Rural Extension and Innovation Systems Journal

volume	17
number	1
year	2021
issn	2204-8758

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volume 17
number 1
year 2021

ISSN: print 2204–8758
ISSN: online 2204–8766

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Editorial Board

Foreword

Volume 17, Number 1 of the *Rural Extension and Innovations Systems Journal* contains Research and Practice papers. The Research section is for publishing outcomes of research in extension. It contains papers which have been subject to a double-blind reviewing process by two independent reviewers. These papers include research into change management, extension, development and innovation systems issues for agricultural and natural resource management that follow a rigorous and recognised disciplinary research methodology and are double-blind reviewed by Editorial Board members and selected reviewers.

Practice papers are informal, accessible articles that document successes, failures and the lessons from extension professionals' experiences. They provide an opportunity for rural advisors and extension practitioners to publish stories and case studies about extension practice, which are relevant to other field operatives, but also show the application of extension theory to practice. They are assessed and edited to ensure coherency and suitability to these goals.

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Roy Murray-Prior

Editor

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The Editor will decide whether a paper meets the criteria for acceptance and then send it out for review under the relevant guidelines. Those articles accepted after the review process will be published.

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- The manuscript contains original work of the author(s) listed and where you have included the work of others this has been fully and appropriately acknowledged.
- The work has not been published previously in a peer-reviewed journal (except as part of an academic thesis, report to funding body or working paper).
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Refereeing process

When a paper is submitted, the Editor will organise the double-blind review process to involve two experts in the field of agricultural extension. In the event of strong disagreement between two referees a third referee may be appointed.

Farmer-to-farmer learning: farmer champion characteristics influence extent of scale out adoption in south-central coastal Vietnam

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Abstract. Improving the livelihoods of smallholder farming communities relies not only on the adoption of new practices by farmers directly participating in research, development and extension activities, but on the subsequent 'scale out' and 'scale up' of resources, knowledge and practices. This Case Study focused on the role of Farmer Champions in farmer-to-farmer learning among smallholder beef farmers in Cat Trinh commune, Binh Dinh province, Vietnam. Data was statistically and thematically analysed from surveys that captured the timing and extent of planting new grass forage cuttings, the implementation of related forage and cattle management practices, and the knowledge transfer that occurred following 15 farmers engaging in a 'Best Bet' participatory extension process. Of the Best Bet Farmers, three farmers adopted the proven technology faster, and to a greater extent ($p < 0.05$). The same farmers influenced the most Scale Out Farmers ($p < 0.05$), including a high proportion of women. These characteristics were associated with the three farmers being identified as Farmer Champions. Natural diffusion of the technology through Farmer Champions maintained high quality scale out (transfer of new knowledge as well as practices), due to their accessibility, availability and generosity during the knowledge transfer process.

Keywords: adoption, extension, farmer champion, farmer learning, knowledge transfer, smallholders

Introduction

People are the most important part of agricultural smallholder systems and understanding what they currently do and why, as well as the context they operate within, is essential for adoption of new knowledge or technology to proceed (Winter & Doyle 2008). Participatory research, development and extension activities have been established as an effective approach to facilitate the adoption and adaption of agricultural technologies by participating farmers in developing countries (Horne & Stür 2003). The 'Best Bet' process is one of these participatory approaches that works intensively with a small number of farmers in a step-by-step process, building on farmers' existing knowledge and practices (Khanh et al. 2015). Lisson et al. (2010) and Khanh et al. (2015) have demonstrated the effectiveness of the Best Bet process in facilitating on-farm change in the smallholder crop–livestock systems of Eastern Indonesia and South-Central Coastal Vietnam, respectively. The success of this extension method lies not only in the implementation of new practices by participating Best Bet farmers, but in the subsequent natural 'scale out' of resources, knowledge and practices from the original participating farmers to neighbouring farmers and communities (Khanh et al. 2014).

Successful farmer-to-farmer learning and scaling out of agricultural technologies has been well documented in South East Asia (Millar et al. 2005; Khanh et al. 2014; Turner et al. 2015), where communities are culturally pro-development and committed to contributing to each other's welfare. For even greater impact, interventions are then needed to facilitate further farmer-to-farmer learning on a larger scale; 'scaling up' as well as scaling out. Scaling up involves decision-making and capacity building at higher levels and adapting the knowledge and technologies to end-users and across variable conditions (Menter et al. 2004). Adapting and applying technologies to different contexts requires an understanding of the principles underlying adoption of technologies to date. Millar & Connell (2010) suggest that farmers who 'champion' adoption of technologies in smaller-scale projects can act as 'sparks', or entry points that initiate scaling up efforts. Farmer Champions are early adopters, good communicators and demonstrate adaptable technologies. Once identified, Farmer Champions could be intentionally included in capacity building efforts at higher levels to help achieve wider-spread extension.

The selection of effective Farmer Champions is therefore essential for successful facilitation of farmer-to-farmer learning by competent extension staff (Millar & Connell 2010). For greatest impact, extension agencies need a greater understanding of farmer-to-farmer learning that occurs

through Farmer Champions, and increased knowledge about how to identify Farmer Champions for active engagement in participatory extension efforts.

Smallholder farming system context in South-Central Coast Vietnam

Enabling sustainable income generation by smallholder farmers is a major development priority for research and development workers focused on the Central provinces of Vietnam (Leddin et al. 2011). While pigs and poultry are the most populous livestock, cattle are a primary ruminant in the lowlands, and tend to be farmed in the more intensive cropping areas, particularly around irrigation systems and along river flats. The cattle are traditionally fed native grasses (grazing or cut and carry systems) and residues from rice, cassava, sugarcane, corn, peanuts and sweet potato. With demand for beef growing in urban Vietnam, there is the opportunity for households in the South-Central Coast provinces to increase and diversify farm income through improved cattle production. Cattle operations on the South-Central Coast are a major supplier of beef for the growing domestic market, but are constrained by low fertility sandy soils and harsh climatic conditions, with production limited by low feed quantity/quality, and undeveloped husbandry practices (Parsons et al. 2013).

A four-year ACIAR funded project (2009-2013; SMCN/2007/109) made considerable progress in integrating new forage and livestock technologies into smallholder farming systems in three South-Central Coast provinces, including Binh Dinh (Ba et al. 2013; Khanh et al. 2014; Khanh et al. 2020). The project initially introduced 15 farmers within a commune of each province to a range of activities including nine practices relating to new forage grass and legume resources and their management; better use of existing local crop by-product feedstuffs; and improved cattle feeding and management options. The selection criteria for the 15 Best Bet Farmer households were that their individual farms should be representative of the prevailing farming systems, with possession of cattle, access to sufficient land for new forage development, and labour availability to implement agreed interventions. Five of the BBFs were specifically recorded as female: three of these female BBFs had husbands who either worked off-farm or were fully occupied with cropping activities, while the wife was responsible for the cattle activities, and the remaining two female BBFs were widows who ran their farms with their children.

The step-wise, participatory approach involved regular interaction between research and development project staff and farmers, and introduced activities of increased complexity and associated risk. The success of the step-wise participatory approach became evident as adoption of forage and livestock technologies was observed to scale out beyond the original 15 Best Bet farmers per commune to farmers not originally involved in the project (Khanh et al. 2014). Best Bet Farmers who were observed as sharing a particularly high amount of resources and knowledge were identified as Farmer Champions (Turner et al. 2015). A second four-year ACIAR funded project (2014-2017; LPS/2012/062) continued using participatory research, development and extension processes to facilitate improved smallholder cattle production and profitability in this region, and also focused on understanding and enhancing the knowledge transfer processes involved in scale out. To further increase the development of smallholder cattle production on the South-Central Coast of Vietnam through the active engagement of Farmer Champions in extension activities (through scaling up), the adoption characteristics of these farmers and their role in knowledge transfer processes was investigated using Case Study methods.

The aim of this Case Study was to assess the role and influence of Farmer Champions on knowledge transfer and adoption outcomes within communes of the previous project. It involved research that evaluated the characteristics of naturally emerging Farmer Champions in Cat Trinh commune, Binh Dinh province, Vietnam, and how these characteristics influenced subsequent scale out in the community.

Methods

A Case Study was undertaken within ACIAR project SMCN LPS/2012/062 to understand the scale out process of forage resources and knowledge about forage and cattle management that followed 15 smallholder farmers engaging in Best Bet participatory extension activities in Cat Trinh commune, Binh Dinh province, Vietnam. This approach was chosen to answer "how" and "why" questions, gather descriptions of participants' adoption behaviour, and understand the smallholder system context as well as the knowledge transfer phenomenon (Yin 2003).

The descriptive study drew from surveys of: the 15 Best Bet Farmers (original participants in the Best Bet process in ACIAR project SMCN/2007/109), three Farmer Champions (three of the 15 Best Bet Farmers who were subsequently identified as having the most influential role in Scale Out; Turner et al. 2015), and 31 of 60 Scale Out Farmers (who received resources and knowledge from the Farmer Champions; McCormack 2015). The semi-structured surveys collected quantitative and qualitative data that included individual and household demographics, and were

tested and refined before being conducted on farmers' properties by project team members in Vietnamese. Further details about the surveys are provided below in Table 1.

Table 1. Participant numbers, timing and content of the surveys carried out with Best Bet Farmers, Farmer Champions and Scale Out Farmers

	Best Bet Farmers	Farmer Champions	Scale Out Farmers
No. participants	15	3	31*
Time of surveys	2010-2013	2015	2015
Survey content	Timing of practices implemented Extent of adoption Numbers of Scale Out Farmers	Details of Scale Out Farmers What resources, knowledge and practices were shared How, when and why knowledge transfer facilitated	Timing of practices implemented Extent of adoption Patterns of engaging in knowledge transfer Motivations for adoption Benefits experienced

*Scale Out Farmer contact details were provided by Farmer Champions

Data analyses

Quantitative data from the Best Bet Farmer surveys detailed in Khanh et al. (2014) were analysed using SPSS Version 2 (2013) and *Statistix 10* (2013). Quantitative data on the implementation of the nine recommended practices for each farmer was accumulatively 'scored', relating to the extent of their adoption. The sequence of practices was as follows: 1) introduction of new perennial grass forages; 2) introduction of tree legume forages; 3) improved management of new and existing fresh forages; 4) significant expansion of existing fresh forage plantings; 5) improved use of on-farm crop by-products to supplement cattle feed; 6) targeted feeding of fresh forages; 7) targeted use of feed supplements; 8) improved cattle infrastructure facilities; 9) improved market targeting for cattle enterprises.

The timing of implementing the recommended practices, extent of adoption, scale-out patterns and the relationships between these variables for Farmer Champions and other Best Bet Farmers were compared. The authors acknowledge that the small sample size limited statistical analyses, and therefore explored the knowledge transfer process further using qualitative methods.

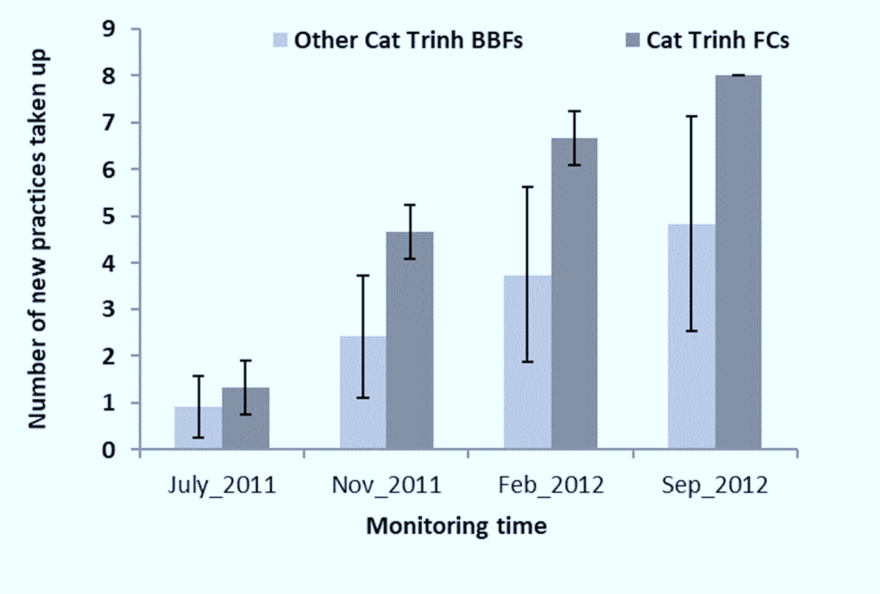
Qualitative data relating to the knowledge transfer process from the Farmer Champion and Scale Out Farmer surveys was thematically analysed and manually coded (Lincoln & Guba 1985; Ryan & Bernard 2000). Themes were shaped by the research aim and literature (Huberman & Miles 1994; Ryan & Bernard 2000). For Farmer Champions, coding focused on their roles as Sources of Knowledge and Resources, and Facilitators of Knowledge Transfer. For Scale Out Farmers, the factors influencing farmers' motivation to adopt, household demographics and the influence of practice change were evaluated.

Results

Best Bet farmer surveys

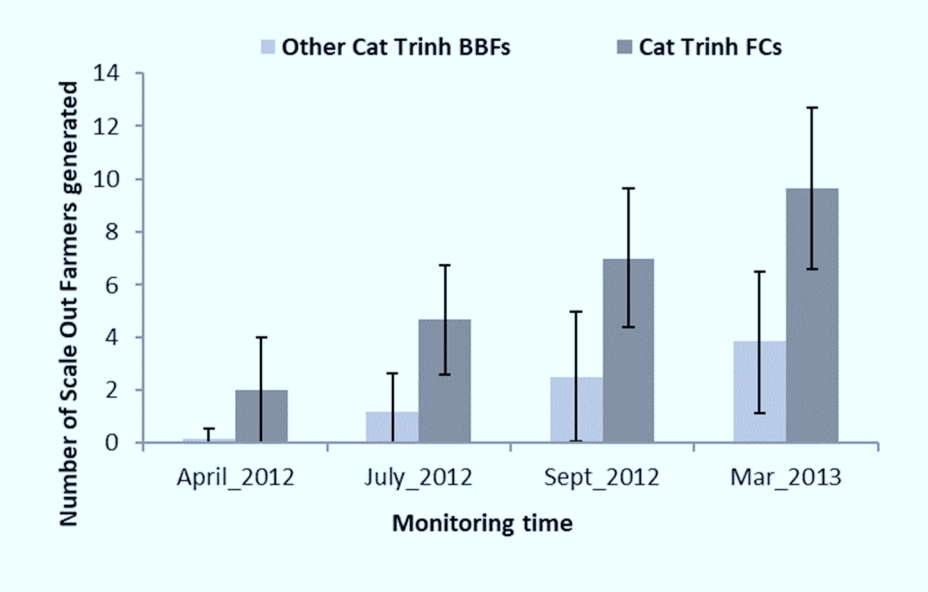
The three Farmer Champions had a faster adoption rate of practices than the other twelve Best Bet Farmers (Figure 1), with a significantly higher number of practices taken up in July 2011 ($p < 0.05$), November 2011 ($p < 0.05$), February 2012 ($p < 0.01$) and September 2012 ($p < 0.05$). By September 2012, Farmer Champions had adopted an average eight new practices of the total nine introduced practices, compared with an average 4.8 new practices adopted by the other Best Bet Farmers. The three Farmer Champions were also more effective agents of informal knowledge transfer than the other Best Bet Farmers (Figure 2), with a significantly higher number of Scale Out Farmers generated in April 2012 ($p < 0.01$), July 2012 ($p < 0.01$), September 2012 ($p < 0.05$) and March 2013 ($p < 0.05$). By March 2013, Farmer Champions had generated an average 9.7 Scale Out Farmers, compared with an average 3.8 Scale Out Farmers generated by the other Best Bet Farmers. By March 2013 there was a strong positive ($p < 0.001$; $R^2 = 0.79$) correlation between the extent of new practices participating farmers had adopted and the number of Scale Out Farmers they had generated (Figure 3).

Figure 1. Average number of new practices adopted by Farmer Champions (3) and other Best Bet Farmers (12) in Cat Trinh commune, between July 2011 and September 2012



Vertical bars represent Standard Deviation

Figure 2. Average number of Scale Out Farmers generated from Farmer Champions (3) and other Best Bet Farmers (12) in Cat Trinh commune, between April 2012 and March 2013



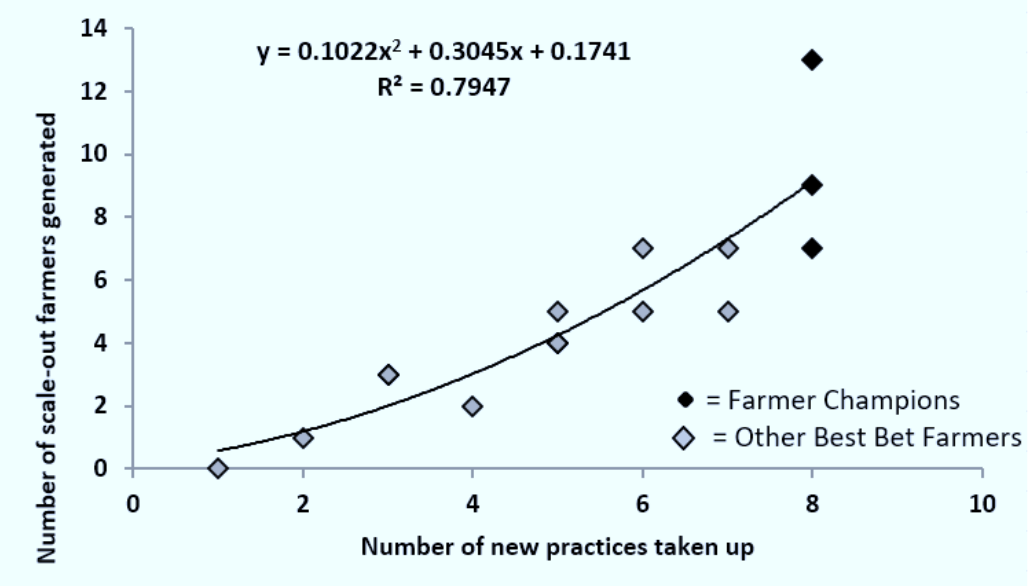
Vertical bars represent Standard Deviation

Farmer Champion survey

Some of the key practices that the Farmer Champions implemented as a result of the knowledge gained through the participatory process are summarised in Table 2. Utilising new forage species with improved quality, productivity and persistence, and increasing the quantity of cultivated forages for cut and carry, have reduced the requirement for cattle to graze marginal common land. Farmer Champion 1 emphasised the importance of his new knowledge and increased reliability of the feed source for his cattle:

> now Mulato is always available in the garden…I can control the feed source in wet and dry seasons when native grass, rice straw and other crop residues may be scarce.

Figure 3. Relationship between adoption of new practices and generation of Scale Out Farmers for Farmer Champions and other Best Bet Farmers in March 2013



Although cattle numbers have not changed, there has been a change from mainly cattle keeping (involving opportunistic sales when money is needed) to more efficient systems that involve regular sales. The three Farmer Champions indicated how important cattle production has become to their overall farming system by ranking it first of a number of farm activities, in terms of contributing to income and planning for future expansion.

Table 2. Changes implemented by Farmer Champions between 2010 and 2015

Change in Practices	Farmer Champion 1	Farmer Champion 2	Farmer Champion 3
Grazing in 2010 (hrs/month)	200	240	240
Grazing in 2015 (hrs/month)	120	120	160
Cultivated forages in 2010	250m^2 local King grass	'Some' local King grass	500m^2 local King grass
Cultivated forages in 2015	1000m^2 Mulato >100m^2 VA06 King grass	500m^2 Mulato 200m^2 Panicum 150m^2 Paspalum 30 Leucaena trees	400m^2 Mulato 200m^2 Panicum

The benefits that the Farmer Champions experienced through adopting the study recommendations led to them becoming known as valuable sources of knowledge and resources. The benefits observed by neighbours, relatives, friends, acquaintances and service providers included:

- increased confidence about feeding and managing cattle due to new knowledge
- increased availability of labour due to decreased requirement for grazing cattle
- decreased costs due to decreased requirement to buy crop-residues for feeding cattle
- increased convenience and reliability of cattle feed supply due to cultivating new forages close to the home
- improved cattle condition due to improved management of their feeding
- increased financial security due to more regular income from cattle sales.

The three Farmer Champions collectively provided the knowledge and resources to increase the efficiency and profitability of at least 60 Scale Out Farmers between 2011 and 2015, through informal and formal knowledge transfer pathways. A key to becoming effective facilitators of knowledge transfer was their willingness to respond to requests and initiate helping other farmers. It was common for there to be multiple visits between farms as Scale Out Farmers developed questions around the next stage of adoption. The three Farmer Champions estimated that 90% of their knowledge transfer occurred informally through social interaction with other farmers and visits between the smallholder farms. An example of this facilitation flowed on from a conversation between Farmer Champion 1 and Mr K at a commune event, about difficulties Mr K was experiencing feeding cattle during the wet season. After the event Farmer Champion 1

immediately took Mr K to his house to provide him with 10 kg of forage cuttings and key advice about how to manage them to ensure a reliable feed supply. Similarly, Farmer Champion 2 described how a visit to his farm changed the life of Mrs M, who was running a small market business and did not have enough time at home to care for her three children. After observing the Farmer Champion's successful cattle production, Mrs M sought from him the knowledge and free forage resources needed to raise cattle and improve the wellbeing of her household. The Farmer Champions demonstrated a common desire to help improve livelihoods in their communities by providing forage resources and time to share advice. Their reputation as experts led to formal requests to be involved in other cattle-related projects, developing commune policy around forage and cattle management, and organising the collection of large quantities of forage resource for other communities.

Scale out farmer survey

Smallholder households: demographics and influence of practice change

Adoption of new forages and the associated changes to forage and cattle management resulted in a reduction in the number of hours spent with grazing cattle for 58% of the Scale Out Farmers (Khanh et al. 2014). Respondents saved an average of 3.9 hours per day (with values ranging from 1-10 hours per day) and this labour was reallocated to other tasks. These tasks included cropping, care of other livestock, other farm tasks (e.g. irrigating and fertilising), off-farm employment, family time and housework.

More than 50% of the Scale Out Farmers interviewed in Cat Trinh commune were women. Of the 17 female respondents, 14 stated that they were either the main person (10) or one of the people (4) responsible for feeding and management of cattle. Of the 14 male respondents 11 replied that either someone else (4) was the main person or they shared the responsibility (7) for cattle related tasks. The other person was either their wife, sister or an elderly relative. This means that in 25 cases out of 31, a woman was either the primary cattle carer or shared this responsibility.

Scale Out Farmers were asked to identify major sources of information used before or after the adoption of forage when they wanted to learn new things. Farmers were able to provide more than one answer, with 100% identifying other farmers as a source of information, 70% identifying other sources, and 35% stating that media was a source of information. Television was the primary media source – a medium through which some ACIAR project extension material is delivered. Fewer Scale Out Farmers identified local extension (13%) and other projects (3%) as sources of learning. The category referred to as 'other projects' was specified as either other ACIAR projects or those run by Government Organisations and Not-for-profit Organisations in the region.

Adoption motivations

The motivations for Scale Out Farmers approaching Farmer Champions for forage resources and pursuing the associated new knowledge and skills around forage and cattle management were also explored in interviews with Scale Out Farmers. The emerging adoption motivation themes are grouped in Figure 4, with each of the circles representing a theme and the sizes of the circles representing the relative prevalence of the theme in the interview data (with the 31 Scale Out Farmers numbered). Many of the responses from Scale Out Farmers aligned with more than one theme, represented by the overlapping circles.

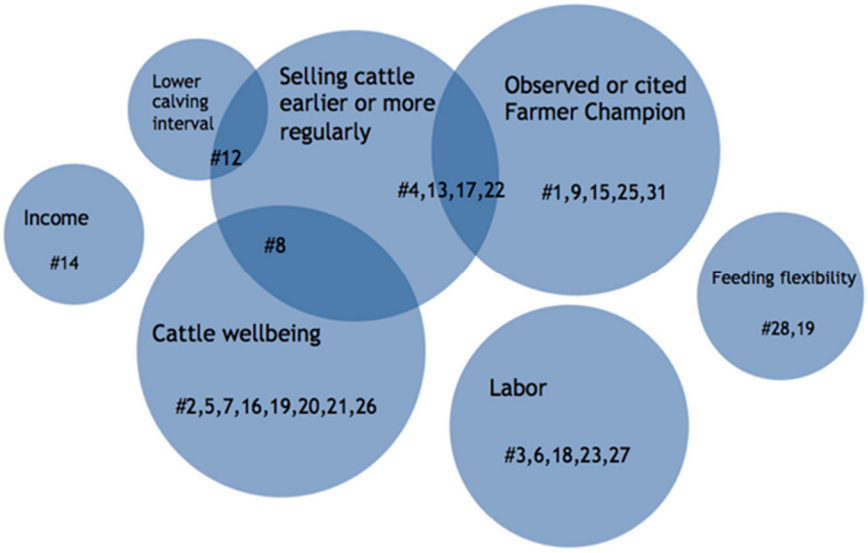
The three major adoption motivation themes that emerged from the data were:

- recognising the opportunity to sell cattle earlier and/or more regularly
- observing increased cattle wellbeing
- influential interactions with a Farmer Champion regarding the successful management of forages.

The majority of Scale Out Farmers discussed cattle welfare, nutrition and saleability as the main motivation for embarking on the adoption process. This is an important indicator about the priorities of farmers in Cat Trinh commune; they were motivated by the desire to improve their cattle production and management and trialled new forage technologies in their smallholder systems to achieve this. Improving cattle production ultimately leads to improved income for their households but only Scale Out Farmer #14 identified increased income as a primary motivator for adoption. Scale Out Farmer #12 identified decreased calving interval as a major benefit of growing new forages and had taken up a number of new practices including early weaning, fattening housed calves for two months before selling, targeted feeding and controlled mating (through AI). The combination of early weaning and increased nutrition from new forages and concentrates had: 'saved a lot of money in feed (for cows) and cows now get pregnant faster'. Adopting the recommended practices had led to the desired change in her cattle production

system, and at the time of being interviewed she was selling calves sooner and more regularly. Of the Scale Out Farmers who were motivated through observing Farmer Champions successfully growing and utilising forages, a couple purchased cattle for the first time as a result of this influence. Scale Out Farmer #9 initially farmed pigs but observed how a Farmer Champion 'had many cattle with low labour inputs, (they) only need straw and forage'. He realised that becoming a cattle producer had the potential for: 'less work for more gain'.

Figure 4. Adoption motivation themes that emerged from the qualitative interview data



Bubble size relates to the number of Scale Out Farmers within each theme and overlapping circles represent where Scale Out Farmers identified multiple motivations/benefits

Discussion

When farmer training is carried out in development projects, its impact can be increased by using step-wise and participatory processes that support subsequent farmer-to-farmer learning. In this Case Study, the effectiveness of the step-by-step transfer of new knowledge through the Best Bet process was evident in participating farmers adopting and adapting many of the recommended forage and cattle management practices. The incremental introduction of new knowledge supported the farmer learning process due to new knowledge building on existing knowledge; to make sense of new information it must connect with an existing frame of reference (Weick 1979, 1995). True learning does not therefore usually result from a single training session, but requires continued support and interaction with knowledge sources (in this case Best Bet facilitators) over time as farmers adapt knowledge and trial applying it on-farm (Turner & Irvine 2017). When initial practice change was successful and some benefits experienced by the farming households, farmers progressed on to apply varying proportions of the subsequent practices. Winter & Doyle (2008) note that even when benefits experienced as a result of change are not monetary, such as reduced time spent by women and children in livestock husbandry activities, they still provide the motivation and confidence for farmers to continue in the learning and adoption processes. Ko et al. (2005) suggest that practice change is evidence that true learning is taking place, as farmers apply and adapt new knowledge to best suit their own farming systems. In this Case Study, true learning among participating farmers was not only demonstrated through positive changes in their own farming systems, but through the extensive sharing of knowledge and resources with other farmers.

The scale out of knowledge and practices from Best Bet farmers interviewed in this Case Study demonstrates the common observation that many farmers prefer to learn about new agricultural technologies from other farmers who have already adopted or adapted that technology on their own farm (Millar et al. 2005; Turner et al. 2017). In the project communities, farmer-to-farmer learning has been identified as a primary mode of knowledge transfer, with far fewer Scale Out Farmers in Cat Trinh commune identifying media (35%), local extension (13%) and development projects (3%) as information sources, compared to other farmers (100%) (McCormack 2015). Farmer-to-farmer learning extends knowledge transfer beyond that achievable through direct extension because it occurs mainly through informal and ongoing interactions between neighbours and relatives (McCormack 2015). Informal interactions also circumnavigate the cultural gender division often observed in organised extension activities, where it is culturally appropriate for males to attend cattle training activities despite females in the household carrying out more of

the cattle-related management role. Of the 31 Scale Out Farmers interviewed in this study, 17 were females who had learned directly from the male Farmer Champions. Bryk & Schneider (2003) highlight the importance of credibility and trust in these effective learning relationships. The informal interactions and existing relationships in the project communities allowed the benefits of changing practices to be observed, provided living examples of how practices were successfully adapted in a similar farming context, and allowed change to gradually take place as communication between farmers continued and confidence to apply new knowledge increased.

The extent of scale out from Best Bet Farmers was related to characteristics of their own adoption. Best Bet Farmers who adopted forage and cattle management practices rapidly and to a greater extent (i.e. a fuller range of the practices taught through the incremental Best Bet training process) were those who shared forage resources and knowledge and skills around forage and cattle management with a larger number of relatives and neighbours. The reputation of these emerging Farmer Champions as experts also led to formal requests by commune extension staff to be involved in other cattle-related projects, developing commune policy around forage and cattle management, and organising the collection of large quantities of forage resource for other communities. Interviews with the three Farmer Champions from Cat Trinh commune revealed that their successful scale out was largely due to their accessibility, availability and generosity. A key to becoming effective facilitators of knowledge transfer was their willingness to respond to requests and initiate helping other farmers.

The benefits that the Farmer Champions had experienced through adopting the Best Bet recommendations led to them becoming known as valuable sources of knowledge and resources and sought out by relatives and neighbours. It was the improved health and saleability of the Farmer Champions' cattle that motivated many Scale Out Farmers to commence changing practices. It was common for there to be multiple visits between farms as Scale Out Farmers developed questions around the next stage of adoption. Between 2011 and early 2015, the three Farmer Champions collectively provided the knowledge and resources to increase the efficiency and profitability of an estimated 60 primary and secondary Scale Out Farmers, through informal and formal knowledge transfer pathways (Turner et al. 2015), 31 of which were interviewed (McCormack 2015).

Monitoring the high quantity and quality of scale out from Farmer Champions led to the suggestion that their active engagement in further development activities to fast track scale out and initiate scale up was likely be highly effective. The active engagement of Farmer Champions in extension of proven technologies has been limited in terms of testing methods and evaluating impacts. Millar et al. (2005) facilitated smallholder farmers from selected villages in Laos being visited by Farmer Champions from another village, to share the benefits of his/her changed practices. Farmers appreciated being introduced to new knowledge by farmers (preferred over extension providers), but this method was not as successful in terms of adoption outcomes as farmer cross visits, which involved farmers from selected villages visiting other villages (with similar farming systems) where the new technology had already been adopted. Cross visits allowed farmers to see technologies at work, question host farmers, exchange experiences and learn practical aspects of how to use the technology (Millar et al. 2005). Given the important role Farmer Champions play in accelerating natural scale out in their own villages, there is the potential to combine these extension methods by using Farmer Champions in cross visits to fast track the learning process.

Conclusion

Winter & Doyle (2008) emphasise the challenge in conducting development projects to increase livestock production in smallholder crop-livestock systems is to understand the systems in enough depth to ensure recommendations around practice change lead to an improved outcome for the family. This Case Study confirms that the facilitated Best Bet process leads to positive change for cattle producing households on the South-Central Coast of Vietnam and that there is significant potential to use Farmer Champions as the 'spark' to accelerate scaling out to initiate scaling up. These findings suggest Farmer Champions in South-Central Vietnam can be identified by their rapid rate of adoption and greater extent of adoption; characteristics which relate to high numbers of subsequent Scale Out Farmers. The selection of these effective Farmer Champions by extension workers is essential for successful facilitation of farmer-to-farmer learning. Key identifiers for extension workers to prioritise are: farmers who confidently apply new knowledge, are observed to experience the benefits of continually improving their practices, and generously share their knowledge and forage resources with other farmers.

Acknowledgements

The authors would like to acknowledge ACIAR funding and the collaborative efforts of Vietnamese and Australian team members involved in projects SMCN/2007/109 and SMCN LPS/2012/062.

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Developing an Extension Model of Practice to guide and empower extension practitioners

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Abstract. A model of practice is a professional framework that guides practitioners and is informed by and integrates the core concepts, theories, tools, interventions and elements of work in a profession. A multi-disciplinary team contributed to the development of an Extension Model of Practice. Using a mixed methods research design, data were gathered from a) semi-structured interviews (n=206) and a survey (n=90) with extension practitioners, b) six co-design workshops with extension agents (n=88), c) three semi-structured interviews with farmers (n=60) and extension leaders. The resultant model conceptualises the helping process of extension and the way extension professionals engage with and support farmers. A suitable support system comprising targeted awareness sessions and training modules is required to sustain its implementation. The model supports early-career professionals and guides service-delivery and the helping process for all extension practitioners to better address the imperative for greater practice change in agriculture in partnership with farmers.

Keywords: agricultural extension, adoption, model of practice.

Introduction

Purposeful improvement of practice is essential for maintaining excellence in one's profession and is at the core of being a professional (Schön 1983; Mylopoulos & Farhat 2015). This lifelong quest for excellence is based on continuous self-improvement and self-examination (Peters & Waterman 1982; Peters & Austin 1985). The concept of reflective practice helps professionals reflect both during and after their activities, to improve their practice (Schön 1983; Bandura 1986; Mann et al. 2007).

Whilst continuous improvement is important, a model of practice provides practitioners with a consistent framework that is informed by and describes the core concepts, theories, models, tools and elements of their work in a given profession and can help guide interventions and evaluations (Hussey et al. 2007; Borg et al. 2010; Higgs 2016). A model of practice helps them know what to do, and refers to a theoretical construction about action-consequence relationships, and primarily instructs practitioners how to intervene to produce a desired effect. In contrast, a conceptual model helps us analyse and understand, and refers to a theoretical tool that helps explain or predict a construct and how the constructs relate to one another (McColl & Pranger 1994).

While commonly used in the education, health, allied health and social work professions (Evans 1976; Weick 1983; Krefting 1985; Kane 1997; Boon et al. 2004; Corey 2013; Toklu & Hussain 2013; Richard & Villarreal Sosa 2014; Taylor et al. 2019; Beamish et al. 2020), a model of practice (or professional framework for the helping process) is not commonly used by agricultural extension practitioners.

Extension is 'the process of enabling change in individuals, communities and industries involved in the primary industry sector and with natural resource management' (State Extension Leaders Network 2006, p. 3). It involves extension agents working with farmers, their families, their management teams and others in the wider agricultural innovation system (as appropriate) to encourage and support voluntary change to improve production, profitability, environmental and social outcomes. It includes raising awareness, understanding, skills, motivation, and pathways to change (Rogers 1962; Feder & Umali 1993; Black 2000; Coutts et al. 2017). Extension practitioners perform a critical role in establishing effective relationships in order to enhance and improve farming practices (Pannell et al. 2006). They use a variety of extension approaches which generally exist along a continuum ranging from top-down directive approaches to bottom-up participatory approaches (Chambers 1988; Feder & Umali 1993; Chamala & Keith 1995; Black 2000; Coutts et al. 2005; Hunt et al. 2011). While there are various extension models, as described by Coutts & Roberts (2003), they all involve interactions with people. However, the importance of building relationships and the enabling qualities of unconditional positive regard, humility and empathy are not emphasised to the degree they are in the Family Partnership Model (Davis & Day 2010), an evidence-based model of practice for helping in the child and family health profession.

Extension is based upon several social principles and approaches (e.g. Tully 1964). The person-centred approach (Rogers 1951) assumes that people change in relationship with others, resolving their problems through a supportive, non-judgemental relationship with a counsellor, without the need of an authoritative, directive intervention (Coghlan 1993; Corey 2013). Ecological systems theory (Bronfenbrenner 1979) situates the individual centrally and surrounds them with interrelated ecological systems. Adult learning principles (Knowles 1973) include the concept of building on the existing knowledge and experience of the adult learner and treating them with respect and unconditional, positive regard. Action learning involves taking action and then reflecting upon the results (Revans 1983). The concept of reflective practice (Schön 1987) explores experience, interaction and reflection, enabling awareness of implicit knowledge and learning from experiences. The farmer-first approach (Chambers et al. 1989) acknowledges farmers as intrinsic problem-solvers and innovators and assisted the move away from transfer of technology approaches to more participative processes. Participatory action research builds on this and emphasises action and participation (Chambers 2008; Chevalier & Buckles 2019). A strength-based practice (Rapp 1998; Buckingham & Clifton 2001; Seligman 2004) emphasises the benefit of building upon an individual's strengths, rather than using a deficit focus. Additionally, healthy professional relationships and strong social bonds have been shown to contribute to productive farmer-advisor interactions (Kuehne et al. 2019). Conversely, a lack of trust and empathy with the farmer is detrimental to this relationship and has contributed to farmers valuing opinions of their peers over scientific experts (Neef & Neubert 2011; King et al. 2019; Frei & Morriss 2020; Rust et al. 2020).

The uptake and adoption of new farming practices, particularly those associated with best management practices, are regarded by some as too slow and not reaching the desired peak level of adoption (Lindner 1987; Pannell et al. 2006; Llewellyn 2007; Kuehne et al. 2017; Rickards et al. 2018). This is affecting contemporary extension challenges in Queensland, including minimising the runoff of sediment and nutrients from coastal farms into the catchments of the Great Barrier Reef (Waterhouse et al. 2017). Another pressing challenge is the practice change imperative for farmers to adopt best management practices to maintain their social licence (Wilburn & Wilburn 2011; Williams et al. 2011).

Extension practitioners play a key enabling role in this change process. Extension practice appears to straddle the disciplines of agricultural science, environmental science, social science, behavioural psychology, sociology and social work. In other helping professions, staff use models of practice to provide a consistent process with evidence-based guidance on practice implementation.

An explicit Extension Model of Practice (EMoP) that integrates many of the above-mentioned theories, principles and processes into a professional framework, could act as a decision-making and service-delivery framework to guide and underpin the work of extension practitioners in their helping role with farmers and others in the system. An EMoP could enable extension agents to be more intentional in their work, with improved clarity of purpose and practice processes to enable greater change in their farming systems. The model of practice could also be highly beneficial to the recruitment, induction and professional development of early-career extension practitioners.

Identifying this as a possible gap and an opportunity for learning from other sectors, a multi-disciplinary team undertook a research project to explore the potential development of an extension model of practice.

Methods

A mixed methods research design enabled the collection of predominantly qualitative data during 2019 and 2020. A purposive sampling technique was used to represent the range of views of extension practitioners and farmers across Queensland. To provide greater representation, an opportunity was provided for the Queensland-based members of the Australasia-Pacific Extension Network (APEN) to contribute via an online survey. This anonymous online survey collected data from 90 respondents from September to December 2019, and posed 10 predominantly open-ended qualitative questions. Key questions included: what is your understanding of the terms extension, adoption and practice change; what challenges, difficulties and worries do you face in your work; what extension approaches are working well; what difficulties and challenges do farmers face; what outcomes would you like to achieve with the farmers with whom you work; what attributes are required to achieve these outcomes; what are the characteristics of an effective relationship with a farmer; and how do you describe your extension approach? Note: for brevity, while the term farmer has been used, the broader farm family and management team are implied to be included.

Semi-structured interviews based on these survey questions were held with 206 extension practitioners/managers from September 2019 to May 2020. These interviews were facilitated via one-on-one and small group discussions. These were predominantly undertaken in person, though some occurred via telephone and virtual meetings.

Five semi-structured interviews were conducted with 60 farmers between September to December 2019. These were conducted physically in small groups and were based on the survey questions. In addition, six online co-design workshops were attended by 88 extension practitioners from May to July 2020. Although initially planned as physical meetings, online delivery was considered the most practical option due to COVID-19 travel and physical distancing restrictions. The use of Zoom for the online meeting and Padlet (an online collaboration tool) to gather data, provided a blend of synchronous and asynchronous communication. This allowed respondents the opportunity to personally enter their thoughts and ideas onto the Padlet canvas both during and after the workshops.

The qualitative data were analysed through a highly recursive process of coding and categorising, in order to allow the themes to emerge. Several researchers were involved in this process to reduce individual bias.

Results

The resultant Extension Model of Practice has farmer-centred practice at its heart (see Figure 1), supported by the three core practice elements of relational practice, change practice, and technical knowledge practice. These in turn are supported by three enablers: the skills and qualities of the extension agent; the personal perspectives, constructs and world views of the extension practitioner and farmer; and the expertise of the extension practitioner and the farmer. Influencing the core practice elements and the enablers, are the drivers of change for making decisions about farming practice: farm productivity, profitability and sustainability in the context of land stewardship. Finally, the model operates within the external structural context of policy, research and development initiatives, the wider social, political and economic climate, and sector systems and structures.

Figure 1. A diagrammatic representation of the Extension Model of Practice

The model situates the farmer centrally, drawing attention to the bi-directional flow of influence within and across the multiple systems that exist in a farmer's broad ecology. This extension practice framework provides an explicit focus on the helping process. It has a greater emphasis on relationships and the crucial qualities of humility, empathy and unconditional positive regard as they relate to the quality of the outcomes and practice change. This is relevant for any

purposeful interaction between two or more individuals, and would apply to all five models (Group facilitation/empowerment, Technological development, Programmed learning, Information access and Personalised consultant) proposed by Coutts & Roberts (2003). It has particular relevance to the Personalised consultant model, with its focus on the farmers and their needs.

Overarching theme: farmer-centred practice

From the analysis of the data collected at the semi-structured interviews and co-design workshops, an overarching theme of farmer-centred practice emerged. This approach requires extension professionals to:

- Engage authentically with farmers, by seeking to engage in a respectful and responsive way.
- Maintain a collaborative partnership, by engaging farmers as full partners in all discussions and decisions.
- Strengthen farmers' capacities, by looking for and acknowledging the strengths, knowledge and skills of farmers and seek to build on these.
- Respond to farmers' priorities, by attending to the issues that are most important to them and seek to help the farmers with them.
- Obtain feedback from farmers, by seeking regular feedback from them. This helps to avoid assumptions and promotes a farmer-centred approach in practice.
- Engage in reflective practice, by taking an in- depth perspective of the strengths and challenges of extension practice with support from others. Reflective practice creates opportunities for learning and change.

Core elements of the emerging model of practice

Analysis of the data also identified three core elements of effective practice: relational practice, change practice and technical knowledge practice. Relational practice relates to the relationship between the farmer and the extension practitioner, which is seen as central to the change process. Change practice relates to both the process and outcome of the collaboration between the farmer and extension agent. Technical knowledge practice relates to the wealth of technical knowledge accrued in practical farming practices and access to networks of expertise. It is asserted that technical knowledge practice helps facilitate a process that acknowledges, utilises and builds on the farmer's existing expertise and knowledge.

These three core practices, together with farmer-centred practice, are all interrelated and cannot be undertaken in isolation. There is a synergy and complementarity achieved from practicing them concurrently.

Relational practice

Relationships between extension practitioners and farmers, while valuable, are also a means for supporting change, so relational practice is at the core of the change process. The aim of relational practice is to develop rapport and understand the needs, goals and priorities of the farmer. Relational practice requires understanding a farmer's world view—demonstrating attentive listening to understand their values, needs and goals (both personal and business). This provides the foundation for change. The emphasis on relational practice is particularly important, as people generally change when in relationship with others (Rogers 1951; Tully 1964).

As part of their relational practice, extension practitioners should be supportive and empathic, by being encouraging, caring and enthusing. Farmers need to experience a connection and rapport with extension practitioners. An effective extension practitioner is facilitative—working alongside farmers to help them achieve their goals; purposeful—helping guide and inspire change; and influential—being focused, determined and persistent. Many of these core attributes are similar to those in counselling and helping roles (Day et al. 2015).

However, if these relationships with farmers are primarily only supportive and connected, the practitioner role can lack purpose and is therefore likely to be more akin to a friendship than working together towards a mutually agreed goal. Conversely, if their role is primarily influential, then the relationship is more akin to that of an advisor.

Change practice

Change practice is fundamental to the extension relationship. Change practice is enabled when time is invested into building effective relationships to achieve a mutually agreed goal. In this context, change is seen as both a process and an outcome, and results from the collaboration between the farmer and the extension practitioner. Both are important and need to be monitored. It is important for the extension practitioner to listen to the farmer, understand what they are saying and elicit what the farmer wants to work on first. Such disciplined practice is opposed to

the common extension practice reflected in having predefined project objectives and limited time to develop meaningful relationships.

Technical knowledge practice

Technical knowledge practice is the third and final core element. It includes knowledge and understanding of the industry and agricultural production systems, current science and research, evaluation (critical thinking and data analysis), and natural systems and the environment. Extension practitioners should have skills and knowledge around the design, conduct and evaluation of suitable interventions that facilitate engagement with farmers, and support organisations and farming communities. These skills include a range of extension methods and techniques, project design, implementation and evaluation.

Enablers

The core practices are supported by three enablers: the skills and qualities of the extension practitioner, the personal perspectives, constructs and world views of the extension agent and the farmer, and the expertise of the extension officer and the farmer.

Skills and qualities

The effectiveness of the model of practice is dependent on the interpersonal skills and personal qualities of the extension practitioner and most importantly, how they are experienced by the farmer. Interpersonal skills are the behaviours and communication methods the extension practitioner uses to interact with others. Personal qualities are the characteristics and disposition of the extension practitioner; how they come across to others and their attitude within the process of change. These qualities are observed and felt by others, and while often thought as intrinsic to an individual, they can be acquired and practiced.

A core set of extension practice skills and qualities emerged from the data, as related to the core elements. Firstly, those related to relational practice:

- Attentive listening—giving careful attention; concentrating; paying attention to non-verbal cues; responding appropriately; maintaining curiosity.
- Genuineness—being authentic, reliable and honest with farmers; being transparent without defensiveness.
- Clear communication—being clear and specific; summarising what has been heard or understood; choosing words carefully; responding to non-verbal cues.
- Emotional intelligence—having emotional strength to hear and accept farmers' thoughts and ideas; maintaining perspective while appreciating others' perspectives; awareness of your own personal feelings and reactions.
- Adaptability—being able to adapt to new information and situations; responding to farmers in a way that suits their style and needs.
- Flexibility—being flexible and able to learn from others.
- Empathy—demonstrating understanding of farmers' experiences; making sense of what you feel as you listen; imagining the farmers' thoughts and feelings; respectfully sharing your thoughts and insights.
- Respectful—valuing farmers' expertise and experience; enabling farmers to make positive decisions; keeping confidentiality.

Secondly, those that related to change practice:

- Negotiating—facilitating joint decision making to come to mutual agreement throughout the change process.
- Working together—explicitly discussing what you can reasonably expect of each other; checking in on the agreement and amending where necessary.
- Utilising strengths—an awareness and understanding of the strengths that each bring to the relationship and how these can be best utilised.
- Reserving judgement—being constructive and sensitive in making judgements.
- Vulnerability—having humility; being aware of our own limitations; being realistic about ourselves.
- Warm enthusiasm—encouraging realistic hope; developing confidence and capacity.

Finally, those related to technical knowledge practice:

- Advocacy—communicating (e.g. research trial results) with farmers and with the public in an accessible way; being there for the farmer's benefit and communicating to all on their behalf.
- Critical thinking—knowing and being able to distinguish effective practice.
- Sharing information—sharing new trends or new ideas from other farms; enabling knowledge exchange.

- Being present—being on farm, seeing something physical happening.
- Responding to individual needs—tailoring advice to an individual farmer's practice or situation to get best result for individual farmers.
- Self-awareness—understanding your limitations and being explicit about what you can or can't do.

Personal perspectives

Another enabler considered to be integral to supporting the core practices of extension work is personal perspectives. Practitioners will undoubtedly bring their own perspectives to any given situation and these unique perspectives influence thinking processes, reactions and responses. In turn, the way people respond to any given situation, event or information influences the perspective of the person being engaged.

Perspectives determine how practitioners view their work, their involvement and roles, and can influence the way they see themselves and their feelings and behaviours. These perspectives influence the willingness and ability of practitioners to engage and use the help available, and their perception of others including their strengths and difficulties. For extension work to be effective, the extension practitioner/farmer relationship needs to develop a common, shared set of perspectives that provide an accurate and helpful understanding of the farmer's situation.

Expertise

The farmer brings the expertise of their individual farming practices and experience, farm history and community to the extension relationship. The extension practitioner's expertise comprises their practice and acquired knowledge. Through the relationship, the extension practitioner and farmer can come to understand and appreciate the expertise and limitations of each other. Extension practitioners need the skills to facilitate the sharing of expertise in a way that acknowledges, utilises and builds on the farmer's own expertise and knowledge, and mobilises the combined strengths and expertise in complementary ways. The relationship is most effective when farmers and extension agents utilise their complementary expertise to collaboratively identify priorities, address challenges and support change.

Drivers

Three drivers of change were identified from the data: productivity; profitability; and sustainable farming, land stewardship and succession. Participants collectively stated that it was crucial to know and understand these key drivers and their interactions when working towards a change in farming practice as they directly influence decisions and affect behaviour.

External context

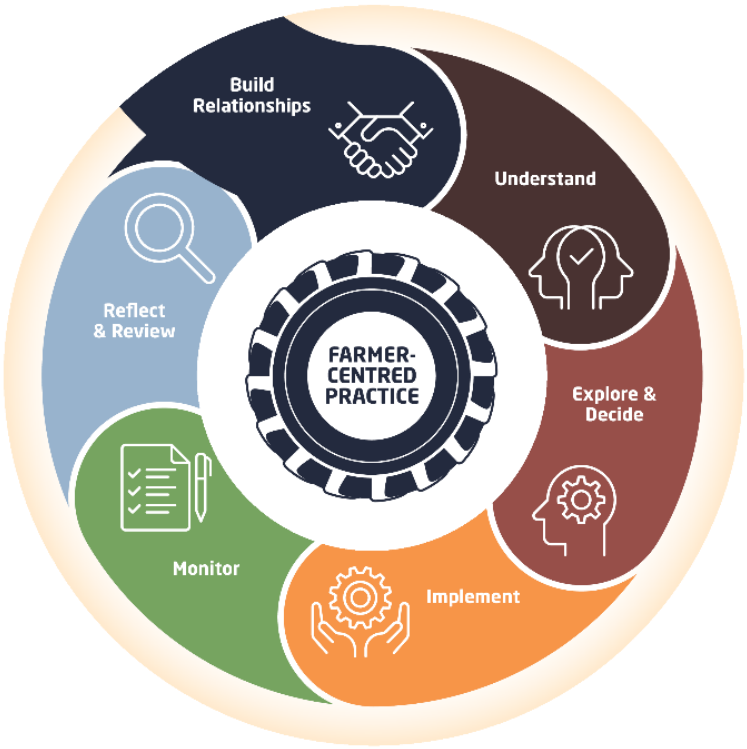
The EMoP highlights the influence of the external context on extension practice and outcomes. External factors including policy, research and development initiatives, the wider social, political and economic climate, and sector systems and structures, also inevitably influence the relationship between the farmer and the extension practitioner, and the resulting practice change. These are particularly important to consider when choosing which other members of the wider agricultural innovation system to include in the project design and implementation.

The extension practice data highlighted six external factors that influence extension practice: industry sector factors; systems; governance, organisations and workplaces; funding and resources; policy and politics; and stakeholders and interactions.

Implementation process

A six-step implementation process (see Figure 2) emerged from the workshops and though it might not be as relevant to the Programmed learning and Information access models, it could be relevant to the other models of Group facilitation/empowerment, Technological development, and Personalised consultant. These steps build on the core element of change practice and further highlight the central focus of farmer-centred practice. The implementation process builds and sustains farmer engagement and supports shared understanding of values, goals and priorities. The order is important—it is essential to establish a collaborative partnership with farmers and an understanding of their preferred priorities and outcomes before identifying strategies for addressing farm challenges or concerns.

Figure 2. Implementation steps for the Extension Model of Practice



The six sequential steps are as follows:

1. Build relationships. Establish the foundation for a collaborative relationship. Begin to get to know the farmer (or group of farmers) and their context, or continue to sustain an existing relationship. Be welcoming and inclusive, engage with farmers and seek to understand them and their context.
2. Understand. Work with farmers to understand their wants and needs, and identify their concerns and priorities. Explore the culture, identity, values and circumstances of the farmer (or group of farmers) and learn about the issues most important to them.
3. Explore and decide. Consider how best to address concerns. Find out what strategies the farmer (or group) is already aware of or using, and share with them information about other effective strategies. Help them to decide what action (if any) they want to take.
4. Implement. Support the farmer (or group) as they undertake their chosen plan. Provide support for change and help them to identify and measure changes or improvements.
5. Monitor. Monitor and evaluate with the farmer (or group) whether the chosen strategy or plan has had the desired effect. If not, revisit earlier steps in the sequence.
6. Reflect and review. Routinely review the priorities and outcomes for the farmer (or group), and reflect on what they have achieved.

Step 1 (build relationships) and step 2 (understand) are foundational steps and may need some time to achieve. They are foundational because the following steps will not be effective if these two steps are not in place, as the priorities of both the farmer and the extension practitioner need to overlap to move forward.

Steps 3 to 6 for the implementation of the EMoP can be viewed as action learning. In practice, these steps can be iterative and flow into one another. The process of review may lead to repeating some earlier steps to refocus.

It is considered important that the implementation is not constrained or rushed. The extension practitioner must view their initial engagement with a farmer as 'relational work' before moving into traditional expertise-driven processes. Subsequently, the early steps in the process may need to be taken more slowly, particularly with those farmers who are unfamiliar in dealing with extension services and professionals. It is important that the process occurs at a pace that is attuned to the needs of the farmer.

Throughout the process, the extension practitioner should facilitate respectful review to identify necessary changes. Negotiated strategies will not always work in predetermined ways and

necessary adjustments need to be readily considered. Such flexibility should be viewed as a strength rather than a weakness, as the process of regular adjustment makes will enable extension interventions to be manageable and effective for the farmer.

Discussion

While the focus of this EMoP is on the helping process and the interaction between a farmer and an extension practitioner, the principles will hold true for groups of farmers interacting with each other in a peer-to-peer program, and with one or more extension practitioners and others involved in the wider agricultural innovation system. Naturally, when scaling up and out, the greater the number of people and organisations involved, the greater the time and resources will be required.

Support frameworks

Supporting practice change can be a very difficult process. Sustained change in practice requires continued focus, support and commitment from stakeholders at all levels. Professionals can be supported to recognise opportunities for change in their practice, but without focused attention and support, they can experience 'practice drift' back to default practices (Regehr & Mylopoulos 2008). It has been understood in the human services sector for some time that while new knowledge, skills and expertise can be transmitted through various forms of teaching, to sustain and embed new learning in professional practice requires more sophisticated strategies (Chaudoir et al. 2013; Bauer et al. 2015; Albers et al. 2020).

Previous approaches to the dissemination of training across workforces have commonly reflected a 'train and hope' approach—where the significant investment made in the delivery of training is followed by hope that the training will then be applied in practitioners' practice (Stokes & Baer 1977). In reality, professionals can be inspired through training to accept new learning and recognise the potential for personal practice change. However, the adult learner must also be supported in a variety of ways to keep new learning alive and applied (Knowles et al. 2014).

Successful implementation of the EMoP requires those involved in the extension service system to collectively embrace and embed the model in all extension related activities and practices. This would require employing bodies and funders to acknowledge and understand the EMoP. This means farmers and those involved in governance, policy development, project monitoring and evaluation, human resource management, staff management and supervision would need to be supported to understand the model. While dissemination of literature might be the most efficient means to support this step, the most effective strategy for supporting key stakeholders to understand the model and its application would be the provision of specially targeted awareness raising sessions and short, targeted training modules for the practitioners, their managers and funders. These would help provide broad exposure to the detail that lies within and behind the model. Utilising strategies that support farmers and key stakeholders to explore the model may enable a more critical examination of structural and procedural adjustments required to ensure the sustainable implementation of the model.

Another support mechanism would be to create a community of practice of EMoP practitioners, enabling peer-to-peer learning and co-development of practical and creative ways to utilise the EMoP. This could also enable mentoring and professional supervision to be undertaken in a supportive environment. A natural fit for this would be the professional association for extension practitioners, such as APEN in Australia and New Zealand. The association could take ownership and carriage of the EMoP to ensure it is given the necessary gravitas for its successful implementation by key stakeholders in the extension sector. The EMoP could provide the foundation of the training activities associated with the APEN professional development credits scheme. Whilst APEN can only guide and recommend best practice extension approaches, it is hoped that sufficient employing organisations will take heed of their recommendations.

Limitations

Despite this model evolving within Queensland, and that the participants did not represent all related industries, a diverse array of participants contributed to the development of the model of practice for extension. It is therefore argued that the EMoP can be considered as applicable to other jurisdictions both within Australia and further afield. Consequently, it would be beneficial for the extant model to be validated in other areas across Australia and New Zealand by running several pilot workshops with representatives from a range of regions and industries. A pre-conference workshop session at the next APEN conference could be one part of this.

Conclusion

This study makes an original and significant contribution towards further building the professionalism of agricultural extension. It highlights that what extension professionals do in the

helping process is important, but it's how they do it that makes the difference. The EMoP integrates many of the core concepts, theories, tools, interventions and elements of previous models to present a unified practice framework. It is this farmer-centred practice, together with relational practice, change practice and technical knowledge practice that forms the core of the model. These practices are interrelated and need to be utilised by the extension practitioner concurrently, whilst explicitly implementing the sequential helping process to realise practice change.

It is intended that the adoption of the EMoP will support the early-career professional to better understand their professional practice and provide support mechanisms. The EMoP could also further raise the level of professionalism in agricultural extension, and better meet the practice change imperative in agricultural industries across Queensland, Australia and beyond.

Acknowledgements

The authors gratefully acknowledge the funding provided through the Enhanced Extension Coordination Program, developed as part of the Queensland Government's Reef Water Quality Program, managed by the Department of Agriculture and Fisheries. The many extension practitioners and farmers who contributed to the co-design of the model are acknowledged, as are the regional extension coordinators, and the members of the project reference panel: Deb Telford (Chair), Mark Mammino, Jeff Coutts, John James, Katri Haanterä, Cathy Mylrea, Graham Harris and Jean Erbacher. The contribution of Joanne Hall (Isis Canegrowers) and Deb Sestak, Tim Moore and Vikki Leone (MCRI) was crucial to the development of the EMoP. The constructive feedback from the two anonymous reviewers was greatly appreciated.

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Factors affecting smallholder farmers' adoption of mobile phones for livestock and poultry marketing in Vietnam: implications for extension strategies

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Abstract. In order to promote smallholders' adoption of mobile phones for marketing, it is important to understand factors that influence their adoption. Hence, the purpose of this study was to investigate factors that affect the adoption of mobile phones for livestock and poultry marketing by smallholders in Vietnam. A two-section questionnaire was administered to 233 smallholder livestock and poultry farmers randomly selected from 573 smallholders in Phu Cat district of Vietnam. A binary logistic regression model was used to analyse the data. This study found that young smallholders who live close to an electricity base, with higher education levels, higher income, own large farms, participate in credit/training programmes, and who are members of community-based organisations, have a greater tendency to use mobile phones for livestock and poultry marketing. Subsidy and the provision of technical short course training on the use of mobile phones for smallholder livestock and poultry farmers are important extension strategies that can strengthen the adoption of mobile phones by smallholders for marketing, and this strategy should be delivered via community-based organisations.

Keywords: smallholders, adoption, livestock and poultry marketing, mobile phones, Vietnam.

Introduction

Agricultural development has been seen as an opportunity for growth in developing nations because this activity can contribute directly to economic growth (Bellon et al. 2020). Small-scale farms often dominate rural farming sectors in the developing world. For example, in the region of Sub-Saharan Africa, East Asia and the Pacific, more than 70% of farms are small-scale, and the income and employment of the majority of smallholders in these areas heavily relies on smallholder farming activities (Lowder et al. 2016). However, the smallholder farmers in developing nations, including Vietnam are encountering challenges in accessing and using knowledge, new technologies, credit and market information for maintaining and developing their livelihood (Pham 2018). Currently, 70% of the Vietnamese population are engaged in the agricultural sector and this sector contributed more than 15% to the total export earnings in 2018 (General Statistics Office of Vietnam 2019). The Vietnamese agricultural sector is preponderated by more than 10 million smallholders, providing an important proportion of the national production in 2018 (General Statistics Office of Vietnam 2019). Livestock and poultry production and marketing are important livelihood activities for many rural Vietnamese smallholder farmers (Burgos et al. 2008).

One of the key development programmes of the Government of Vietnam over the last decades has been helping smallholder farmers to gain access to markets (Tran and Dinh 2014). However, according to Pham (2018), many Vietnamese smallholders are facing numerous difficulties in accessing marketing information. The main marketing problems for the smallholder farmers are non-reliable market information, incomplete information and inappropriate information (Pham 2018). Information and Communication Technologies (ICTs) such as mobile phones, internet systems, radios, TVs and computers are important measures for lessening these marketing problems. According to Krone et al. (2016) and Bachaspati (2018), the utilisation of ICT tools such as mobile phones, radio and internet-connected computers for marketing can contribute to eliminating intermediaries, reducing transaction costs and finding suitable clients. Mapiye et al. (2020) suggest that ICTs help to strengthen communication of market information and enable producers to be constantly linked to diverse sources of market information and communication pathways. Prior studies (Mwantimwa 2017; Mapiye et al. 2020) also suggest that effective use of ICTs presents a great chance for enhancing information access for rural communities.

In developing nations, mobile phones are one of the most popular forms of ICTs used by farmers (Nyamba & Mlozi 2012; Krone et al. 2016; Hoang 2020a; Hoang 2020b). Tekin's (2011) study shows that mobile phones had assisted farmers to identify the market where they could get the best price for their produce. Mobile phones have enabled producers to concentrate and look for useful and up-to-date material such as market information and the prices of agricultural inputs from social and business networks, according to Overa (2006). The use of mobile phones can assist farmers improve their bargaining position because mobile phones help farmers to make contact with various suppliers and buyers (Krone et al. 2016).

According to Alavion et al. (2017), to promote the use of ICTs for agricultural product marketing, its ease of use, with advantages such as fast dissemination of information, needs to be demonstrated and the ICTs have to be made available to prospective users. The Government of Vietnam has strongly encouraged the producers' utilisation of ICTs for facilitating the country's development over the last decade. However, the unitization of ICTs by Vietnamese smallholder farmers for marketing of agricultural products is still very limited (VietNamNews 2017). To facilitate smallholder farmers' adoption of ICTs tools, such as mobile phones for marketing, it is crucial to understand what the factors are that shape its adoption.

Research into the adoption of ICTs for marketing by producers has been conducted in some countries (Senthilkumar et al. 2013; Mittal & Mehar 2016; Alavion et al. 2017). Reviewing existing literature reveals that the farmers' use of ICTs for marketing is associated with either one, or some, of the following characteristics:

- demographic characteristics of producers including: age, gender and education level (Tekin 2011; Senthilkumar et al. 2013; Mittal & Mehar 2016)
- socio-economic characteristics of producers including income, access to a micro credit system and farm size (Senthilkumar et al. 2013; Ogutu et al. 2014)
- situational characteristics of producers including: distance from the producer's home to local markets and distance from the producer's home to an electricity base (Tekin 2011; Ogutu et al. 2014; Abebe & Cherinet 2018)
- institutional characteristics of producers including: taking part in training programs (Abebe & Cherinet 2018).

However, few studies have investigated the integration of the mentioned characteristics about the smallholders' adoption of ICTs for marketing. In addition, there is scant research that has investigated smallholders' adoption of mobile phones for livestock and poultry marketing. Moreover, the findings reported in the existing ICT adoption literature (Senthilkumar et al. 2013; Ogutu et al. 2014; Mittal & Mehar 2016; Alavion et al. 2017; Hoang 2020a) are mixed. For instance, a study by Mittal & Mehar (2016) in India, used a multivariate probit model to investigate factors that shape the use of ICTs by farmers for marketing, found that the Indian farmers with a higher education level tended to utilise modern ICTs including mobile phones and internet-linked computers for marketing more than those with a lower education level, which is similar to the findings of Folitse et al. (2018) who conducted research on mobile phone adoption by farmers in Ghana. Mittal & Mehar (2016) also report that the Indian farmers who owned larger farms were better modern ICTs users than those who owned smaller farms. In contrast, Abebe & Cherinet (2018) investigated farmers' adoption of ICTs for marketing in Ethiopia and found that size of farmland had no effect on the adoption of both traditional and modern ICTs for marketing by cereal farmers, which is the same as Ogutu et al. (2014) findings who undertook a study on the farmers' adoption of ICTs for marketing in Kenya.

Abebe & Cherinet (2018) also found that Ethiopian farmers who had higher incomes were in a better position to adopt ICTs for marketing than those who had lower incomes, which contrasts with the findings of Senthilkumar et al. (2013) who found that income of Indian dairy farmers was negatively related to their level of utilising ICT tools for marketing. In addition, the distance from the producer's home to the markets negatively affected the adoption of ICTs for marketing, whereas access to credit programs had a positive effect on the producers' ICT adoption for marketing (Abebe & Cherinet, 2018). Taking all these characteristics together, it is clear that the producers' adoption of ICTs for marketing is context-dependent. Although, the socio-economic, situational and institutional characteristics of producers shaped their adoption of ICTs for marketing, the way these characteristics influence their adoption varied, depending on the contexts and marketing and production systems in which producers operated. Vietnamese livestock and poultry smallholders are operating very small-scale farms, and the Vietnamese production and marketing systems are changing from a conventional (traditional) to a modern system (Maruyama & Le 2012). As such, Vietnamese smallholders' practices to use mobile phones for marketing of agricultural produce will not be the same as the farmers' utilisation of mobile phones for marketing in other contexts. This research is designed to investigate factors that affect the adoption of mobile phones for livestock and poultry marketing by Vietnamese smallholder farmers. The research will provide useful insights as to what influenced smallholder farmers' adoption of mobile phones. Such insights will be of value for proposing policies to enhance the use of ICTs for marketing. This will help increase the uptake of ICTs by smallholder farmers and improve market access for smallholder farmers in Vietnam.

Study region and methodology

Study region

This research was conducted in Phu Cat district of Vietnam. The Phu Cat district comprises 681 km^2 (68,071 ha) and, in 2019, its population was 193,262. The agricultural sector is a key contributor to the district's economy (Binh Dinh Statistical Office 2019). About 90% of the district's inhabitants reside in rural regions and participate in farming activities (Binh Dinh Statistical Office 2019). Facilitating agricultural development is, thus, a key area of the social and economic development plan for the Phu Cat district (Phu Cat District People's Committee 2019). Agriculture in Phu Cat district consists of cropping, livestock/poultry, forestry and fishery activities. However, livestock and poultry are the important contributors to the district economy and, hence, central areas for the agricultural development in Phu Cat district. The recent official statistics show that livestock and poultry accounted for 67% of the total gross output from agriculture in 2018 (Binh Dinh Statistical Office 2019). The main livestock and poultry in the Phu Cat district include beef cattle, pig, chicken, duck and buffalo.

Sample, instrumentation and data collection

This research utilised a cross-sectional survey research design (De Vaus 2014). To obtain a standard sample size for this study, a technique of random sampling was applied to choose participants and a sample size formula suggested by De Vaus (2014) was employed to determine the needed number of participants at a 5% precision level. Accordingly, a statistical sample size of 233 smallholder livestock and poultry farmers were randomly chosen from a population of 573 smallholder livestock and poultry farmers who farmed livestock and poultry in the Phu Cat district of Vietnam. The total population of 537 smallholder livestock and poultry farmers is in the household list of the district, which was obtained from the Phu Cat District People's Committee Office.

A two-section standardized questionnaire was created to gather data. The first section contained statements on: (1) types of livestock and poultry farmed and marketed, prices of selling the livestock and poultry produce; (2) sources of livestock and poultry marketing information; (3) ICTs use by smallholders for marketing; (4) the extent of use of ICTs for livestock and poultry marketing. The extent of use of ICTs was measured on a five-point Likert scale, which ranged from "never use" to "very often use"; and (5) constraints to ICTs use. The second section collected socio-economic information such as age, gender, education level and income. The questionnaire was pre-tested with nine smallholders and it was evaluated by a group of experts from a university for face and content validity. Five experienced enumerators were employed to administer the questionnaires in the study region. The survey was conducted from March to May 2020.

Data analysis

Data were coded and analysed in SPSS version 20. Descriptive statistics including frequency, percentages, means and standard deviations were used. Inferential statistics including Chi squares test and T-test were applied to identify the relationships between independent variables associated with the adoption of mobile phones for livestock and poultry marketing. A model of binary logistic regression was employed to examine the effect of the exploratory variables on the dependent variable (Agresti & Finlay 2009). The binary regression analysis was chosen because this type of analysis helps to predict a discrete outcome of the dichotomous dependent variable from either dichotomous, continuous or discrete independent variables (Agresti & Finlay 2009). The exploratory variables were theoretically chosen from the relevant literature (Senthilkumar et al. 2013; Mittal & Mehar, 2016; Alavion et al. 2017; Abebe & Cherinet 2018) and based on the important characteristics of smallholder farmers in the study area.

The dependent variable used in this research is a dummy variable, which assigns a value of 1 for mobile phone user and 0 otherwise. The basic form of the binary regression model (Agresti & Finlay 2009; De Vaus 2014) utilised in this research is presented as follows:

$$\mathrm{Ln}\left[\frac{Pi}{1-\mathrm{Pi}}\right] = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + \cdots \beta nXn.$$

Where:

Pi is the likelihood that the smallholder is a mobile phone user.
1− Pi is the likelihood that the smallholder is a non-mobile phone user.
β_0 = is an intercept.
β_1, β_2... βn are slopes of the equation in the logistic regression model.
X_1, X_2... Xn are vectors of relevant smallholder characteristics.

Table 1 shows the characteristics of hypothesised dependent and exploratory variables in the adoption of mobile phones for livestock and poultry marketing. There were four dummy variables and six continuous variables.

Table 1. Hypothesized variables in the use of mobile phones for marketing

Variables	Explanation	Category	Measurement
Dependent variables			
Mobile phone users	Use of mobile phones for livestock and poultry marketing	Dummy	1 = User; 0 = Non-user
Independent variables			
AGE	Age of smallholders	Continuous	Years
EDULEV	Level of education of smallholders	Continuous	Years
DISTMAR	Distance from local markets	Continuous	m
DISTELEC	Distance from electricity base	Continuous	m
FARMSIZ	Farm size	Continuous	m^2
INCOME	Total annual income	Continuous	VND[a]
GENDER	Gender of smallholders	Dummy	1=male; 0= female
CREDITPA	Participation in credit programs	Dummy	1 = yes; 0 = no
TRAINPA	Participation in training programs	Dummy	1 = yes; 0 = no
CBOPA	Participation in CBOs[b]	Dummy	1 = yes; 0 = no

[a]: VND is Vietnamese dong. About 22,000 VND = 1 USD.
[b]: Community-based organisations (CBOs).

Results

Main characteristics of the livestock and poultry smallholders

Table 2 describes main characteristics of the livestock and poultry smallholders in the study region. Overall, the majority of the smallholders in this region were middle-aged. In particular, a large proportion of the smallholders were aged between 45-54 (39%), followed by those aged between 35-44 (25%), aged between 55-64 (17%) and aged between 25-34 (10%). About 53% of the respondents were female and 47% of the respondents were male. The majority of the smallholders' education level was in 'junior high school' (66%). In contrast, only about 10% of the smallholders graduated 'senior high school' and approximately 7% of the smallholders obtained 'certificate/technical training'.

A large percentage of the smallholders had an annual income from 46-60 VND million (36%), followed by annual income from 31 to 45 VND million (28%) and annual income from one to 30 VND million (18%). The average area of farmland owned by a smallholder in the study region was 2,650 m^2 (0.265 ha). The percentage of the smallholders who took part in technical training programmes conducted in the study region was 44%, while the percentage of those who did not take part in these programmes was 56%. The percentage of the smallholders who participated in rural credit programs operated in the study region (46%) was less than those who did not participate in these programmes (56%). In contrast, the percentage of the smallholders who were members of community-based organisations such as farmers' union, women's union and cooperatives (87%) was much greater than those who did not participate in these types of CBOs (13%).

Type of livestock and poultry produced and marketed by the smallholders

Table 3 presents types of livestock and poultry farmed and marketed by the smallholders. Overall, the smallholders participating in this research farmed and marketed several livestock and poultry including: chicken, beef cattle, pig, buffalo, goose and duck. A majority of smallholders produced and marketed chicken (74%), followed by beef cattle (55%) and pig (51%). However, only a small proportion of smallholders farmed and marketed buffalo, goose and duck, accounting for about 7%, 7% and 5% respectively.

Sources of market information

Table 4 describes sources of market information used by the smallholders in the study region. In general, the smallholders in this region sought livestock and poultry market information from a large number of sources including: neighbours, other farmers, preferred collectors, local markets, mobile phones, TV, women's union, internet and Facebook. The main smallholders' source of livestock and poultry market information was from neighbours (98%), followed by other farmers (80%), preferred collectors (60%), local markets (58%) and mobile phones (56%). About 11% of the smallholders reported getting market information through TV, which was about one fifth,

compared to livestock and poultry market information sought from mobile phones. In contrast, a small number of the smallholders reported looking for livestock and poultry market information through the farmers' union (7%), women's union (7%), internet (5%) and Facebook (3%).

Table 2: Characteristics of the smallholders

Smallholders' characteristics		Value[c]
Age (years)	18-24	9 (3.9)
	25-34	23 (9.9)
	35-44	58 (24.9)
	45-54	90 (38.6)
	55-64	39 (16.7)
	65 or older	14 (6.0)
Gender	Male	111 (47.6)
	Female	122 (52.4)
Education level	Did not go to school	20 (8.6)
	Primary school	20 (8.6)
	Junior high school	154 (66.1)
	Senior high school	23 (9.9)
	Certificate/technical training	16 (6.8)
Income/year (VND million)	1-30	42 (18.0)
	31-45	64 (27.5)
	46-60	78 (35.5)
	61-75	28 (12.0)
	More than 75	21 (9.0)
Farm size (m^2)	Average farm size	2,650.9 (range: 700.0 - 5,500.0)
Participation in training programs	Yes	103 (44.2)
	No	130 (55.8)
Participation in credit program	Yes	106 (45.5)
	No	127 (54.5)
Participation in CBOs	Yes	203 (87.1)
	No	30 (12.9)

[c] : Values in parenthesis are percentages and without parenthesis are numbers

Table 3: Types of livestock/poultry marketed by smallholders

Name of produce	Responses		Percent of Cases
	Frequency	Percent (%)	(%)
Chicken	173	37.2	74.2
Beef cattle	128	27.5	54.9
Pig	119	25.6	51.1
Buffalo	17	3.7	7.3
Goose	16	3.4	6.9
Duck	12	2.6	5.2

frequencies reflect multiple responses; *N* = 233

Table 4. Sources of market information

Sources	Responses		Percent of Cases
	Frequency	Percent (%)	(%)
Neighbours	228	25.6	98.3
Other farmers	185	20.7	79.7
Preferred collectors	139	15.6	59.9
Local markets	135	15.1	58.2
Mobile phones	129	14.5	55.4
TV	25	2.8	10.8
Farmers' union	17	1.9	7.3
Women's union	17	1.9	7.3
Internet	11	1.2	4.7
Facebook	6	0.7	2.6

frequencies reflect multiple responses; *N* = 233

The use of mobile phones for livestock and poultry marketing

Table 5 shows distributions of the smallholders by mobile phone use for livestock and poultry marketing in the study region. It was found that 129 smallholders used mobile phones for livestock and poultry marketing, while 104 smallholders did not use mobile phones for doing so. The smallholders who utilised a mobile phone for seeking livestock and poultry market information in this study were considered as mobile phone users. In contrast, the smallholders who did not use a mobile phone were treated as non-mobile phone users. Accordingly, about 55% and 45% of the smallholders were found to be mobile phone users and non-mobile phone users, respectively (Table 5).

Table 5. Distributions of smallholders by mobile phone use for marketing

ICT tools	Number of respondents	Percentage (%)
Mobile phone users	129	55.4
Non-mobile phone users	104	44.6
Total	233	100.0

Extent of use of mobile phones for marketing

Table 6 outlines the extent of smallholders' use of mobile phones for livestock and poultry for marketing. It can be seen that a number of the smallholders taking part in this study frequently used mobile phones for their livestock and poultry marketing. In particular, about 34% (80) and about 17% (38) of the smallholders reported using mobile phones for livestock and poultry marketing as "often" and "very often" respectively. In contrast, about 45% of smallholders reported not using mobile phones to market livestock and poultry produce.

Table 6: Extent of smallholders' use of mobile phones for marketing

Extent of use ICTs (mobile phones)	Frequency	Percentage (%)
Never	104	44.6
Rarely	4	1.7
Sometimes	7	3.0
Often	80	34.3
Very often	38	16.3
Total	233	100.0

Relationships between smallholders' characteristics and mobile phone use

Tables 7 and 8 report relationships between smallholders' characteristics and mobile phone use for livestock and poultry marketing in the study region. Generally, the use of mobile phones for livestock and poultry marketing was statistically associated with several characteristics of the smallholders. In particular, the chi-square test results in Table 7 showed that the use of mobile phones for livestock and poultry marketing by the smallholders was statistically associated with their gender and training program participation at less than 1% (p<0.01) and with their credit program participation at less than 5% (p<0.05). Similarly, the t-test results in Table 8 revealed that the smallholders' age, education level, distance from their home to electricity base, their farm size and income were statistically significant at less than 1% (p<0.01).

Table 7. Distribution of dummy variables by mobile phone use for marketing

Variables		Total		Mobile phone users		Non-mobile phone users		Chi-squares test
		N	%	N	%	N	%	
Gender	Female	112	52.4	56	24	66	28.3	9.28 ***[d]
	Male	111	47.6	73	31.3	38	16.3	(0.002)
Credit Participation	No	127	54.5	61	26.2	66	28.3	6.07 **[e]
	Yes	106	45.5	68	29.2	38	16.3	(0.014)
Training Participation	No	130	55.8	58	24.9	72	30.9	13.75 ***
	Yes	103	44.2	71	30.5	31	13.7	(0.000)
CBO Participation	No	25	10.7	10	4.3	15	6.4	2.67 [NS f]
	Yes	208	89.3	119	51.1	89	38.2	(0.102)

[d] : significant at ≤ 0.01
[e] : significant at ≤ 0.05
[f] : non-significant.

Table 8: Distribution of continuous variables by mobile phone use for marketing

Variables	Mobile phone users		Non-mobile phone users		t-test
	Mean	Std. Dev.	Mean	Std. Dev.	
Age	3.46	1.19	4.04	1.01	-4.02 ***[d] (0.000)
Level of education	3.24	0.84	2.68	0.95	4.65 *** (0.000)
Distance from local markets (m)	1,973.25	873.43	2,089.42	751.55	-1.07 [NS f] (0.284)
Distance from electricity base (m)	392.48	255.45	493.46	273.61	-2.90 *** (0.004)
Farm size (m^2)	2,831.93	1,208.18	2,426.53	1,149.15	2.60 *** (0.01)
Income	3.94	1.04	3.31	1.23	4.14 *** (0.000)

[d] : significant at ≤ 0.01
[f] : non-significant.

Price of livestock and poultry marketed by the smallholders

Table 9 describes variation in prices of livestock and poultry when marketing them between mobile phone users and non-mobile phone users. It is clear that smallholders who used mobile phones were marketing their livestock and poultry produce at a higher price than those who did not use mobile phones to do so. In particular, t-test results in Table 9 showed a statistically significant difference in the average price per one kg of chicken and pig at a significance level of less than 1% ($p<0.01$); beef cattle at a significance level of less than 5% ($p<0.05$); and duck and goose at a significance level of less than 10% ($p<0.1$).

Table 9. Variation in prices among smallholders (VND)

Produce	Average price in VND/kg			t-test
	Mobile phone users	Non-mobile phone users	Mean difference	
Chicken	75,376.34	73,308.64	2,067.70	3.78 *** [d] (0.000)
Duck	40,166.66	39,666.66	500.00	1.86 * [g] (0.092)
Pig	40,445.94	38,444.44	2,001.50	5.17 *** (0.000)
Beef cattle	100,057.14	94,385.96	5,671.17	2.17 **[e] (0.031)
Goose	61,000.00	59,333.33	1,666.66	1.79 * (0.095)
Buffalo	76,333.33	72,000.00	4,333.33	1.13 [NS f] (0.274)

[d] : significant at ≤ 0.01
[e] : significant at ≤ 0.05
[g] : significant at ≤ 0.1
[f] : non-significant.

Factors affecting the adoption of mobile phones for marketing

Table 10 presents logistic regression model output for mobile phone use for livestock and poultry marketing. Generally, the characteristics of smallholders influenced their adoption of mobile phones for livestock and poultry marketing. Among the ten exploratory variables analysed, eight variables were found to be statistically significant and influencing the smallholders' adoption of mobile phones for livestock and poultry marketing. In particular, age of smallholders (AGE), distance from smallholders' home to the electricity base (DISELEC), farm size (FARMSIZ), income of smallholders (INCOME), participation in credit programs (CREDIPA), and participation in training programs (TRAINPA) were found to be statistically significant at less than 5% (0.05). Smallholders' education level (EDULEV) and community based-organisation participation (CBOPA) were found to be statistically significant at less than 1% (0.01).

Table 10: Logistic regression model output for mobile phone use for marketing

Variables	Coefficient	Std. Err.	*p value*
AGE	-0.393**	0.162	0.015
EDULEV	0.708***	0.211	0.001
DISTMAR	0.000^{NS}	0.000	0.269
DISTELEC	-0.002**	0.001	0.023
FARMSIZ	0.000**	0.000	0.030
INCOME	0.320**	0.161	0.047
GENDER	0.546^{NS}	0.368	0.138
CREDITPA	0.870**	0.345	0.012
TRAINPA	0.748**	0.349	0.032
CBOPA	1.402***	0.516	0.007
Constant	*-3.644***	*1.313*	*0.005*

N = 233
LR chi square (10) = 88.04***
Prob>chi-square =0.000
Model correction 80%.

Constraints to the use of mobile phones for livestock and poultry marketing

Table 11 reveals constraints to mobile phone use for livestock and poultry marketing by the smallholders in the study area. Generally, the key constraints that hinder the adoption of mobile phones by smallholders for livestock and poultry marketing in the study area were (1) 'high cost of using mobile phones' (64%), followed by 'lack of knowledge/skills to use applications on mobile phones' (55%). 'Mobile phone network problems' and 'not knowing how to use mobile phones' were the other main constraints to smallholders when using mobile phones for livestock and poultry marketing, and accounted for about 34%.

Table 11. Constraints to the use of mobile phones for marketing

Type of constraints	Responses		Cases
	No.	(%)	(%)
High cost of using mobile phone	150	30.7	64.4
Lack of knowledge and skill in using applications on mobile phones	129	26.4	55.4
Mobile phone network problems	80	16.4	34.3
Do not know how to use mobile phones	80	16.4	34.3
Poor quality battery	43	8.8	18.5
Unable to buy mobile phones	6	1.2	2.6

Discussion

Our analysis results show that the adoption of mobile phones for livestock and poultry marketing by smallholders was positively and significantly associated with their CBO participation. This means that the smallholders who are members of CBOs, have a greater tendency to adopt mobile phones for marketing. In the mainstream literature (Senthilkumar et al. 2013; Ogutu et al. 2014; Mittal & Mehar 2016; Alavion et al. 2017; Folitse et al. 2018), nothing has been written about the importance and impact of smallholders' CBO participation on their adoption of mobile phones for marketing of livestock and poultry. Agricultural extension programs designed to assist smallholder farmers adopt ICTs for marketing should consider smallholder farmers' participation in existing CBOs. Developing and sustaining the CBOs such as farmers' union, womens' union and agricultural cooperatives for rural smallholder farmers and promoting smallholders' use of ICTs via these organisations could be the good extension strategy to foster the adoption of mobile phones for marketing by smallholder farmers.

Adoption of mobile phones for livestock and poultry marketing by smallholders was positively and significantly associated with their participation in credit programmes, and participation in training programmes, a finding not reported in previous studies. The results suggest that the smallholders who participate in credit/training programmes have a greater tendency to adopt mobile phones for marketing of livestock and poultry. One possible reason is that in rural Vietnamese communities, smallholders who participate in credit programmes and training courses often have more human and financial resources and this can lead to being in a better position to adopt mobile phones for marketing of livestock and poultry. The Government of Vietnam must pay more attention to training smallholder farmers through both informal and formal education systems.

The district and provincial agricultural office, regional extension centres and other development agents need to provide training and orientation to smallholder farmers on how to obtain marketing information through using of ICT tools.

Adoption of mobile phones for livestock and poultry marketing was also negatively and significantly associated with age of smallholders and the distance from smallholders' homes to an electricity base, which means that younger smallholders who live close to an electricity base tend to use mobile phones for livestock and poultry marketing more than older ones who live far from an electricity base. A previous study by Abebe & Cherinet (2018) found that the adoption of ICT tools by Ethiopian farmers for cereal marketing was negatively affected by the age of the farmers, but it was not statistically significant, which is supported by this research.

It was found that the use of mobile phones for livestock and poultry marketing was positively and significantly associated with their education level. This means that smallholders who are at a higher education level are in a better position to adopt mobile phones for marketing of livestock and poultry. The findings from this study are generally consistent with findings reported in the literature (Mittal & Mehar 2016; Alavion et al. 2017; Abebe & Cherinet 2018), that farmers who are well-trained tended to be ICT adopters.

The results from this study indicate that smallholders in the study area look for market information of livestock and poultry from a wide range of information sources including: neighbours/friends, other producers, preferred collectors, local markets, mobile phones, TV, mobile phones, women's union, internet and Facebook. This suggests that market information for one type of produce such as beef cattle can be best gained from one source, such as other producers, while market information of other produce, such as chicken, may be best available from the local market. This also suggests that any single source of information may not meet all market information needs of the smallholder livestock and poultry farmers.

The results from this study also indicate that major constraints such as 'high cost of using mobile phones' and 'lack of knowledge/skills to use applications on mobile phones' are hindering the smallholder livestock and poultry to adopt mobile phones for marketing. Other constraints to the adoption of mobile phones for marketing include (1) 'mobile phone network problems' and (2) 'not knowing how to use mobile phones'. Subsidy and the provision of short course technical training on the use of mobile phones for smallholder livestock and poultry farmers are important extension strategies that could strengthen the adoption of mobile phones by smallholders for marketing. This strategy should be delivered via CBOs. This research needs to be replicated in other regions of Vietnam to better understand factors affecting the ICT adoption for marketing by smallholder farmers. The results gained will help to develop a national strategy for delivering development programs such as enhancing market access for Vietnamese smallholder farmers.

Conclusions and implications

In order to facilitate the smallholders' adoption of ICTs for marketing, it is important to understand factors that influence its adoption. This study is designed to determine factors that affect the adoption of mobile phones for livestock and poultry marketing by the Vietnamese smallholders. Based on the results of this study, it is concluded that younger smallholder farmers with higher education levels who live close to an electricity base, have higher income, own large farms, participate in credit/training programmes, and who are members of CBOs, have a greater tendency to adopt mobile phones for marketing of livestock and poultry. Extension strategies such as, improving marketing access for rural smallholder farmers through using of ICTs should create favourable conditions for smallholder farmers to access rural credit services and take part in agricultural cooperatives or interest groups. These are significant policies that need to be put in place to foster smallholder farmers to adopt ICTs for marketing.

The 'high cost of using mobile phones' and 'lack of knowledge/skills to use applications on mobile phones' are major constraints which are hindering the smallholder livestock and poultry to adopt mobile phones for marketing. Other constraints to the adoption of mobile phones for marketing include (1) 'mobile phone network problems' and (2) 'not knowing how to use mobile phones'. Enhancing infrastructure systems including electrical supply systems and basic literacy about the utilisation of ICTs are important. Financial credit should also be provided to smallholder farmers.

Results of this study should be shared with agricultural extension officers and policy makers to identify the suitable strategies for delivering market information to smallholder farmers, including developing agricultural extension programmes/strategies which shape agricultural development for the country. Extension strategies designed to promote smallholder farmers' adoption of mobile phones for marketing in developing countries should collaborate with existing CBOs and focus on young smallholder farmers with higher education levels.

Acknowledgements

The authors of this research would like to thank Hue University for its financial support in conducting this research.

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Underlying causes for farm abandonment among small-scale cane growers in a farmer regrouping project in Mauritius

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Abstract. Sugar cane in Mauritius currently occupies 56,000 ha, an area which has declined at an accelerated rate in the last decade. The Field Operations, Regrouping and Irrigation Project (FORIP), funded by the European Union, was implemented in 2006 to sustain cane production in the small-scale grower sector. By 2015, the Project covered 7,300 hectares. However, some growers who benefitted from the scheme started abandoning the rehabilitated fields. This study aimed at assessing the area abandoned and identifying the main reasons for abandonment. An island-wide survey involving 259 beneficiaries was carried out in different agro -climatic zones. The survey revealed that farm abandonment was more prevalent in the very humid and humid zones and among part-time growers cultivating less than one hectare. The main reasons for abandonment were low yields and high costs of labour and transport, leading to low profitability. The findings should help relevant authorities to take necessary remedial measures.

Keywords: Farm abandonment, sugar cane, FORIP, European Union, agro-climatic zones

Introduction

Agricultural land abandonment may be defined as 'a cessation of agricultural activities on a given surface of land which leads to undesirable changes in biodiversity and ecosystem services' (European Union 2013, p. 22). Abandonment of agricultural land has been a commonly observed trend in many parts of the world and it constitutes a depreciation of environmental capital stock with many negative socio-economic and environmental consequences (Khanal & Watanabe 2012). In Mauritius, in marginal areas where sugar production is less profitable, abandonment of sugar cane land presents a risk of accelerated soil erosion on sloping terrain causing pollution of nearby lagoons, disrupting the beach-lagoon-reef equilibrium and impacting adversely artisanal fishing and tourism sectors (Tonta & Ramasamy 2006). Since 2001, the area under cane cultivation has decreased from 77,321 ha to 63,780ha in 2010 (SIFB 2011). In this study, the cane fields considered as abandoned were those where sugar cane harvesting was no longer being carried out. Previous studies have revealed that land abandonment was mainly due to lack of irrigation, land speculation, rocky fields, lack of time and scarcity of labour (MSIRI 1996).

Following the 2006 reform of the European Union (EU) sugar regime, there has been a gradual drop in the sugar export price to the EU, starting with a 5% drop in 2006 to reach a 36% drop by 2009. Support measures were put in place by the EU to enhance the competitiveness of the sugar sector in sugar protocol countries to adapt to the new market conditions (MIPAMSP 2011-2013). Thus, the Field Operations, Regrouping and Irrigation Project (FORIP) financed by the EU, was initiated by the Mauritius Sugar Authority (MSA) in 2006 with a view to improve cane and sugar production among the small and medium growers cultivating sugar cane up to 25 ha. The aims of the scheme were to increase cane yields through adoption of better or promising cane varieties, better cultural practices, and timely harvest and delivery of cane to the mills and decreased cost of production through economies of scale involving better hiring services for land preparation equipment, transport of inputs and contracting out harvesting operations. Some 12,000 ha of sugar cane lands were targeted to be rehabilitated by 2015.

The scheme, under the responsibility of the Mauritius Cane Industry Authority (MCIA), provided free de-rocking and land preparation facilities as well as inputs for planting the fields of the beneficiaries. All field operations were contracted out as the works were carried out on large blocks ranging between 8 and 65 ha. The fields were handed over to the beneficiaries three to four months after planting. By the end of 2015, some 7,300 ha were rehabilitated. According to the contract agreement, it was understood that the beneficiaries should keep their fields under sugar cane for at least seven annual harvests.

However, it was observed that several beneficiaries had abandoned their fields after the implementation of the project, despite the free facilities provided. Farm abandonment in FORIP is a matter of concern for socio-economic, environmental and political reasons. In view of the massive investment made by the EU and the Government of Mauritius into the project, there was need to identify the areas that were most affected and the reasons for cane land abandonment, so that appropriate remedial measures can be taken.

To assess the extent of cane land abandonment and the reasons thereof, a survey of the growers who had abandoned their fields in the different FORIPs across the island, was carried out. The

objectives of the study were to (i) identify the fields abandoned in FORIP between 2006 and 2015, (ii) assess the extent of the cane land area abandoned, and (iii) identify the main reasons for abandonment. It was expected that the evidence-based study would help decision makers to reverse the trend and at the same time to bring other unutilized abandoned cane lands of the growers under productive use.

Methodology

The survey methodology consisted of:

7. A desktop review of FORIPs established since 2006 on a yearly basis up to 2014
8. Field visits to FORIP sites
9. Face to face interviews with beneficiaries at their residence
10. Interviews by phone for those who were not met at their residence, using a simple questionnaire comprising closed and open-ended questions. Questions asked concerned profile of the grower (name, gender, current occupation, contact details), profile of the field abandoned (location, size, variety grown, cane yield), reasons for abandonment.

Analysis included counts and percentages.

The whole population of 259 growers who had abandoned their fields in the FORIP scheme were targeted, with a response rate of 83%, representing 215 respondents. Certain questions remained unanswered for the following reasons:

- questions were not applicable to their situation
- respondents could not recall figures
- no records were kept by the respondents.

The survey started in February 2016 and ended in June 2016.

Results

Area abandoned

From the desktop study (i.e. from lists of FORIPs available at the Policy Unit (MCIA) and the Farmers Service Agency) and field visits to the FORIPs, it was apparent that after harvest 2015, some 259 beneficiaries had either abandoned their fields or had put them to other uses. Thus, a cumulative area of 259 ha of land under sugar cane had been abandoned, representing a total loss of some 20 000 tonnes of cane over the period 2006 – 2015 (Table 1).

The first abandonment of sugar cane fields in FORIPs was recorded in 2008, only two years after the start of the project. The figure progressed yearly to reach 92 cases in 2015, bringing the total area abandoned in FORIPs to 259 ha at the end of that year. Cane land abandonment was more prevalent in the south, the east and the centre, the west and the north being affected to a lesser extent.

Nevertheless, the extent of abandoned cane land as a percentage of the total area planted revealed that the south was most affected, followed by the centre (Table 1). This situation could be attributed to several factors including the prevailing climatic conditions, land suitability for cane growing, and varietal adaptability.

Table 1. Area abandoned as a percentage of total area planted in FORIPs

Sector	South	East	West	Centre	North	Total
Area abandoned (ha)	87.6	81.1	4.5	64.2	21.6	259
No of Growers	79	76	3	77	24	259
Total area planted (ha)	1648.3	3170.7	285	1258	934.2	7296
Area abandoned as % of total area planted in sector	**5.3**	**2.6**	**1.6**	**5.1**	**2.3**	**3.5**

An important part of the land under cane cultivation in the southern regions is on sloping terrain. The central region is located within the super-humid zone with an average of 3,500 mm of annual rainfall, considered as moderately suitable for cane growing,

The northern and western regions are in the drier sub-humid zone with less than 1,500 mm of annual rainfall where the soil is very suitable for cane growing under irrigated conditions. Most of the eastern region is flat terrain located within the humid zone with an average annual rainfall of 2,400 mm. The varying agro-climatic conditions could be a major cause for the differing rates of abandonment observed.

Cane varieties planted in FORIPs

By end of year 2014, 7,296 hectare+s had been planted, one third of which was under variety R570, followed by varieties M1400/86, R579, and M3035/66 (Table 2). Among the different varieties planted in the FORIPs, the largest area abandoned was under variety M1400/86. The second most abandoned variety was R570. Other significant areas abandoned were under varieties M703/89 and M387/85.

Total area planted by variety vs area abandoned in each sector

An analysis of the area abandoned for each variety as a percentage of the total area planted for that variety shows that the highest percentage of land abandoned was with variety M1394/86 followed by varieties M703/89 and M387/85 (Table 2).

Varieties R570 and R579 had less abandonment although they were planted over larger areas. Variety M1400/86, also planted over a large area, mostly in the super-humid and humid zones, had 4.3% of abandonment. For variety M1394/86, 21.5 % of the area was abandoned in the south, while abandonment of variety M703/89 was observed in the southern and central parts of the island (Table 2). A larger proportion of variety M2593/92 planted in the south was abandoned in comparison with variety M1400/86 in the same sector. Subsequently variety M703/89 was no longer recommended for the high rainfall areas (MSIRI 2011).

Table 2. Area abandoned by variety as % of area planted

Variety	Area planted (ha)	Area abandoned by sector(ha)					Total area abandoned (ha)	Area abandoned as % of area planted with the variety
		South	East	West	Centre	North		
M703/89	258.8	14.9	-	-	17.4	-	32.3	12.5
M1394/86	34.0	7.3	-	-	-	-	7.3	21.5
R573	78.7	-	-	-	0.8	-	0.8	1.0
M1400/86	1,508.7	23.7	2.5	4.5	22.6	11.3	64.6	4.3
M52/78	73.3	0.2	-	-	-	-	0.2	0.3
M2593/92	443.5	15.9	2.3	-	1.1	1.0	20.3	4.6
R570	2,394.0	15.0	22.1	-	-	9.3	46.4	1.9
M387/85	302.9	-	21.4	-	7.3	-	28.7	9.5
R579	1,063.5	10.1	4.5	-	-	-	14.6	1.4
M3035/66	964.0	-	28.3	-	15.0	-	43.3	4.5
M1176/77	151.0	-	-	-	-	-	-	-
Others	23.6	-	-	-	-	-	-	-
Total	**7296**	**87.1**	**81.1**	**4.5**	**64.2**	**21.6**	**258.5**	**3.54**

Cane category before abandonment

The term cane category used here defines the number of crops harvested during one crop cycle. It was observed that 70% of the respondents had abandoned their fields after the 4th harvest and almost 11% had abandoned after the first harvest (Table 3), although the normal cane cycle in Mauritius spans over 7 years.

Table 3. Cane category before abandonment

Cane Category	PC	1R	2R	3R	4R	5R	6R	Total
No of respondents	21	35	41	43	28	22	11	**201**
% of total	10.5	17.4	20.4	21.4	13.9	10.9	5.5	100

PC: Plant Cane R: Ratoon

Cane yield before abandonment

Ninety-one per cent (91%) of those who had abandoned their fields experienced yields below 70 t/ha. It was nevertheless observed that 9% of beneficiaries with fields yielding above 70 t/ha had also abandoned their fields (Table 4). At a sugar price of Mauritian Rupees (MUR) 15,000 per tonne, a yield of 70 t/ha is above the break-even costs for rainfed regions in Mauritius. This would suggest that factors other than low cane yield could also be responsible for cane land abandonment.

Table 4. Cane yield before abandonment

Cane yield (ha)	< 25	>25≤ 50	>50≤ 70	>70	Total
No of growers	31	93	50	17	**191**
% of total	16.2	48.7	26.2	8.9	100

Size of abandoned fields

Investigation on the size of the fields showed that land abandonment was most prevalent among beneficiaries who were cultivating plots less than 1 ha. Nevertheless, a few growers with larger farm sizes (>4 ha) had also abandoned their fields (Table 5). Though farm size as well as absence of scale economies would be a driver of land abandonment, there could be other underlying reasons.

Table 5. Field size abandoned by growers

Field size (ha)	≤ 0.422	0.422 ≤ 1	1 ≤ 2	2 ≤ 4	>4	Total
No of growers	64	79	40	19	3	**205**
% of total	31.2	38.5	19.5	9.3	1.5	100

Place of residence

The place of residence of a grower and the location of the field could impact on the management of the field operations. For the survey, the place of residence was defined as being within or outside the factory area (FA) where the field was situated. Most of the small growers do not reside on their farms. The survey results show that the majority of respondents (72%) living within their factory areas had abandoned their fields. Hence, it cannot be inferred that place of residence was a major factor influencing land abandonment.

Gender status and cane abandonment

The respondents who had abandoned their fields were mainly males. It is generally believed that women are more vulnerable to adverse situations. They usually face problems regarding harvests and transport of their cane. However, the survey results did not confirm this perception (Table6).

Table 6. Gender status of FORIP beneficiaries (2006-2014)

Gender of growers	Male	Female	Total
No of FORIP beneficiaries	4162 (66.5)	2009 (33.5)	6261
No abandoned	155 (3.7)	60 (2.9)	215

Figures in parenthesis represent % of total FORIP beneficiaries

Reasons for abandonment of fields

The respondents were asked about the reasons for abandoning their fields. The different answers are listed in Table 7. The responses comprised mainly economic and social issues. Technical aspects were mentioned in about 8 % of responses (varieties, wrong planting), while 12 % of the responses were related to resources such as labour shortage and input costs.

Low yields and low revenue were the main reasons for field abandonment. Almost 14% said that cane cultivation was not profitable. High labour cost was considered as an important cause of abandonment. Other lesser important factors contributing to farm abandonment included "wrongly" planted fields (insufficient fertilizers, planting time not conducive to germination) and cane fires. As discussed earlier, the responses confirm that distance from residence to field was not viewed as an important reason for field abandonment.

Table 7. Reasons for abandonment of fields

Reasons	No of responses	% of Total
Low yields	125	16.9
Low revenue	116	15.6
Not profitable	103	13.9
Labour unavailability	69	9.3
High labour costs	68	9.2
High transport cost	51	6.9
Variety not good	49	6.6
Old age	40	5.4
Succession problems	23	3.1
High input cost	21	2.8
Sickness/Death of grower	20	2.7
Not enough time	17	2.3
Crop damaged by monkeys/pigs	12	1.6
Converted to food crops	9	1.2
Planting not well done by contractor	8	1.1
Criminal cane fires	8	1.1
Field far from residence	3	0.4
Total	742	100

Discussion

Agro-ecological aspects

The total area abandoned by the end of 2015 represented around 3.5% of the total area planted and 4% of beneficiaries. Land abandonment was more prevalent in the super humid and humid zones than in the irrigated areas of the North and West. The mountainous regions of St Felix/Bel Ombre in the South West were also affected. In these sloping terrains, land abandonment could have a damaging ecological impact due to erosion and mudslides leading to soil degradation and productivity loss.

An analysis of the varieties planted show that M703/89, M1394/86 and M387/85 were most affected. The procumbent growth habit and limiting harvest periods of these varieties would be drawbacks for the small-scale grower: cane cutters are reluctant to cut canes which are lodged. Moreover, labour unavailability at the appropriate time for harvest lead to late harvests of fields impacting on yields as well as on labour and transport costs. It is worth mentioning that variety M703/89 is no longer being recommended for the high rainfall zone (MSIRI 2011). Variety M2593/92 performed well under irrigated conditions. Prevailing climatic conditions during the time of planting would also influence cane growth and ultimately cane yields. During initial stages of the project, the variety to be planted in a FORIP was based on its performance on the estates and the decision to plant was taken by a Project Implementation Committee (PIC). Initially growers were not represented on this committee. Selecting the right variety in collaboration with growers for the given locality is therefore of utmost importance. Indigenous knowledge should not be ignored. It is also to be reckoned that date of planting influences germination and subsequent growth of the cane (MSIRI 1996).

Socio-economic aspects

The survey has confirmed that the growers are an aging group. Aging as well as part-time growers generally utilize hired labour for the cultivation of their fields; hence, with the increasing costs of labour, their costs of production turn out to be high and uneconomical. With lower sugar prices, the sugar industry is finding itself in a cost-price squeeze situation just as in neighbouring countries like South Africa. According to Thompson (2010), declining profits affect growers' livelihoods and lesser inputs go into the fields, thus, underinvestment leads to lower yields, ultimately mining the crop down to unsustainable levels. Price of sugar which was MUR 18,620 in 2007 dropped to MUR 14,612 for the 2009 crop and ultimately to MUR12,694 in 2014 (MSS 2016) while the cost of production has been ever increasing. The cost of production in Mauritius is one of the highest in the sugar world. Mauritius being a small country with relatively good road network and transport facilities, place of residence of the growers did not seem to have an influence on land abandonment.

More than 91% of the respondents who had abandoned their fields experienced yields below 70 t/ ha. Would this mean that with yields below 70 t/ha, it is not cost-effective to grow cane in Mauritius? It is also apparent that the plot size of the growers is too small to provide them with returns for a decent livelihood. Growers "reluctance "to operate in groups has hindered achieving economies of scale. Leasing out the land or management contracts with millers have been suggested as a solution in the past (MSIRI 1996*)* but there has not been any significant adoption. It is opined this might be due to lack of trust of farmers towards millers.

The main reasons for abandonment put forward by the respondents were of socio-economic nature (low returns, high labour and transport costs, aging growers, lack of time). Nonetheless, low cane yields and the variety grown were also perceived as drivers of cane abandonment.

This survey has revealed that fields abandoned in FORIPs were mainly in the super humid and marginal areas resulting in low yields hence lower returns to the grower. Nevertheless, it is to be noted that other growers in the same areas continue to cultivate their fields despite uneconomic farming, probably because of social and cultural reasons. Further investigation of this group of growers would help to know their socio-economic background and their resilience to adversities.

The way forward

With growers' resistance to lease land to or enter management contracts with the corporate sector, alternative solutions may be contemplated. With the changing socio-economic profile of the small-scale-growers (part timers, aging) and increasing cost of production they would be more inclined to adopt novel leasing arrangements. Efficient growers within a given cooperative could be selected to take on lease fields of other members who are unable to manage their fields. Such an approach would allow the contractor-grower to gain from economies of scale, at the same time preventing the lessor to abandon his/her field. Certain contractors who are also growers are presently operating along this line. Such an approach has been successful in government funded irrigation schemes in South Africa, which was based on agreed principles including grower-led and ownership of solutions and voluntary participation. (Thompson. 2010).

Credit Cooperative Societies might take on lease farms of its underperforming growers and operate like the "*Cooperative d'utilisation de materiel agricole*" (CUMA) (Wikipédia 2020) in certain neighbouring countries. In a CUMA, a few progressive farmers within a cooperative invest in mechanical equipment to cultivate their farms and offer services to their fellow members. The Fair-trade certified cooperatives, which are eligible for an extra premium of 60 US dollars per tonne of sugar, could be those groups targeted for such schemes. To kick start them, seed capital could be raised from the premium. However, for this to happen there needs to be a paradigm shift at the level of growers, cooperative management and service providing institutions, who need to assist the groups through the change process.

Close monitoring actions need to be developed for the fields planted in the grouping projects to ensure a continuous and proper management of the fields. A Site Monitoring Committee was set up in 2010. However, the team must be well motivated for this task.

Marginal areas for cane growing should not be included in future FORIPs or similar schemes. Areas not suitable for cane planting should be targeted for alternative uses such as agro-forestry. The MAAS report had recommended inter-alia growing of palm and reforestation of areas unsustainable for farming in the very difficult areas (AGRECO,2007). Government has come up with a macadamia planting project and growers whose lands are not sustainable for cane could opt for this remunerative crop. Appropriate support schemes (financial and technical) need to be devised for these growers. A good marketing strategy is essential for the alternative crops.

To adapt to the changing socio-economic circumstances, training, information and advisory services need to be reinforced. Advisory staff should be trained to be more effective in disseminating improved farming and managerial techniques.

Conclusions

Abandonment of agricultural lands seems to be a global phenomenon and Mauritius is no exception. Nevertheless, from the survey results it can be inferred that the area abandoned in the FORIPs was low compared to the total area planted. The FORIP has been instrumental in maintaining the small-scale cane growers in business up to now.

This study has also confirmed that farm abandonment was mostly due to a combination of socio-economic factors and agro -ecological dynamics in particular areas viz the centre and the sloping terrains in the south. Despite financial incentives provided to growers with conditions attached, farm abandonment could not be prevented. Therefore, investments in projects in low potential areas resulting in low returns should be avoided. Inclusion of beneficiary representatives in the

design and implementation process is of utmost importance in decision making. A bottom-up approach would allow beneficiaries voice out their opinions and thus indigenous knowledge could be tapped. Since Mauritius is committed to produce sugar for its traditional export markets, cane production needs to be sustained. However, the livelihoods of the growers also need attention from relevant authorities.

Acknowledgements

The author would like to thank the CEO of the Mauritius Cane Industry Authority for his support as well as the staff and growers who participated in this study.

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Developing a training system for Plant Health Clinics in the Pacific region by and for regional trainers

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Abstract. This article describes the development of a training manual for plant health doctors to operate plant health clinics in four countries in the Pacific region by regional trainers for their national trainers. It briefly reviews the advantages of a plant health clinic approach to agricultural extension services for farmers, and the need to provide extensive training for the clinics to be effective. The manual incorporates learning approaches based on the understanding and development of pedagogical content knowledge designed to engage trainees in high level cognitive learning. The paper also outlines key aspects of the manual.

Key words: extension, plant health clinics, training manual development

Introduction

Globally there is now high awareness of the many challenges that confront the agriculture sector, including crop losses due to increases and spread of pests and diseases, loss of arable land through impacts of climate change, population growth, depletion of soil fertility, pesticide and herbicide overuse and resistance, and access to global markets (Swanson 2008).

The Australian Centre for International Agricultural Research (ACIAR) which represents a significant part of the agricultural component of the Australian aid program, has been active in the Asia-Pacific region since 1982. It aims both to assist Pacific island countries to strengthen their ability to compete in global markets, and to improve the outlook in countries of the region, where subsistence farming remains the major source of food security (ACIAR 2019). ACIAR projects aim to develop sustainable plant health systems that align with the UN Sustainable Development Goals. They also reflect concerns over the high regional use of pesticides that constitutes a major threat to human, animal health and ecosystem health. To this end, the projects promote Integrated Pest and Disease Management (IPDM) approaches to reduce pesticide use and increase biodiversity on farms (Furlong 2016; Furlong et al. 2019). Here, we report on elements of the project 'Responding to emerging pest and diseases threats to horticulture in the Pacific Islands' (HORT/2016/185), which focuses on the development of plant health clinics in the Pacific countries of Fiji, Samoa, Solomon Islands and Tonga.

The changing nature of agriculture extension and advisory services

Effective agriculture extension and advisory services (EAS) have long been regarded as the key to empowering farmers to move to more sustainable and productive plant health systems and for poverty reduction for small-scale farmers worldwide (Swanson 2008). Over the last decades, EAS have seen an evolution from the top-down model of the expert visiting farmers and offering advice, to situating farmers at the centre of the system (Anderson et al. 2006; Swanson 2008; FAO 2019). Here, farmers are seen not as passive recipients of expertise, but rather as human resources and experts, central to the agricultural enterprise, and who are best placed to determine its effectiveness (Feder et al. 2001). The main models of farmer-centred EAS are farmer field schools (FAO 2019) and more recently, plant health clinics (Boa et al. 2016).

Plant health clinics

Plant health clinics (PHCs) represent a farmer-centred program designed to share information particularly around the use of IPDM approaches, as well as attempting to address the difficulties of farmer-to-farmer transmission. Plant health clinics are held at locations where farmers work or sell their produce, so they can bring samples of pest and disease problems affecting their plants to the venue. Trained staff, called 'plant health doctors', usually from Extension or Research services, provide one-on-one consultations where plant health problems are diagnosed, and farmers are provided with short and long-term management advice in the form of a prescription.

Plant health clinics in the Pacific islands

Several plant health clinics have been run in the Pacific region in Fiji, Samoa and Solomon Islands since 2012, and have experienced varying levels of effectiveness and stakeholder engagement. In 2013, an evaluation of pilot PHCs in Solomon Islands, the first country in the region to hold PHCs, was undertaken (see Furlong et al. 2019). This identified areas that needed improvement,

including clinic ownership, frequency of clinics, appropriate venues and expanding management beyond cultural controls and importantly, that more training should be held on specific pests and diseases.

Continued monitoring of PHCs held in Solomon Islands has provided further guidance for the development of training (Alabae 2017). Successes included a high level of farmer enthusiasm because the clinics were held where farmers gathered regularly; good access to resource materials such as fact sheets and information posters; and good communication between farmers and extension staff. Areas that required further improvement included awareness, a more efficient registration process and the need for a standard, easy to use prescription form. The advice provided by the doctors was not always clear to farmers, and farmers did not always bring whole samples of pests and diseases. Lack of confidence and experience in identification and diagnosis of plant pests and diseases are considered critical barriers to a successful PHC program.

Another glaring gap in the first Pacific PHCs was the lack of follow-up and debriefing on the effectiveness of the clinic. Notes and data were not always kept, and doctors did not always discuss and reflect on the experience, share their learning, or follow up with farmers about how they had accepted and used diagnoses and management advice. Early clinic experiences in Fiji echoed the lessons from Solomon Islands (M Mua 2020 pers. comm., 27 May).

Plate 1. One of the first plant health clinics held in Fiji

Reproduced by kind permission of Mereia Fong-Logavatu, Ministry of Agriculture, Fiji and Mani Mua, Plant Health, Land Resources Division, Secretariat of the Pacific Community, Fiji.

Based on these learnings as well as a reading of the literature on the success of PHCs in other parts of the world (e.g. Boa 2016), the project HORT/2016/185 was designed to include the development of a regional plant health system-based PHC program. The initial aim was to increase the number and improve the PHCs already in place in Solomons Islands, Fiji and Samoa, and to establish a PHC program in Tonga.

The importance of effective training

Successes in empowering farmers through EAS remain patchy and continue to experience shortcomings. Srivastava (2013) suggested that reasons include the often-weak knowledge base of extension officers, effectiveness of communication of technical messages to famers, knowledge of how the messages are acted on, and the failure of national organisations to oversee, monitor and evaluate the activity. During clinics, plant health doctors may be afraid to admit to farmers that they are not able to diagnose a problem, which may in turn lead to incorrect advice or no advice being given.

It became clear that a rigorous plant health doctor training program was an essential element in the success of PHCs. The level of expertise required to become an effective plant health doctor cannot be overstated. It includes knowledge and skills to diagnose and manage plant health problems, understanding the complexity of a plant health system as an agro-ecological system and the many requirements for plant health. Doctors must also be well-versed in effective means of training and communication, monitoring and evaluation of programs and especially, developing good relationships with farmers.

Development of the plant health clinic program in the Pacific region

To progress the development of PHCs, a Project Advisory Group (PAG) was formed that included heads and senior personal of Research and Extension services from the four participating Pacific countries to promote a regional cooperative approach. Other PAG members included ACIAR plant pathology, entomology and education consultants.

The PAG members began by considering the overarching question: "how can we design effective plant health clinics in the Pacific region as part of an integrated plant health system?" Then followed an intensive three-day discussion addressing all aspects considered necessary for the program's success.

A training manual was identified as key, but drawing on previous experience in the region of manuals being little used, the regional trainers decided they should design and develop the manual themselves. By doing so, they considered this would ensure the development of a strong sense of ownership, where trainers would be motivated to use the manual in their national training. The sense of ownership would be bolstered by including names of the authors of each chapter of the manual as well as those who had tested it and had provided a review.

Development of the content sequence

The PAG spent time considering the structure, sequence and technical information to be included in the manual. Six chapters were proposed and sequenced as follows:

Chapter 1: Introduction to plant health clinics - background, need for PHCs, effective communication and pedagogy;
Chapter 2: Identification and diagnosis of plant pest and diseases;
Chapter 3: How to deal with unknowns including use of digital platforms such the Pacific Pest Pathogens & Weeds app (Lucid Central 2020), PestNet, CommCare app (Digimagi 2020), WhatsApp;
Chapter 4: Management Options 1: Cultural control (i.e. use of IPDM methods);
Chapter 5: Management Options 2: Using pesticides (considered necessary as most farmers continue to rely on them);
Chapter 6: Running a plant health clinic (setting up, running, data collection and post-clinic review and reflection – simulation and actual clinics).

A 7th chapter on monitoring and evaluation was also proposed but later omitted to allow the trainers to gain further experience in the field before deciding on how to proceed with this aspect.

Structure of the manual chapters

Next, the regional trainers selected a chapter and over two days, worked in small groups to draft the content. Crucially, they worked in inter-country groups which further strengthened the regional aspect of the program.

For each chapter, the task of the development team was to:

- Decide the content their national trainers need to know.
- Map the sequence for the training of each topic.
- Seek out and document supporting resources.

At this early stage of its development, the manual was designed as two volumes: a trainees' version containing the technical content as well as blank exercise templates to be completed during the training, and a trainer's version containing background information, answers to the exercises, photos of pests and diseases and pesticide labels to be used in the exercises, and other resource material. After initial testing in the field, two volumes proved too unwieldy to use and the decision was taken to combine all information into a single volume.

Training pedagogies

Training pedagogies (also known as androgogies – adult learning processes) in agricultural extension have often tended to be trainer-centred, based on providing mainly technical knowledge and delivered in expository lecture format to an often passive audience, along with some field work. Further, the conceptualisation, content and development of the training program and manuals may have been carried out by donor organisations in countries far from where the program is to be delivered, and rarely include direct input from in-country stakeholders. The CABI Plantwise program has attempted to address this, for example recently Plantwise has developed an online simulation and other materials for plant health doctor training (CABI 2019b).

In the Pacific region, anecdotally, trainers and advisors are known to complain that training is often not taken up or does not seem to be sustainable. Trainee attendance may be poor or sporadic. Training manuals are developed, often at great expense, but may never be used and

little or no change in practice is achieved. While there are many reasons for this, a key one would seem to be that there is little ownership or personal investment in the development and trialling the training process.

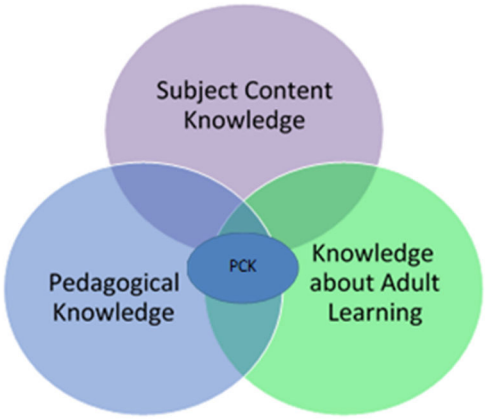
Pedagogical content knowledge

The development of the first draft of the manual represented an intensive and highly focused effort on behalf of the regional trainers to cover content they believed critical to effective PHC training. What was still required and considered necessary to strengthen the effectiveness of the manual, was the inclusion of learning processes that would move trainers away from the lecture format and reliance on surface level tasks such as recall. Hence, a key feature of the manual is the inclusion of focused learning exercises which are cognitively challenging and require higher order processing of the material (Biggs & Collis 1982; Bloom 1984; Anderson & Krathwohl 2001).

Hence to be effective, a trainer is required not only to be familiar with the technical content required to deliver PHCs, but also knowledge of how people learn for deep understanding, and the approaches to teaching and learning that are consistent with these. These elements of training are collectively referred to as pedagogical content knowledge (PCK), first described by Shulman (1986) and now commonly relied on in education systems.

PCK includes three domains. First, subject content knowledge such as technical knowledge about pests, diseases, identification and diagnosis, management methods, setting up and operating PHCs. Second, knowledge of how adults learn, including awareness that people learn in different ways and have different learning needs; and third, pedagogical knowledge of teaching strategies based on knowledge of learning that scaffold knowledge acquisition and engage learning at a deep level (Figure 1).

Figure 1. The three domains of learning leading to the emergence of pedagogical content knowledge (PCK)



Those involved in training instinctively understand that PCK is important even if they are not familiar with the terminology. During testing of the manual in Tonga, for example, when asked to list the qualities of a good trainer, regional and national trainers included elements of all PCK domains, such as good subject content knowledge, but also planning (pedagogical knowledge), communication skills and empathy towards learners (knowledge about learning).

A further task of the manual, then, was to overtly include PCK. To this end, a consultant with a background in adult education worked with the first draft of the manual to develop learning exercises designed to align the PHC training with pedagogical content knowledge to enable deep learning throughout. Background information on PCK for trainers was also include in the manual.

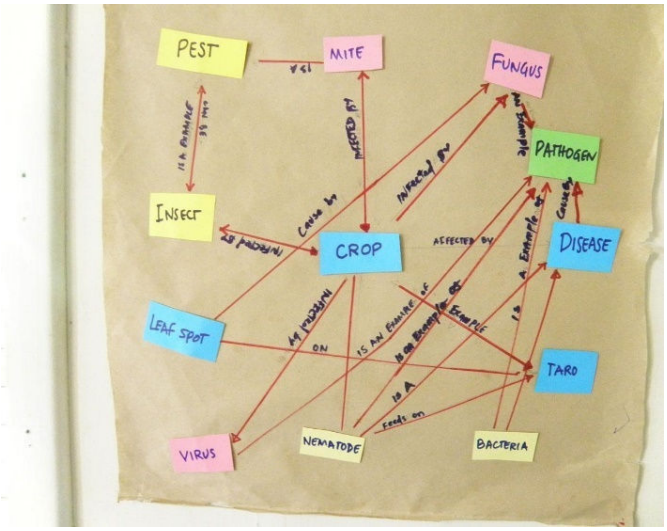
The learning exercises in the manual include:

- brainstorming in a small or whole group
- small group discussion
- cause and effects diagrams
- short information lecture (e.g. PowerPoint)
- quizzes
- concept mapping (Figures 2 & 3)
- completing elements in a table
- gleaning information from pictures/photos and justifying the decisions

- using digital resources
- practical and field work, e.g.
  - observing pests and diseases in the field
  - collecting and identifying pest and disease samples
  - making up home-made pesticides
  - preparing samples to send away for diagnosis
- role play and simulation of a PHC
- setting up and running a PHC with local farmers
- review, reflection and decisions on changes after the PHC (Figures 4 & 5).

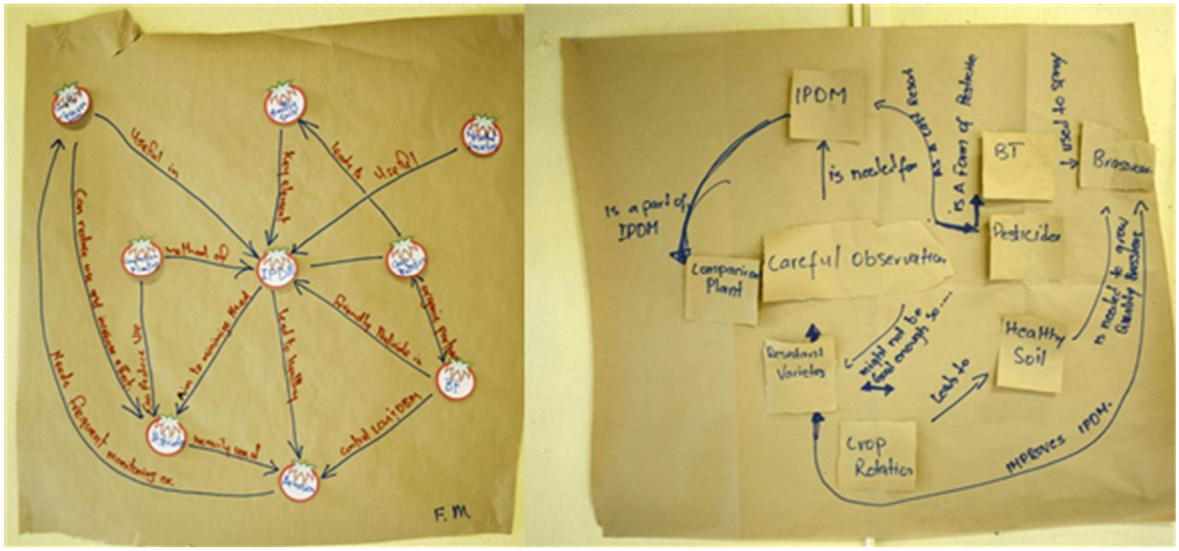
Figures 2 and 3 show examples of concept mapping developed during PHC training.

Figure 2. Concept map linking insect pest, pesticides, food crops, food supply, resistance varieties, good plant hygiene, monocropping, beneficial insects, oil price



created in Solomon Islands

Figure 3. Concept maps linking IPDM, companion plants, pesticides, Bt, resistant varieties, healthy soil, brassicas, crop rotation and careful observation

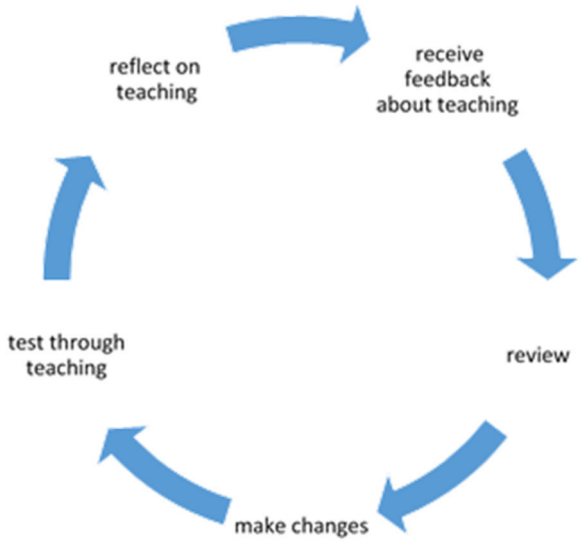


created in Tonga

Reflective Practice

A further dimension critical to effective learning is reflective practice, where both trainers and trainees reflect on their teaching and learning, receive feedback and use this to improve their practice for continuous improvement (Figure 4).

Figure 4. The reflective learning cycle



Reflection is particularly important at the end of a plant health clinic when the plant health doctors bring their samples, prescription sheets and farmer interview data back to the classroom to analyse their diagnoses, discuss their recommendations, consider what further learning is required and which farmers need to be followed up.

Key innovations

Four key innovations in the training and development process have been included in the manual:

1. Prescription form

A prescription form with carbonless copy pages adapted from CABI's Plantwise program (CABI 2019a) records farmers' data at the clinic to provide a diagnosis and management suggestions and a record for monitoring and evaluation. The copy of the form is retained by the doctor for reflection purposes after the clinic.

2. Digital platforms

If the technology is available, an ongoing innovation is the use of digital platforms. The Pacific Pests, Pathogens & Weeds facts sheets (full and mini Fact Sheets) (Lucid Central 2020), with some 500 entries, has been made available as a downloadable app to the trainers to use during training and at the clinics. PestNet also remains a very useful resource (PestNet community).

Instead of the prescription form, the CommCare app (Digimagi 2020) can be used with a smartphone to record the data at the clinic, and is currently being trialled with some success. It allows two-way SMS messaging between the doctor and the farmer, and enables the doctor to fill in the prescription form offline and download later when a wi-fi connection becomes available. CommCare incorporates multimedia and importantly for the project, supports multiple languages. Because it is typed rather than handwritten, it also avoids problems with hard-to-read handwriting.

WhatsApp platforms have also been developed for PHCs in all four participating countries. These are actively used by trainers and plant doctors to share information, as well as to seek assistance while a clinic is running, where experts are asked to stand by to provide advice. The manual includes information and exercises on using these platforms.

3. Farmer feedback interview

A farmer feedback interview and questionnaire is administered to farmers directly after they have consulted the clinic. Questions include whether the farmers' problem was diagnosed, whether they understood the diagnosis and were able to carry out the doctor's recommendations, whether they would recommend the clinic to others, and ideas for improvement. The clinic manager or another person who speaks the farmer's language conducts the interview and completes the form. The manager collates the information from all the forms to present and discuss at the reflection after the clinic.

4. Reflection and evaluation process

A rigorous reflection and evaluation process follows the clinic. Using copies of the prescription forms matched with samples of pest and diseases and summaries from the farmer feedback forms, the plant health doctors share and discuss their diagnosis and recommendations. They then reflect and report on successes and well as issues that require further improvement, using the template in Figure 5.

Figure 5. Post clinic reflection template and example

What went well?	What didn't go so well?	What training is still needed?	What improvements will be made for the next PHC?
A lot of farmers came	Only a few women came	Identification and diagnosis	Make sure awareness targets women in particular. Arrange for more diagnosis practice before clinic

Progress on PHC training and clinics operating since the start of the project

Once the training manual became available in a usable form, leadership of training was transferred to the regional trainers responsible for the training of their national plant health doctors. Trainers provided feedback to the project team regarding modifications and edits. Publication of the manual is now in process.

Within the region, some variations between countries have already been noted, with Fiji, as the largest and most developed of the four participating countries making the most progress and now emerging as the regional leader. It is encouraging to see that each country has now included plant health clinics in their annual workplans, and that ongoing training is recognised as an integral element of the plant health system.

Pathways are also being developed to integrate plant health clinic education into agriculture education at Fiji National University (FNU) and Solomon Islands National University (SINU) to ensure sustainability of the program.

Concluding remarks

Plant health clinics represent a relatively new approach to the management of pests and diseases where farmers have direct access to extension officers trained as plant health doctors. The development of a training manual for PHCs by those who use it, which explicitly draws on PCK to foster deep learning is an attempt to develop a sense of ownership over the process of advancing successful EAS across the region, and considered key to its sustainability. The next steps will include monitoring and evaluation to understand more clearly the quality of the learning that is taking place among trainers and trainees, and the extent to which farmers are able to use and act on the doctors' advice. With continued participation and engagement of regional and national trainers in providing reflection and feedback, continuous improvement in crop protection is considered achievable.

Acknowledgements

We acknowledge the following for their valuable expertise and feedback in the process of development and testing of the plant health clinic manual:

Plant Health, Land Resources Division, Pacific Community: Fereti Atumurirava, Visoni Timote, Unaisi Turaganivalu (Fiji) and Patrina Ziokera (Solomon Islands).
Fiji: Ministry of Agriculture, Koronivia: Mereia Fong–Logavatu, Taniela Navuku, Makereta Rasukamaimaleya and Toloi Vasuidreketi.
Papua New Guinea: The University of Goroka: Lilly Sar.
Samoa: Ministry of Agriculture and Food, Crops Division: Sailo Pao, Tommy Tuuamalii, Fa'alelei Tunupopo and Aleni Uelese.
Solomon Islands: Kastom Gaden Association: Pita Tikai.
Ministry of Agriculture and Livestock: Rosemary Alabae, Maria Gharuka and Helen Tsatsia.
Solomon Islands National University: John Fasi.
Tonga: Ministry of Agriculture, Food, Forests and Fisheries: Emeline Ahoafi, Sione Foliaki, Sela Tupouniua and Tevita Tukunga.

This work was funded by the Australian Centre for International Agricultural Research project HORT/2016/185.

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