data collection. The PDs also anticipate benefits of mobile devices for referral purposes through other related initiatives such as Pestpoint (Box 2).

All PDs indicated that their involvement in Plantwise had increased their performance as advisers on plant health. Among the reasons mentioned was the keeping of records which encourages them to study more to solve the problems farmers encounter in their fields. All PDs felt that mutual trust between them and the farmers facilitated the collection of plant

health information from the farmers. They gave some ideas on how to increase farmer attendance at the plant clinics, and hence boost data collection:

- 🌿 Ensure strategic positioning of plant clinics easily accessible to farmers
- 🌿 Vary the frequency of PCs or use special/ flexible opening hours during the cropping season
- 🌿 Increase availability of, and access to, quality reference material to trigger farmers to visit plant clinics more often

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Box 2. Plantwise and Pestpoint

Some plant doctors are also engaged in Pestpoint. This is another (global) programme aimed at pest identification in crops. It keeps a digital platform where people can join and receive advice from both peers and experts on evidence-based pest identification.

The programme started early 2016 in Myanmar, and participation has been limited to PPD staff so far. The PPD staff involved have been provided with a tablet which not only contains relevant information but also offers additional functions. For instance, a little magnifier can be attached to the tablet which automatically translates a magnified image in its screen when a picture is taken of the (tiny) pest-infested spots on a crop. Such an image may ease and /or accelerate accurate detection of a pest. When the user is unsure whether the pest is bacterial or fungal, he or she can seek advice via the Pestpoint platform.

One of the PDs in Ayeyarwady region involved in both programmes makes use of the Pestpoint tools to support the Plantwise work and considers this complementarity as beneficial to his overall work as an agricultural extension officer.

Data collection: other Plantwise DMS actors' views

The regional data managers, the NDM and the PW-M Project Coordinator put great value on the recording of plant health data in a DMS. They appreciate contributing to a growing repository of plant health information. While the people directly involved in data collection (PDs) mainly observed practical challenges to the smooth operation of the process, other PPD staff primarily stressed the qualifications of PDs being key for reliable data collection. They expressed their concern whether recent graduates were capable enough to properly address crop management problems and thus obtain quality data. They believe that recent graduates trained as plant doctors could not be considered equivalent to, for instance, plant pathologists, entomologists, IPM experts with years of working experience. Also the former Deputy Director of the PPD emphasized that quality of data is more important than quantity (Box 3).

In sum, for the smooth collection of quality data, the availability of sufficient material and human resources is a prerequisite. In addition, the skills of a qualified, experienced, dedicated and communicative plant doctor will contribute to farmers' trust and willingness to share their pest problems with PDs, thus contributing to reliable data collection.

> **Box 3. Plant doctors' qualifications contribute to reliable data collection**
>
> According to the former PPD deputy director, a plant doctor should be qualified to make proper diagnoses of pests and diseases. This starts with training but it requires time and patience to become an acknowledged expert. The more experienced PPD staff selected to be trained as PDs have the advantage of having built trust relationships with farmers compared to the younger/newly recruited staff who have to gain experience to become trusted experts in their specialised area. "*The nature of a plant doctor is quite similar to a medical practitioner. As he becomes older, he will be well equipped with experience which will earn him more trust of the patients,*" he said.
>
> Next to training, time and patience, he added the importance of dedication of the plant doctors. He mentioned the example of a female PD in Ayeyarwady region who opened a Facebook account to communicate with the farmers and to share her expertise with other colleagues within the PPD or other DOA divisions. Her activities were successful and provided the basis for the regional DOA in Ayeyarwady to expand and upscale its activities on plant health extension.

4.3.2 Data processing: data entry, harmonisation and validation

Plant doctors-cum-data managers' views

The data are supposed to be transferred from the prescription forms to the digital system twice a month. However, the lack of sufficient equipment prevents regular data entry. There is only one computer available at each PPD office which has to be shared with other PPD staff as well. The data managers find this frustrating.

As the majority of the regional data managers have filled in the forms as PD, they are familiar with the data they enter into the system. However, they still consider their computer skills limited. Before their training on data harmonisation, validation and analysis, they did not have any experience with data entry. They are aware of the importance of having reliable data entered into the system and feel they lack the experience and confidence to take on more responsibility. They harmonise the data and upload them to POMS but they are currently not prepared to assist, let alone take over, data validation and analysis from the NDM.

The NDM added that the use of English in POMS and the different tools is sometimes challenging for PDs/ data managers working with prescription forms written in the local language. Because of this, a lot of work eventually ends up with the NDM.

The significant data entry lag time observed in Section 4.2 is likely to be caused by a combination of transfer time, insufficient computers, staff and skills as well as language complications.

These challenges may be further exacerbated when the number of PCs will expand as planned. For successful expansion of the plant clinic network in Myanmar the regional data managers will have to take up more of this work. This requires comprehensive data management training and more computers and staff. To help address the problems with staff scarcity, the PPD offered two of their junior staff (recently graduated M.Sc. Agriculture students) for this purpose. Yet, this does not make up for the insufficient equipment available. Besides, the recruitment of qualified staff willing to commit themselves to a long(er) term engagement with Plantwise is sometimes challenging, due to other interesting positions for graduated agricultural scientists in the job market.

At the moment, the NDM is the only person skilled to do data validation, apart from the PW-M Project Coordinator, who does not have time for this due to other responsibilities. The NDM can request support from the head of the PPD, entomologists, plant pathologists and the Pesticides Registration Board (PRB) as they are all operating under similar mandates and working for the same cause of plant health protection (besides, they reside in the same PPD compound). However, the collaboration is informal in nature. A national validation team however was not yet in place at the time of the study. Its establishment was set for 2017. Due to the limited experience with data validation in Myanmar, it is too early to discuss the feasibility of the validation protocol. Formalisation of data validation procedures should also include discussions about what data quality standards are required by whom and for what? What quality management scheme is feasible and relevant in a Myanmar context?

The NDM and the Project Coordinator know the importance of reliable data to be entered into a system that is meant to be used as a tool for (future) policy making, among other functions. The Project Coordinator therefore strongly feels the responsibility to recruit capable staff. The NDM considers command of the English language, computer skills, and expertise in pest and disease diagnosis and management critical to the successful functioning of the DMS. She believes that her role should mainly focus on human resources development, i.e. the training of (junior) staff to become qualified data managers. In (the near) future the two assistants at the Yangon office should conduct the activities of the NDM independently. The PW-M Project Coordinator, in turn, feels the responsibility to continuously encourage/ convince PDs/ data managers of their vital roles in the Plantwise DMS, as they are the primary contributors to the system. For the Plantwise DMS to become sustainable, staff should have sufficient and satisfying future prospects and incentives to avoid staff turnover.

The deputy director of the PPD suggested that existing (e.g. Pestpoint tablets) and future e-systems (e.g. POMS) may potentially contribute to the development of a reliable data bank containing trustworthy plant health information that can serve as input for the development of new/updated pest lists for many crops within Myanmar. Further investigation into how the two systems could complement each other is therefore required.

4.3.3 Data use: analysis and sharing

The regional data managers indicated that they do not feel comfortable and experienced enough to do data analysis despite the training they received (including modules on data validation and data analysis) and despite the fact that the group came together every three months to discuss the data they had collected.

Both the NDM and the PW-M Project Coordinator are well-equipped to conduct data analysis but it is mainly the NDM who does it. If the NDM discovers inaccuracy of data provided for by the PDs/regional data managers, she usually contacts them to inform them about this and to obtain the accurate data. This probably explains why the % of harmonized data is high and increases over time (Table 7). The NDM explained that harmonised and validated data are uploaded to POMS and then used for reporting. However, Table 7 shows that validated data do not appear in the system. It is not possible to say whether this is because validated data are not recognised in POMS or because validated data have not been uploaded.

Clinic data reports are generated (in principle and preferably bi-monthly) and shared with the PPD Director, who is the Plantwise National Coordinator (NC), the PW-M Project Coordinator and CABI SEA. The reports show the number of gender-disaggregated clinic queries received per region and per month, crop queries, diagnoses made and types of recommendations given by the PDs (cfr. the example of the excerpt of an automated reports as shown in Figure 6). The POMS data also provide the input for a description of PW-M activities in the annual reports. Additionally the PW-M Project Coordinator posts information, based on PCs' data, on DOA's website once in a while.

POMS data in Myanmar have not (yet) been used for policy making and/ or research purposes, although mention was made of a national Plant Health System Strategy for 2016 – 2020 being drafted in which the use of plant clinic data is an important component (MoALI, 2016). So far, the plant clinic data have mainly been used for monitoring clinic activity and plant doctor performance.

4.4 SWOT analysis

A SWOT analysis of the Plantwise programme was carried out with the PW-M project team, i.e. considering both the DMS and the general Plantwise programme in Myanmar. Table 10 summarises the results. It shows that the dedication and interest of people to participate in the programme are perceived as strengths, facilitating increased mutual trust between farmers and plant doctors.

Table 10 SWOT analysis of Plantwise Myanmar by the project team

Strengths	Threats
• Dedicated and enthusiastic staff • Easy take-up of DMS by staff • Clinics are a good tool to improve communication skills • Increased trust of local farmers	• High staff turnover • Need financial support for sustainability • Overlapping with and similar activities of other projects (e.g. Pestpoint, KOICA, JICA)
Weaknesses	**Opportunities**
• Paper based system is time consuming • Junior staff have little field experience • Junior staff not (yet) familiar with DMS • Limited equipment for PDs and data managers (e.g. reference materials, computer) • Lack of data validation team • Limited communication and collaboration between different institutions involved • Currently limited support from decision makers • Limited use of the plant clinic data	• Data to offer baseline support for pest quarantine and SPS purposes • Support to general pest list information • Development of an information network among PDs and data managers across the country • Sharing information on pest problems and solutions among different institutions • Linking more closely with Pestpoint • Multi-stakeholder/ round table dialogue • Use PC incidence data to predict pest outbreaks and early establish warning system • A well-functioning DMS is seen to eventually contribute to food safety and security

Underutilisation of data is recognized as a weakness as is the fact that the paper-based system is time consuming. It takes months to get the data into POMS. The use of plant clinic data to predict pest outbreaks and as such function as an early warning system is seen as an opportunity. And so is a well-functioning DMS considered to eventually contribute to food safety and security.

Although all respondents very much appreciate Plantwise's aim to establish a well-functioning DMS, they have the feeling that resources are lacking to have it run smoothly. A misbalance in the distribution of resources is observed. Currently, both financial and human resources are provided for by the PPD. Plant doctors, for instance, are recruited from within the PPD where the workload is already high. The Deputy Director of the quarantine section within the PPD for instance, sympathizes with the concept of a plant health system strengthening but stresses that broader stakeholder collaboration is required to achieve this. He suggests recruiting extension officers from AED/DOA for the Plantwise programme to secure sufficient personnel to sustain plant clinic operations and the related actions of the wider system.

5. Conclusions

The functioning of the DMS in Myanmar

The paper-based data collection process is perceived as time-consuming. The data of the 23 plant clinics are entered by eight data managers who have to share two computers. Plant doctors are eager to shift to an e-based system in (the near) future. This would smooth the processes of data collection, entry into POMS and harmonisation.

The harmonized data is uploaded to POMS bi-monthly (in principle) by the NDM who is currently the only person capable and available for doing so. The shortage of staff familiar with data processing in POMS combined with the lack of computers might partly explain the considerable lag time observed. It is uncertain to what extent data validation has been done and how it is recorded in POMS. There was no data validation taking place by late 2016. The formal establishment of a national data validation team is a priority for PW-M in 2017.

Data use

The POMS data are currently under-used. At present they are mainly used to report gender-disaggregated statistics of PC visits per region and per month and queries made by farmers. They further show the diagnoses made and recommendations given by the PDs. These reports are only shared with a few people within the Plantwise team. As far as known, data are not shared with others to discuss analyses and the required actions. Neither are POMS reports sent back for discussion to plant doctors nor have POMS data in Myanmar been used for policy making and / or research purposes yet. However, a national plant health strategy being drafted includes the use of plant clinic data as an important component to further develop in the years to come.

ICT opportunities

The rapidly increasing developments in ICT could contribute to creating synergies with other existing information systems aimed at supporting plant health advisory services. Where data management systems can be technically designed to communicate with each other, in

practice their functioning will depend on people fostering proper use and sharing of combined data.

Collaboration with similar initiatives, like Pestpoint, might contribute to strengthen the PHIS whereby systems can complement each other. Some of the PDs are participating in the Pestpoint programme as well and see the complementarity of the programmes. They are particularly content with the tablets provided by Pestpoint offering them access to offline and online information supporting them in pest diagnosis. Similar to Plantwise, Pestpoint aims at contributing to food security and safety through pest control and timely pest identification.

ICT developments might also be incentives for young(er) people to engage in agricultural extension. This calls for PW-M to explore the opportunities for accelerated deployment of an e-based system (e-plant clinics) which Plantwise has already implemented in other countries. Besides motivating (younger) staff, this may further facilitate more efficient data processing, managing, and data analysis.

Institutional commitment and sustainability

It will take time to have the DMS in Myanmar functioning the way it was aimed for: having a system in place from which data can be drawn to address existing and emerging plant health threats as well as contributing to improving quality of advisory services and decision making at various levels.

There are several logistical and organisational challenges regarding management and use of clinic data, in particular the limited availability of qualified staff and equipment to ensure a smooth data management process.

Securing staff and making computers available are therefore high on PW-M's agenda for 2017 and onwards, especially in light of the plans to further expand the plant clinic network. Currently, all PDs are recruited from the PPD which seems to be understaffed already. PPD tries to link junior to senior staff to collaborate as a plant doctors' team. Engaging with the AED/DOA extension apparatus is of particular importance in order to secure sufficient staff and staff stability, strengthen the synergies between extension and plant protection and to enhance the resilience of the system. The two sections have different but highly complementary mandates.

A functioning DMS does not only depend on human resources, materials, infrastructure and procedures. It also requires an enabling institutional environment with clear communication and management structures, as well as high-level commitment to allocate budgets for agricultural extension, including data management and use. In this regard, strenuous efforts are (continuously) needed to increase wider political engagement beyond PPD. Broader alliances with other plant health stakeholders are crucial in order to strengthen and sustain the plant health system. The development of a Plant Health System Strategy for Myanmar 2016-2012 is an important sign of national commitment.

Towards the development of a DMS assessment framework

The two country studies provided the inputs for the development of a generic framework to assess the functioning of the DMS in other Plantwise countries. We felt that most of the qualitative research methods used in Myanmar sufficed in essence. The mapping exercise gained insight into the flow of information and data between the key actors involved in the PW-M DMS. It also revealed the challenges that people encounter. The FGDs and individual interviews provided a clear image of both the organisational and data processing flows. This

also applies to the perceptions people have with regard to the functioning of the DMS as well has the challenges and opportunities they observe. A concluding SWOT analysis was helpful to summarize the SWOTs of the DMS and the general Plantwise programme in Myanmar.

For future assessments, POMS data for the specific country should be consulted prior to conducting SWOTs, mapping exercises, FGDs and individual interviews. Both country studies focused on interviews with people involved in the first stage of the DMS process, i.e. the data collection. Future assessments should also prioritise/include more interviews with the key actors in the data processing and data use stages to gain more insight into how plant clinic data are dealt with and used along the entire data management chain.

Further emphasis could also be given to assessing the relevance, feasibility and usability of the DMS tools and protocols, e.g. prescription form, data analysis tools, harmonization and validation tools, POMS. These aspects were not addressed in this study.

Based on the results from Kenya and Myanmar and further discussions and analysis of POMS data, a generic assessment framework has been developed wherein each of the DMS phases – data collection, processing and sharing/use – are assessed against the key indicators: *efficiency, feasibility and quality* (Posthumus et al., 2017).

6. Recommendations

A number of ideas to improve and optimize the DMS in Myanmar were shared during the interviews and meetings held. These are summarized below in a bulleted list of recommendations and complemented with observations by the research team.

1. To explore the possibilities of engaging staff from the extension division within DOA as plant doctors.

2. To make resources available to recruit new staff to be trained as PDs and to cater for sufficient tools for data processing and management, including data analysis and use in the regions.

3. To accelerate the implementation of the e-plant clinics as it is considered to motivate (younger) staff, contribute to efficient data processing and management, facilitate accurate data analysis and as such support efficient up-scaling.

4. To increase communication and collaboration between the different sections PPD, i.e. IPM/Quarantine/Plantwise as they have similar and complementary mandates. Plant clinic data could in principle foster focused and joint interventions by stakeholders working in crop protection/ plant health.

5. To improve collaboration with other stakeholders, i.e. research institutions and private sector (e.g. agro-input dealers) as this may stimulate the idea that improved plant health data management will contribute to a more responsive nationwide plant health system. Encouraging stakeholder partnering may contribute to enhanced institutionalization of the DMS in the long run.

6. To (further) explore the use of Pestpoint data as a complementary resource.

7. To establish a national validation team consisting of research partners, e.g. DAR (Department Agricultural Research), YAU (Yezin Agricultural University), PPD. This includes agreements on how quality management of data should look like: purpose, quality standards, data requirements (field in the prescription form), protocols, financing and institutional roles.

8. To incorporate extra functionalities within the DMS which allow for instance the reporting of monitoring activities. Also, a functionality that allows the recording of farmers' traditional pest management practices for further testing and dissemination as relevant.

9. To explore the feasibility of adding functionalities to POMS which could support tracking follow-up actions after recommendations have been made. Such functionality could also provide input to furnish feedback mechanisms/ information sharing, hence stimulate more use of the data.

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Annex. Summary of informants' views

	Motivations and incentives Plantwise engagement	Benefits & Values of the system	Challenges	Opportunities
Field level - Plant Doctors - Regional Data Managers	• Engage in an extension system that makes use of ICT to improve plant health	• Possibility to make use of online and offline versions of CABI Plantwise Knowledge bank for reference • Increasing confidence in the system by Plant Doctors and farmers	• Insufficient equipment, i.e. computers • Limited experience with data harmonisation • Junior data managers require more experience and knowledge in data validation • Workload for data managers PDs is high • Limited number of data managers whereas clinic data are increasing – translation from Myanmar to English time consuming	• Eagerness to work with an e-based system, desire for tablets for all PDs and not only those PDs who are also trained by Pestpoint • Data analysis for focused management of plant health activities • Increasing farmers' access to visit plant clinics (e.g. through deployment of mobile plant clinics) and thus enhancing plant health data collection
Project level **PW-M team** (based at CABI PW-M office in Yangon) - **PW National Data Manager** - PW-M Project Coordinator	• Awareness raising of Plantwise among stakeholders, incl. policymakers • Management and analysis of clinic data • Exploring progress of other Plantwise partner countries	• Increased use of POMS data used for reporting statistical overviews	• Limited human resources to recruit PDs and data managers, e.g. PDs are currently recruited from PPD staff of which the numbers are insufficient to cover extension services in all townships (e.g. one PPD officer to cover 25 villages) • Limited equipment • Current lack of a national validation team • As yet, limited analysis of POMS data to support policy making	• Data analysis for research and policy purposes • Plantwise has an ambitious and clearly set sustainability roadmap supporting institutionalization
Institutional level - PPD staff - MoALI representatives at regional level	• The development of a PHIS/data bank	• Plantwise support to small scale farmers • Plantwise DMS as a digital PHIS will grow with time	• Limited staff within PPD • Currently: limited cooperation and communication among stakeholders involved	• Enhanced communication and collaboration between all stakeholders • Link with DOA extension division for staff to join the Plantwise programme • Potential to build a reliable PHIS when programmes as Plantwise and Pestpoint collaborate with PPD/MoALI • E-system considered to support efficient up-scaling • Use of Pestpoint data as a resource, complementary to Plantwise

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