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Diagnostic support to plantwise plant doctors in Kenya

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Effective extension services are essential to provide farmers with skills and knowledge to manage pests and diseases. These services are provided by government agencies, non-governmental organisations, community based organisations as well as various actors in the private sector. Plantwise aims to help farmers lose less of their crops to pests and diseases, through among other strategies, the establishment of networks of plant clinics. Farmers visit these clinics and explain their plant health problems to plant doctors, who are mostly extension agents trained to provide diagnosis and give recommendations for pest management. However, plant doctors need diagnostic support in order to provide accurate diagnosis especially when faced with new pests. This study was carried out in Kenya to establish the diagnostic support available to plant doctors in the country and provide suggestions for improvement. A total of 133 plant doctors were interviewed and plant clinic data in the Plantwise online management system (POMS) database reviewed to find out how often plant doctors indicated the intention to send samples to a diagnostic lab as a follow up action. Plant doctors interviewed were aware of diagnostic services, and 65% indicated an intention to send samples for diagnosis. Thirty per cent of those interviewed had sent samples to a diagnostic centre, and feedback generally took several days with feedback not received in 27% of the cases, suggesting a need to improve coordination between research and extension. Plant doctors using tablet computers had better access to diagnostic support from their peers through their social online network.

Key words: Extension service, plant clinic, diagnostic service, plant doctor, plantwise.

INTRODUCTION

Agricultural extension plays a major role in dissemination of information to farmers with a view to increasing productivity at the farm level. The Government of Kenya through the Ministry of Agriculture Livestock and Fisheries (MoALF) takes the lead in provision of extension services in the country. In order to break with traditional supply-driven and top-down extension provision, the National Agricultural Extension Policy (NAEP) was established in 2001 advocating for a demand-driven extension system (Kibett et al. 2005). Alongside government agencies, various private actors comprising community based organisations, non-governmental and faith based organisations also provide extension services (Nambiro et al., 2005). Plant clinics, a new type of farmer service promoted by CABI's Plantwise programme, are a key component of the plant health systems approach which

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Figure 1. Distribution of diagnostic centres in Kenya.

aims to strengthen links between research, extension, regulation and input supply. These services are by nature demand driven since farmers are the ones who determine the need for advice. They are run by trained plant doctors who are mostly extension staff from the MoALF (Scheidegger and Graf, 2013). Set up in public places such as markets and produce delivery sheds, farmers bring plant samples to the plant clinics for diagnosis and recommendations to manage the pest problems. Details of the farmer name, gender, crop grown, symptoms observed and the recommendations given by the plant doctor are recorded. Currently, data capture methods include paper and electronic using mobile tablet computers (Wright et al., 2016). Data recorded by paper are digitised, cleaned and uploaded to the Plantwise online management system (POMS) data base. Electronically captured data are directly uploaded to the POMS database. All the data in POMS can be downloaded, validated and analysed. Plant doctors occasionally need diagnostic support in order to make correct diagnoses and give the right recommendations (Danielsen et al., 2013). Good and timely diagnosis is essential for management of further spread of pests to new areas and therefore issues that hinder plant doctors' access to quick, accurate diagnostic service must be identified and addressed. Misdiagnosis may lead to more loss of yield and resources to the already resource constrained small scale farmer. Diagnostic support to plant doctors in Kenya is mainly provided by research centres, with the National Agricultural Research Laboratories (NARL) in Kabete taking the lead in provision of these services. However, it is important to establish the diagnostic support these centres contribute to the plant doctors and the linkages that would enable sustainable access to diagnostic services. Figure 1 shows the distribution of diagnostic centres across the country.

MATERIALS AND METHODS

A total of 133 plant doctors in all 13 counties implementing Plantwise in Kenya were interviewed (Table 1) using a questionnaire with both open-ended and close-ended questions. The questionnaire was pre-tested among plant doctors in three

Table 1. Number of plant doctors interviewed in each of the 13 counties implementing Plantwise in Kenya

County	Number of plant doctors interviewed
Nakuru	23
Trans Nzoia	22
Embu	17
Machakos	17
Nyeri	8
Kajiado	8
West Pokot	7
Bungoma	7
Elgeyo Marakwet	6
Kirinyaga	6
Narok	5
Kiambu	5
Tharaka Nithi	2
Total	**133**

Table 2. Plant samples quality as rated by plant doctors across 13 counties in Kenya

County	(%) rating		
	Good	Average	Poor
Tharaka Nithi	100	0	0
Nyeri	88	12	0
West Pokot	86	14	0
Embu	76	24	0
Machakos	76	18	6
Narok	75	0	25
Kajiado	63	37	0
Nakuru	61	39	0
Kiambu	60	40	0
Elgeyo Marakwet	50	50	0
Kirinyaga	50	33	17
Bungoma	43	57	0
Trans Nzoia	27	55	18
Average percentage	62	33	5

clinics. Questions were centred on the quality of samples brought to plant clinics, whether plant doctors have links with diagnostic service providers, if they had sent samples to the lab and how long it took to receive feedback. Plant doctors were also asked to give suggestions on how to strengthen their links with diagnostic service providers and how to enhance accessibility and sustainability of diagnostic services. Plant clinic data downloaded from the POMS database were used to ascertain the number of times plant doctors indicated an intention to send samples to a diagnostic centre.

Data analysis

Data were analysed using MS Excel and Statistical Package for Social Science (SPSS), to generate descriptive statistics and correlations. Qualitative data were coded and content analysis performed.

RESULTS

Challenges faced by plant doctors in making plant pest diagnoses

POMS data showed that 65% of the plant doctors indicated an intention to send samples to a diagnostic centre. Thirty percent of those interviewed during the study said that they had sent samples to a diagnostic centre. However, plant doctors from different counties showed varying need for diagnostic support. Almost all plant doctors indicated that farmers either presented crop health problems verbally or carried plant samples to the clinic. Plant doctors were asked to rate the quality of samples as either good, average or poor. Overall, 62% rated the plant samples as good, indicating that they were fresh and representative enough. In Tharaka Nithi, all plant doctors indicated that farmers presented fresh and representative samples of plant health issues. However, in four counties, 5% of plant doctors indicated that samples presented by farmers were of poor quality (Table 2).

Accessibility of diagnostic services to plant doctors and feedback on samples sent to the diagnostic centres

Over 90% of plant doctors are aware of the availability of diagnostic services and 64% said they have links with diagnostic service providers and can easily engage with them. A diagnosis report was received for 63% of the submitted samples. All plant doctors in Tharaka Nithi and Trans Nzoia received the diagnosis report after a few weeks, Kajiado county after many months and feedback was not received at all in Elgeyo Marakwet county (Table 3). Sixty three percent of those who indicated that they had sent samples for diagnosis indicated that the diagnostic service was a free service to farmers. There were significant positive correlations between plant doctors who said they had links with diagnostic services and those who had sent samples to the laboratory for diagnosis (figure. 2). Plant doctors who indicated likelihood to encounter difficult plant health issues most likely forwarded the samples to the laboratory for diagnosis (Figure 3).

Plant doctors' suggestions on strengthening diagnostic support

Plant doctors were asked to give suggestions on how their links with diagnostic service providers could be strengthened. They suggested increased interactions

Table 3. Period taken before receiving a diagnosis report on samples sent to the lab

County	% receiving Immediately	% receiving after few days	% receiving after few weeks	% receiving after few months	% receiving after many months	% Results not received
Bungoma	0	50	0	50	0	0
Elgeyo Marakwet	0	0	0	0	0	100
Embu	50	33	0	0	0	17
Kajiado	0	0	0	0	100	0
Kiambu	0	33	67	0	0	0
Kirinyaga	0	100	0	0	0	0
Machakos	0	86	14	0	0	0
Nakuru	0	0	20	7	20	53
Narok	0	0	0	0	0	0
Nyeri	0	0	0	0	50	50
Tharaka Nithi	0	0	100	0	0	0
TransNzoia	0	0	100	0	0	0
West Pokot	0	0	0	0	0	0

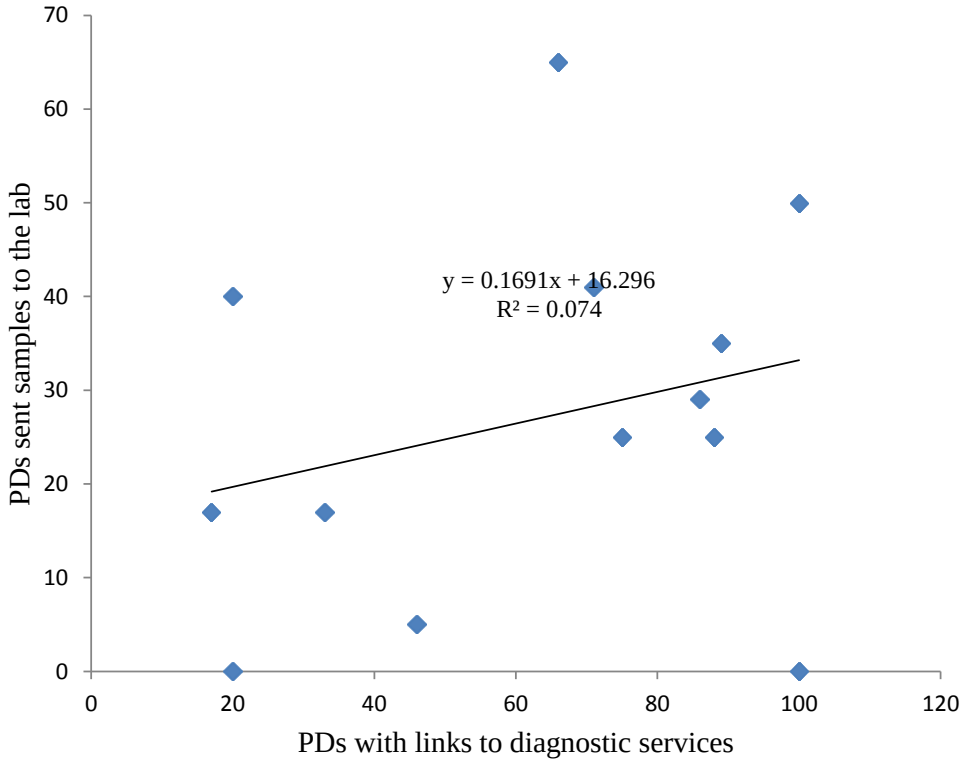

Figure 2. Correlations between Plant doctors with links to diagnostic services and those sending samples to the lab.

with diagnostic service providers through joint trainings, regular backstopping by plant health experts during plant clinic sessions, and exchange visits to the diagnostic centres. About 20% of plant doctors suggested sharing of research findings on pests and diseases. A further 17% suggested that diagnostic service providers perform quick diagnoses as this will boost farmers' confidence in plant clinics. Plant doctors suggested that farmers' awareness creation on the availability of diagnostic services, how to sample plants for diseases and insect pests should be done by the service providers (Figure 4). Plant doctors without tablets showed interest in adopting tablets to use

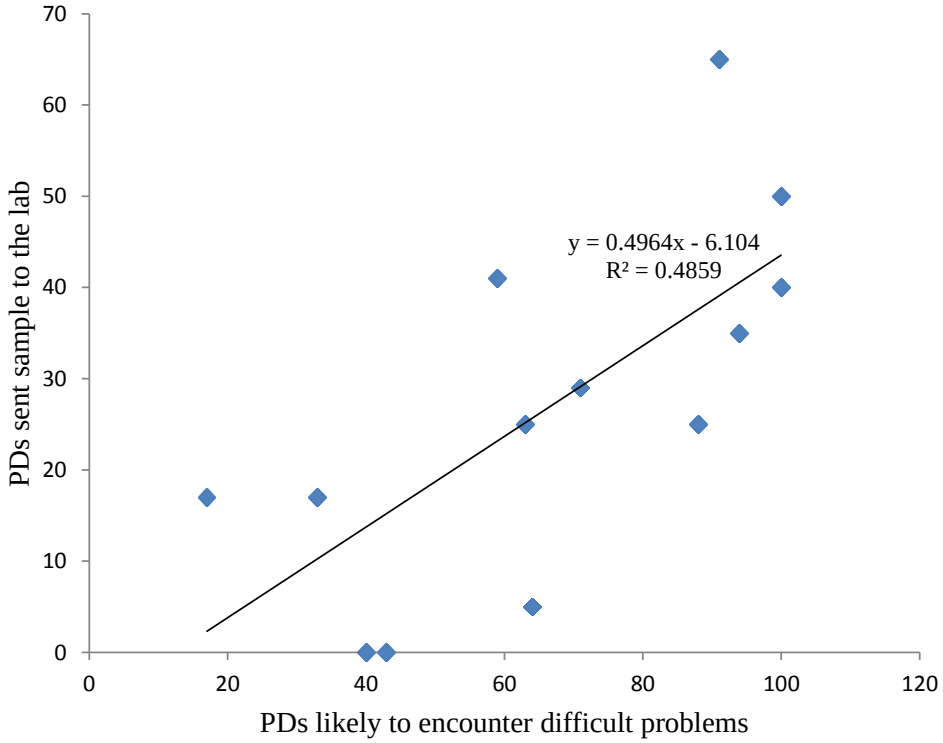

Figure 3. Correlations between Plant doctors with likelihood to encounter difficulties in diagnosis and those sending samples to the lab.

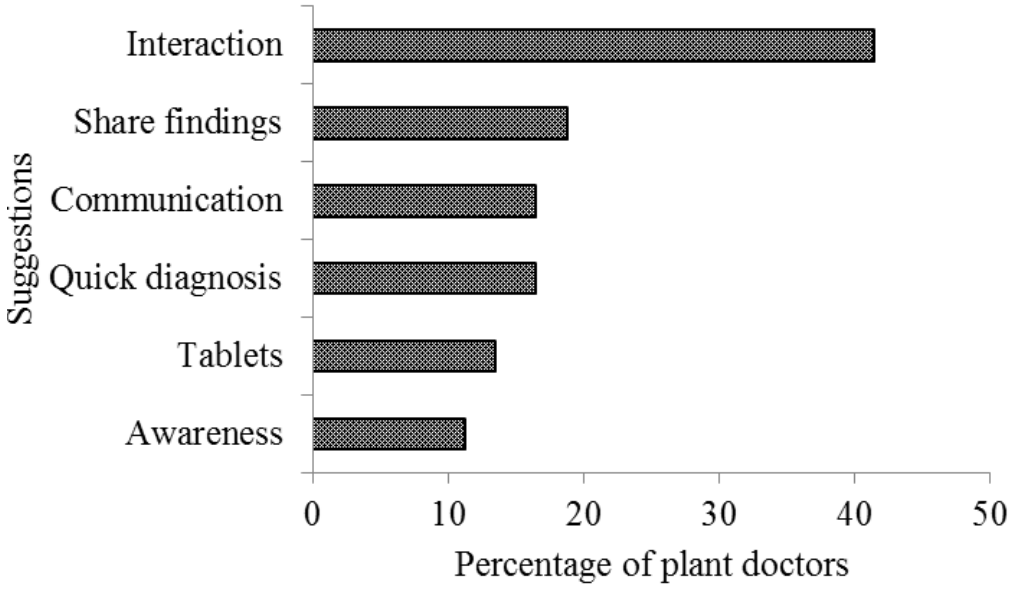

Figure 4. Suggestions by plant doctors on how their links with diagnostic services can be strengthened.

at the plant clinics.

To ensure efficient and sustainable access to diagnostic services, over 60% suggested targeted trainings, having factsheets for all crops, specialised equipment such as microscopes and pH meters as well as tablet computers for all plant doctors to enable them access to literature

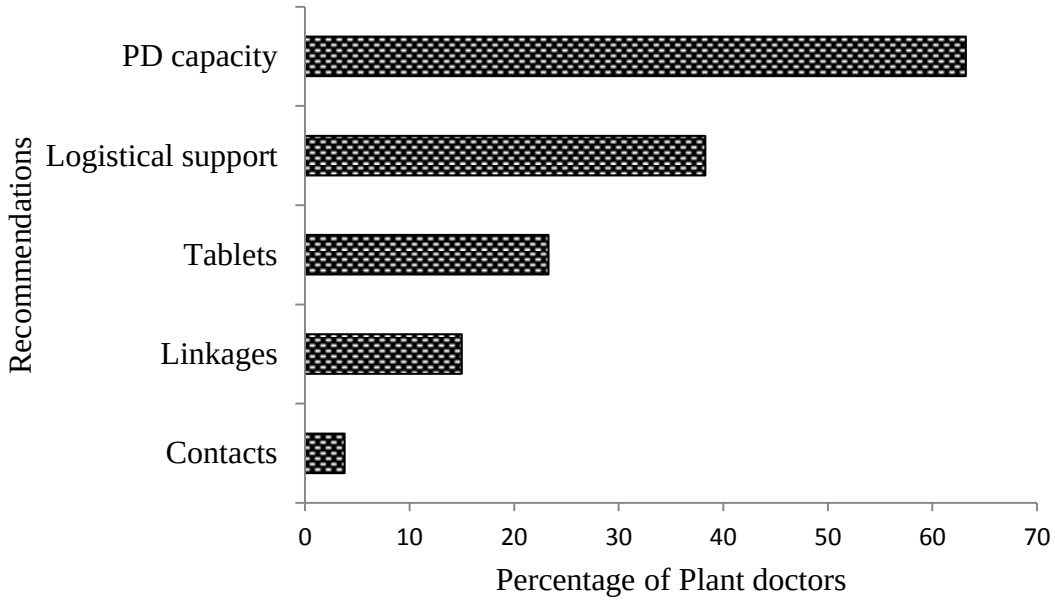

Figure 5. Recommendations for efficient access to diagnostic services by plant doctors.

on insect pests and diseases. Logistical support for sampling, transport and cameras were requested. Plant doctors also suggested that they needed to be linked with diagnostic labs that are located close to them and have the individual contacts of plant health specialists to whom they can refer difficult cases (Figure 5).

DISCUSSION

Challenges faced by plant doctors in making plant disease diagnoses

Plant doctors need diagnostic support from their peers and the plant health experts. Over 60% indicated the intention to send samples for further diagnosis, with only 30% saying that they had sent samples to a diagnostic centre. Poor institutional linkages in the plant health system for instance between extension and plant health experts in diagnostic centres (Kibett et al., 2005) may contribute to plant doctors lacking the confidence to approach these centres, despite having the need to. It may also be due to lack of logistical support to send samples to diagnostic centres and the absence of a quick feedback mechanism. While few of the plant doctors indicated difficulty in diagnosing plant health cases presented by the farmers, the poor status of some of the samples presented may have led to difficulties in diagnosis. This points to a possible positive response bias with plant doctors not willing to admit that they were not able to diagnose a problem. Some farmers did not bring plant samples with them to the plant clinic opting to describe the symptoms on the crop to the plant doctor, while some carried poor or average quality samples. There is therefore a need to train farmers on proper sampling procedure to ensure that plant doctors make correct diagnoses and recommendations which will result to better pest and disease management (Miller et al., 2009).

Accessibility of diagnostic services to plant doctors

Despite the fact that plant doctors interviewed said they were aware of diagnostic services, and some had sent samples to the labs for further diagnosis, it took a long time to receive the diagnosis report. A diagnosis report was not received for about 27% of the submitted samples. In Embu County, plant doctors received the diagnosis report immediately. In this case they personally carried samples to the diagnostic centre since it is located within close proximity to plant clinics. This shows that having the diagnostic centre close to plant clinic sites enables plant doctors to easily access these services and get quick assistance. In other counties, there were challenges with transporting the samples to the diagnostic centres and collecting samples from farmer fields when samples brought to the clinic were not good quality. This is because often times, financial allocations to extension services are low and vehicles used by extension officers are in a poor condition (Muyanga and Jayne, 2006).There was a significant positive correlation between plant doctors who have links with diagnostic services and plant doctors who had sent samples to the lab. Strong linkages with diagnostic centres and individual plant health experts will enhance diagnostic support and further collaboration

between researchers, diagnostic labs and plant doctors. On the other hand a plant doctor who has no links with diagnostic services may be less inclined to access these services when faced with difficult problems (Boa, 2013). According to Danielsen et al. (2012) there are few samples sent to diagnostic centres in Uganda due to absence of clear referral mechanisms and detachment of plant clinics from research institutions.

Plant doctors suggestions on strengthening diagnostic support

Increased interaction with diagnostic service providers, enhanced diagnostic capacity for plant doctors and logistical support to send samples to diagnostic centres were among the suggestions given on strengthening diagnostic support. However, in order to achieve efficient and sustainable diagnostic support to plant doctors there needs to be proper coordination between research and extension and formal mechanisms for engagement put in place. The Government of Kenya, through the Agricultural Sector Development Strategy 2010-2020 (ASDS) and the National Agricultural Sector Extension Policy (NASEP) emphasizes the importance of a robust agricultural extension system and recognises the need for linkages between extension and research (GoK, 2010). The NASEP has adopted a sector-wide approach to extension service delivery and aims to ensure that extension personnel are well trained by conducting in-service staff training. The policy further underscores the need for extension services to be well coordinated, thus providing an enabling environment for interactions between plant doctors and research centres, who are the diagnostic service providers. There are however institutional constraints hindering these interactions such as lack of adequate funding to implement and facilitate useful engagements (GoK, 2010). The weak linkages between plant clinics and diagnostic centres have been reported in Uganda and Ghana where there is no established mechanism for sending samples to diagnostic centres (Cornelius and Coffie, 2015; Danielsen and Matsiko, 2016). The ASDS aims to create strong links between research and extension through coordination of all stakeholders, including private sector actors and to improve agricultural training institutions (GoK, 2010).

Plant doctors without tablets showed interest in adopting them as these would enable them to access diagnostic services faster as opposed to physically taking samples to diagnostic centres. Telegram, an online network, enables them to share with each other crop health problems that are difficult to diagnose. Such plant disease diagnostic networks assist in dealing with the problem of pest and disease identification more efficiently by increasing the speed and accuracy of diagnostic procedures (Miller et al., 2009). They bring together individuals and institutions who are experts in plant disease diagnosis within and outside countries, therefore increasing surveillance at local and regional levels. The tablet computer also facilitates access to the knowledge bank which has information tools such as factsheets to assist in diagnosis (Wright et al., 2016). These services are however only accessible to plant doctors who have the devices. Use of ICTs such as electronic apps, websites and social media improves access to informational products, expert commentary and alerts thus enabling the agriculture sector to efficiently deal with pest and disease outbreaks (Srivastava, 2013; Bostock et al., 2014; Isard et al., 2015). In addition to diagnostic networks, the technique of image processing which involves the use of computer vision applications to detect plant diseases accurately and timely has been seen as a way of improving the efficiency of plant disease diagnostics. This technique can be used on smartphones, eliminating the need for complex equipment and complex software packages (Petrellis, 2015).

Conclusions

Plant doctors are generally aware of the availability of diagnostic services but the poor linkages between them and these institutions hinder useful interactions. This is seen from the difference in number between plant doctors who intended to refer samples and those who actually sent them to a diagnostic centre. The fact that in most cases it took a long time to receive the diagnosis report is seen as a contributing factor to low utilization of these services with plant doctors not feeling motivated to send samples. There is need to strengthen links between research and extension in order to build plant doctors confidence in approaching the diagnostic service providers. Use of ICTs is a fast and efficient way of ensuring access to these services, with the plant doctors already on telegram reporting that they are assisted immediately.

Conflict of Interests

The authors have not declared any conflict of interests.

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