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ICT Leadership Education for Agricultural Extension in Sri Lanka: Assessing a Technology Stewardship Training Program

Gordon A. Gow
University of Alberta, Canada

Uvasara Dissanayeke
University of Peradeniya, Sri Lanka

Chandana K. Jayathilake
Wayamba University of Sri Lanka, Sri Lanka

Isuri Kumarasinghe, Kumudu Ariyawanshe, Sanduni Rathnayake
Department of Agricultural Extension, University of Peradeniya, Sri Lanka

ABSTRACT

This article reports on a technology stewardship training program to promote ICT leadership development with agricultural extension practitioners in Sri Lanka. Researchers used a multimethod approach with a single embedded case study. Data were collected using a pre-course survey, formal course evaluation, classroom observation, and semi-structured interviews with participants. Kirkpatrick's four-level evaluation model was used to structure analysis of the results. Findings from this study show a positive response to technology stewardship training among agricultural extension practitioners in the course, that learning objectives of the course are achievable when offered as an in-service training program, that self-confidence with ICT is improved, and that some participants applied their learning in a post-course activity. Results from the study also raise a number of considerations for future course design in order to better support digital leadership development in practice. Technology stewardship training shows promise as a form of ICT leadership education for agricultural communities of practice in Sri Lanka and elsewhere. This article contributes to a better understanding of the role of social learning among communities of practice in agricultural extension services, and in contributing to effective use of ICT for agriculture development more broadly.

Keywords: *Leadership education, information communication technologies, technology stewardship, communities of practice, agricultural extension, Sri Lanka*

INTRODUCTION

The Global Forum on Rural Advisory Services (GFRAS) "New Extensionist" position paper argues for a rethinking of the role of extension and advisory services in a changing world. Extension and advisory services remain central to the agricultural innovation system (AIS) that encompasses organizations, enterprises, and individuals across the public, private, and non-profit sectors. The GFRAS position paper argues that "improved interaction among the large number of actors in the AIS is critical for innovation and this process often has to be facilitated" (Davis and Sulaiman, 2012, p.2).

There is growing recognition, if not consensus, among stakeholders, that digital ICTs can make a significant contribution to this improved interaction by reducing transaction costs (De Silva &

Ratnadiwakara 2008), while creating human and social capital through enhanced informational capabilities (Gigler, 2015).

Despite the availability of affordable digital devices and services in Sri Lanka (ITU, 2017), promoting effective use of ICTs within the agricultural innovation systems remains a priority for capacity development and education programs (Sri Lanka Ministry of Agriculture, 2019; Dissanayeke *et al*., 2014).

Recognizing the need for more training and related research to improve ICT competencies in agricultural extension, the Board of Study in Agricultural Extension of the Postgraduate Institute of Agriculture, University of Peradeniya has recently introduced a short course in technology stewardship training. The target group for the short course is primarily agriculture and rural development officers, such as extension workers, community development agents, field officers of private and nonprofit sectors who are seeking skills and competencies in the use of ICTs to improve work practices and outcomes.

The course was created as part of an ongoing international action research project to improve effective use of ICTs among agricultural extension practitioners and their communities of practice (Gow, 2018). "Effective use" is a concept drawn from the community informatics literature and refers to "the capacity and opportunity to successfully integrate ICTs into the accomplishment of self or collaboratively identified goals" (Gurstein, 2003). This is a transformative approach to development (Avgerou, 2008) that reflects an emphasis on building community capacity to participate in the choice and evaluation of ICTs and related innovation practices.

This paper outlines the theoretical and conceptual framework for the overall study, describes our approach to technology stewardship and the training program introduced at the University of Peradeniya. The paper then reports on responses from a cohort that completed the course in 2018. Finally, we conclude by reflecting on the results and their implications for further development of the training program, as well as its contribution to the aims of the wider study.

EXTENSION AND ADVISORY SERVICES IN SRI LANKA

The agriculture extension system in Sri Lanka operates in a complex structure (Weeratunga, 2001; World Bank, 2007) where more than 20 public institutions, central and provincial government Ministries deal directly or indirectly with extension. In addition, private and non-governmental sector organizations operate their own extension services, sometimes collaborating with state sector extension providers. State sector extension systems are arranged to cover all subsectors of farming, mainly following a product-based approach. For instance, the food crop sector caters to research and extension needs of rice, fruit crops, vegetables, and other field crops while the plantation sector operates extension services for tea, rubber, coconut, and sugarcane growers. Separate extension systems handle export agriculture crops, ornamental crops, livestock, fisheries and forestry sectors. The state extension and advisory services follow various extension and educational strategies but act primarily in a top-down and supply-driven approach (Wanigasundera, 2015).

ICT-based information dissemination programs have been introduced in almost all of the extension sub-sectors in recent years, but these initiatives have delivered mixed results. Many of the early programs were funded through the World Bank under its e-Sri Lanka Development Project which was implemented from 2004-2011. The project was instrumental in developing basic ICT necessities, such as websites, databases, and other basic supports for agricultural related organizations.

Other important ICT initiatives in the food crop sector include a cyber-extension project that introduced offline computer-based learning material for farmer education, an agriculture advisory call-line service to answer farmer queries, a farmer database for e-marketing, and an agriculture-focussed wiki for networking and knowledge sharing (Wijekoon, 2014). In addition, there have been private sector and state sector collaborative projects such as "Govi Mithuru" which provide timely advice to farmers regarding crop management practices (https://www.dialog.lk/govi-mithuru/), and an Agri Price Information Index which provides daily wholesale market price information to registered users (http://www.harti.gov.lk/). With the growing availability of smartphones, a range of new mobile apps have become available, including the Govipola (http://www.govipola.lk/) "virtual agri-market". Commercial social media platforms, such as Facebook, also play an important role in supporting communications and knowledge sharing among agricultural stakeholders in Sri Lanka (https://www.facebook.com/krushitv/).

In spite of these developments, achieving effective use of ICT in agricultural extension continues to present challenges for many reasons. Some of the important ICT initiatives such as the cyber-extension project did not meet expectations mainly due to poor digital literacy among the extension officers. Other challenges include a general lack of awareness and/or low levels of interest among farmers and extension officers with regard to ICT tools, administrative obstacles within the extension system, and a lack of independent research to evaluate ICT initiatives and identify pathways to adoption (Wijekoon, 2014). These are compounded by the lack of a clear ICT policy for agriculture information dissemination, limited resources to implement, maintain and update ICT solutions such as databases, poor communication infrastructure, unavailability of proper networks among agriculture stakeholders, and poor linkages among researchers, extension systems and farmers (Sri Lanka Ministry of Agriculture, 2016).

The technology stewardship approach is intended to address some of these shortcomings by training extension officers and advisors in a set of change leadership skills, with the goal of fostering effective use of ICT within agricultural communities of practice. This is a transformational leadership strategy (Yamamoto & Yamaguchi, 2019) that contrasts with the top-down, supply-side approach to ICT deployment that has been dominant in the extension system to date. It has other advantages such as encouraging the selection and use of low-cost ICT platforms in alignment with a set of normative principles that emphasize active community choice in the adoption of ICTs (Kleine, 2013) and engagement activities that support inclusive innovation (Heeks, *et. al*., 2013) in the development of digital services.

TECHNOLOGY STEWARDSHIP

Responding to the need for leadership training is a challenge in part because of the various ways in which the concept can be defined and interpreted (Bolden, *et.al.,* 2011). The growing use of terms like "digital leadership" and "e-leadership" complicate the matter further, with some studies narrowly focused on the need for senior executives to improve their interpersonal communication skills with ICTs (Roman *et al*., 2018) or how to lead change through effective use of social media (Ahlquist, 2014). We might refer to these as an incremental perspective inasmuch as they seek to enhance existing leadership practices using digital technologies.

On the other hand, a wider perspective on the subject is taken up in executive leadership training for public servants that aims to build competencies from among a suite of "digital literacy" skills intended to advance and improve the management of government ICT initiatives (Androsoff, 2019). Digital literacy in this context includes a diverse range of subjects such as agile project management, cloud computing, artificial intelligence, open source software, data visualization, cyber security, and so forth. This latter approach, which we might refer to as a transformative perspective, falls within a growing body of literature in "digital business leadership" that examines

the skills and competencies required to lead organizations through a process of "digital transformation" (Viaene, 2017).

Positioned somewhere in between the incrementalist and transformative perspectives on digital leadership is the concept of technology stewardship as it appears in the communities of practice literature:

> *Technology stewards are people with enough experience of the working of a community to understand its technology needs, and enough experience with or interest in technology to take leadership in addressing those needs. Stewarding typically includes selecting and configuring technology, as well as supporting its use in the practice of the community.* (Wenger, White & Smith, 2009, p. 25)

An appealing feature of the technology stewardship approach is its association with communities of practice as a locus of social learning. Wenger, McDermott & Snyder (2002, p.4) define a community of practice as

> *'groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis'*.

Community and practice are linked across three areas of mutual engagement, joint enterprise, and shared repertoire (Wenger, 1998, p. 73).

The community of practice concept presents an alternative to organizational units or geographically-based structures of association and is often more accurate in how it reflects the ways in which professionals interact and engage in social learning activities associated with day to day practice (Wenger, McDermott & Snyder, 2002). This provides an important consideration because in some cases motivation for adoption and use of ICTs might be situated with respect to crosscutting professional or livelihood concerns rooted in varied social networks that do not follow formal organizational and/or geographical lines. For example, the UN's Food and Agriculture Organization (FAO) sponsors a community of practice on food loss reduction, which the body notes serves as a global convener and an integrator of knowledge related to post-harvest loss (PHL) reduction. This learning initiative spans organizational and geographical boundaries, offering what they note as a platform to facilitate global and cross-sector linkages and information sharing amongst stakeholders and relevant networks, projects and programs that are offered (FAO, 2018).

The role of a technology steward can take varied forms. For instance, it might be a part-time role taken up in response to an immediate need within the community. In other instances, it might be an ongoing commitment combined with a broader set of responsibilities. Participation of a technology steward can be voluntary and self-appointed but will still usually require that an organization allocate time and resources to an individual taking up the role. A technology steward may be assigned to the role by members of a community of practice, or by an organization that recognizes the contribution of having a lead role in that group in fulfilling its overall mission. The role might be active on a day to day basis, or it may only be required periodically when a particular challenge or opportunity arises—perhaps, for example, on a seasonal basis when a community might seek to use ICTs for a specific type of activity (e.g., sharing market information during harvest). Motivations for taking on the role of technology steward are varied but typically include leadership opportunities, personal learning and growth, reputation building, and satisfaction in serving the community (Wenger, White & Smith, 2009, p. 29).

An important question for education research in agricultural extension is whether a planned approach to technology stewardship that includes a formal training component might improve

effective use of ICT over the long term. Initial research conducted by members of the research team provided evidence to suggest that an in-service training program operated in collaboration with a post-secondary institution can provide extension practitioners with essential skills and competencies for leading change in ICT practices within a community of practice (Gow, 2018; Jayathilake, *et al*., 2017). These early efforts led to the creation of a short course in technology stewardship being offered through the Postgraduate Institute of Agriculture at the University of Peradeniya in 2018.

Technology stewardship training

The GFRAS "New Extensionist" position paper notes that an important but often overlooked area of capacity development for extension advisory services (EAS) includes competence in the application of ICTs with an emphasis on a so-called "soft" skill set that includes training in facilitation, coaching, and leadership.

The new soft skills needed by EAS professionals and by organisational leadership require new and unconventional approaches to learning (action learning). These are not currently offered through schools and universities and would require important changes in the way schools and universities design and implement courses.

Action learning is described in the position paper as an approach that

> *"takes advantage of staff members' tacit knowledge and experiences and creates opportunities to experiment, reflect and share their learning while solving real problems in the organisational context"* (p. 14).

The process requires outside facilitation and can succeed where organizations provide opportunities to lower and middle staff, as described in the position paper, "to experiment with different approaches" (p. 14).

Among its recommendations, the position paper identifies the need to develop curricula for continuing education and skills development in EAS, while establishing training programs for EAS on "coaching, facilitation, leadership, vision building" with collaboration between government and educational partners (p. 18).

The technology stewardship training course is intended to provide a collaborative framework for action learning oriented toward communities of practice in agricultural extension. Although a number of training resources have been introduced in recent years intended to support the use of digital media for agricultural development (Raj & Bhattacharjee, 2017; Andres & Woodard, 2013; FAO, 2013), including an FAO online course titled "Social Media for Development" that features a short module on technology stewardship (FAO, 2013), these resources do not address the full spectrum of technology stewardship as a form of community-based change leadership, nor do they support an action learning pedagogy intended to put learning into practice.

Design of the Training Program

The training course is founded on a basic model described in Wenger, White & Smith (2009) but has been adapted for in-service training with agricultural practitioners. More specifically, it customizes the basic model with sector-relevant language, while adding new activities in the areas of community engagement and evaluation of ICT in use (Gow, et. al., 2018a).

In-service training is conducted over two-days covering four learning modules. Each learning module includes a mix of short lectures, hands-on activities, and group discussion:

- Session 1: Principles and practices of technology stewardship
- Session 2: Engaging your community and creating a campaign
- Session 3: Choosing an ICT platform and rapid prototyping
- Session 4: Planning and managing a campaign

The first session provides an opportunity for peer sharing of experiences with ICTs, with an emphasis on stories of both successes and failures. Course facilitators weave key concepts and practices in technology stewardship into this discussion using a case study. In the second session participants working in small groups are asked to consider and choose a community of practice as a point of focus for the remaining activities. Participants are then directed through a set of activities using a course workbook to conduct an analysis of the community of practice and its challenges, and to identify a priority concern for immediate action. This is followed by a set of procedures described in the workbook that results in a structured goal statement to be used to inform and evaluate an ICT-based pilot study ("campaign") with the community of practice (see Figure 1). While these activities are introduced to participants in a classroom setting, the method is intended to be carried into the field setting and conducted with community members as a form of participatory action research.

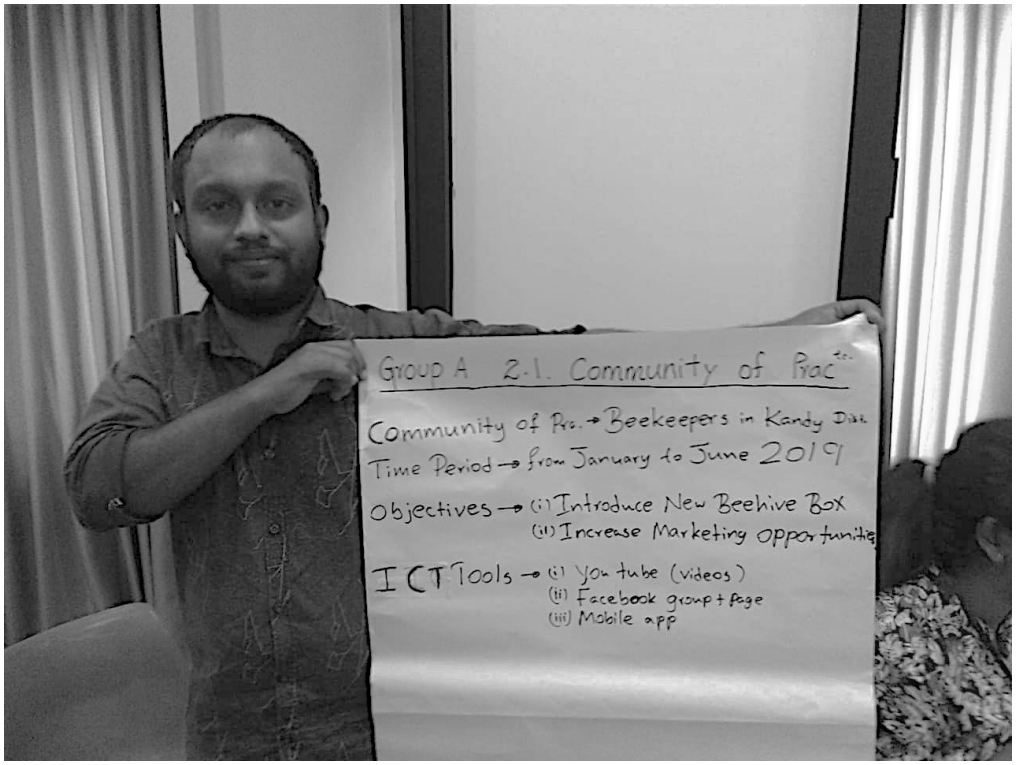

Figure 1*: A* participant displays the results of a campaign planning exercise completed during the course

(Participants have granted permission for the authors to use their images in video and audio recording, in photographic, video or electronic reproduction form in any materials, publications, websites, social media sites, and public screenings for research or educational purposes.)

Having articulated a campaign goal, participants are then taken through a series of steps leading to the identification, comparison, and provisional selection of an ICT tool or platform suitable for the campaign. Following the model in Wenger, White & Smith (2009), the course differentiates between ICT "tools" as discrete functional components (for example, text messaging, photo sharing, video conferencing) and ICT "platforms" as a set of interoperable tools bundled together in a software application or service (for example, WhatsApp, Google G Suite).

The course workbook includes a procedure for conducting "rapid prototyping" of the ICT platform to test functionality and suitability with the community. This step follows principles similar to those used in agile project management (Dearden & Rizvi, 2015), with an emphasis on developing and testing in small incremental steps. From a change leadership perspective (Kotter, 2007), rapid and provisional deployment of the ICT platform also creates an opportunity for a "short term win" by involving the community in the experience of experimentation with a new practice. In other words, rapid prototyping offers community members an opportunity to test and to provide comments on a new ICT application without having to make a long-term commitment to it at the outset.

The final classroom session leads participants through a three-phase campaign planning exercise that includes provision for collecting data at various stages that will contribute evidence to an evaluation (see Figure 2). Evaluation is critically important to assess both formative and summative outcomes of the campaign and to be able to report results back to the community and organizational sponsors that may be vital to providing support going forward. Campaign evaluation is therefore an essential competency for the technology steward to be able to recognize and further encourage effective ICT use among community members.

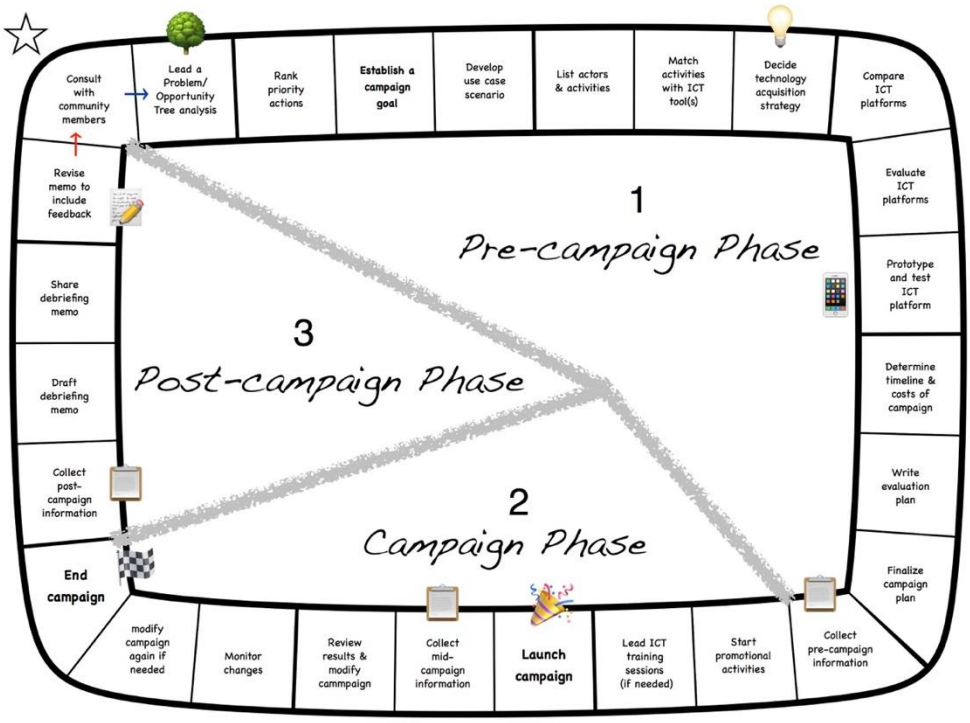

***Figure 2**:* Campaign planning taught using a board game analogy

Participants complete the final classroom session by drafting an individual action plan (IAP) in which they select an activity to be completed with a community of practice outside the classroom as an optional capping project. The IAP provides a number of choices for participants based on the four training sessions, ranging from conducting a community engagement activity, completing a rapid prototyping exercise, to designing a campaign and evaluation plan.

METHODOLOGY

Study Design

Rather than focus on a specific ICT application, the course is premised on training a cohort of practitioners in the principles and practices of technology stewardship and providing support as they attempt to take up that role with their respective communities of practice. The primary consideration is to equip a cohort with a common set of skills and techniques and then to observe how that training contributes to technology stewardship in practice. As such, outcomes are not necessarily a direct measure of ICT appropriation or impact of ICT on specific agricultural practices per se, but rather the overall influence of the technology steward within a community of practice over time.

The larger study, which includes cohorts in other countries, is based on an action research design with an embedded case study (Yin, 2018). Participants are trained as a single cohort in a common set of skills and techniques, but each member of the cohort is given freedom to act in accordance with the needs and interests of their own community of practice. The study is therefore designed around multiple units of analysis:

1. the experience and impact of the training program at the cohort level;
2. the experience and impact of training at the individual participant level;
3. the impact on the community of practice to which the technology steward belongs.

For this article we are reporting on a single case study with embedded units of analysis, with a primary focus on the experience and impact of the training at the cohort level.

Kirkpatrick's (1994) model was used to assess the technology stewardship course at the cohort and individual levels. This model has been widely accepted and used for assessing organizational, community, as well as ICT related training programs (for example, Karri & Kode, 2011), taking into account four levels of evaluation: reaction, learning, behaviour, and results.

Level 1 Reaction: This level focuses on learner reaction to what is offered, the experience of participants in the training course, and the satisfaction with the learning experience. It is the most immediate outcome of a training program. An anonymized course evaluation based on a standard instrument used at the University of Alberta was used to assess learner response to the course. The evaluation includes several categories of questions: response to course content and delivery, quality of instruction, classroom setting and course administration, as well as provisions for comments on improving the course.

Invitation letters were sent to 28 organizations identified from a cross section of agriculture related organizations in the country. Seven organizations nominated 22 officers working in extension and advisor services. Three participants representing the private and post-secondary sector self-nominated. Altogether 25 participants were selected for the course. A syllabus describing the course content and learning objectives was sent by email to participants two weeks prior to the scheduled start date. The research team also created and added participants to a private WhatsApp group in order to share information updates about the course.

The course was taught over two days in classroom facilities at the main campus of the University of Peradeniya. All but one of the participants attended both days of the course. Class began at 09:00 a.m. each day and was scheduled to end at 4:30 p.m. Course materials and in-class training were presented in English, which is the usual practice for post-secondary education in Sri Lanka.

Participants selected for the course completed a pre-course questionnaire that collected contact and demographic information, previous ICT experience, including an open-ended question that asked what they hoped to learn from the course.

Level 2 Learning: Learning can be assessed based on the degree to which participants appear to understand the course material and the extent to which stated learning objectives were achieved. Learning objectives for each of the four modules were described in the course syllabus and presented in class by the research facilitators during the course. Participants were not tested on the material but instead were given individual and group assignments to complete in class, generating a range of learning artifacts in the process. Learning artifacts included completed activities in the course workbook as well as flipchart diagrams and notes on index cards. Participants shared their artifacts in class discussions and were also invited and encouraged to take and post photos of their workbooks to a private WhatsApp group as portfolios of their learning.

For this study we assessed three facets of learning:

1. Learning of discrete skills and techniques based on the extent to which participants appeared to achieve the learning objectives in each of the sessions;
2. the extent to which the overall learning objective was met based on the ability of each group of participants to integrate course activities into a hypothetical campaign plan in the classroom setting;
3. the extent to which the overall course learning objective was met based on participants' intent to undertake one or more activities outside the classroom as indicated in their Individual Action Plans (IAPs).

Working in small groups, the participants completed the tasks and activities for the first two sessions. Due to time constraints, we were unable to complete all of the activities in sessions 3 and 4. Participants were, however, given time to complete their Individual Action Plan assignment at the end of the final session.

Level 3 Behaviour: This level addresses the question of whether the training has influenced the behaviour of the participants and how they intend to apply the skills and techniques in their professional practice. It may also include changes in attitudes and perceptions about their role as extension officers and advisors attributable to the training experience. In light of the overall study, it was hoped that the training course would lead some learners to undertake activities associated with the technology steward's role where possible and that, at minimum, learners overall would express an intent to act based on their experience in the course. Intent to act was identified in the Individual Action Plans (IAP), while data on behavioural and attitudinal factors was gathered through follow-up interviews conducted with participants several weeks after completion of the course.

Upon completion of the classroom sessions, all participants were asked to complete an Individual Action Plan (IAP), intended to assess their intent to act on skills and techniques learned in the course. The IAP was voluntary and would not be evaluated as part of the course work, although participants were given the opportunity of earning a certificate of advanced standing if they attempted a capping project and submitted a report based on the results. Participants were also informed that members of the research team would be available to provide assistance with the capping projects if requested.

Level 4 Result: This level considers the extent to which behavioural changes contribute to program-level or community objectives. Rather than focusing on specific ICT platforms, long term results should consider the extent to which the presence of a technology steward influences ICT-related practices with a community of practice. We did not undertake a specific assessment of community level results for this study. In future, we anticipate collecting longitudinal and comparative data from multiple learner cohorts in order to assess results.

FINDINGS

Level 1: Reaction

Along gender lines, there was a slightly larger margin of male participants at 63%. In terms of reported age, 41% of the cohort were 25-35 years, and 36% were between 36-45 years. A smaller margin (18%) were over 45 years of age and the youngest participant was under 25 years of age.

When asked about highest level of education attained, most participants reported some form of advanced degree or diploma, including post-graduate degrees (50%), and bachelor's degrees (36%). The remaining three participants reported post-graduate diploma, diploma, or high school in their responses.

The professional background of most participants was in public sector extension (88%) with others coming from private sector extension (4%), and university staff and students (8%). Public sector extension officers represented government research institutions (40%), agriculture development agencies (28%), government departments (16%) and ministries (4%). Most participants worked in the plantation crop sector (68%), and the food crop sector (16%).

Participants who worked with public sector extension organizations included field officers (52%), supervisors (24%), and managers (12%). All participants were based in Sri Lanka and represented a cross-section of regional districts.

In terms of previous ICT experience, participants were asked a range of questions about the use of ICT in their professional role. All participants were active users of ICTs, with 64% indicating daily use of the Internet for work-related information. When asked about ICT use for agriculture-related activities, more than half of the participants indicated using social media, video, and SMS (text messaging), with less than 14% indicating other forms such as broadcast radio, online courses, or instructional application software. Most participants rated their previous experience with ICT services and application as “somewhat satisfied” (73%), followed by “very satisfied” (14%) and “no opinion” (9%). One participant indicated “somewhat unsatisfied” in his/her response.

The questionnaire also asked what participants hoped to learn from the course, which provides some insight on motivation and expectations. Responses tended to focus specifically on how participants hoped the course could improve personal ICT skills:

> *To gain knowledge on usage of ICT for my extension/development activities*
>
> *Improving practical knowledge needed for extension*

A few comments were suggestive of a wider perspective that viewed ICT use as part of a larger goal within the agricultural innovation system;

> *[the] digital world is part of our DNA now, so we have to use new technology for ... extension services ...*

To design a novel extension communication method by using ICT

To identify effective and farmer-friendly agricultural extension method

In sum, initial reaction to the course was positive as indicated by responses to the invitations and participation in the classroom sessions. Participants represented a range of organizations involved in direct contact with farmers. Most were frequent users of ICT and familiar with common platforms. Most participants viewed the course somewhat narrowly as an opportunity to enhance their ICT skills in relation to their professional activities, with a few participants making comments that suggested their awareness of the role of ICT within the wider agricultural innovation system.

Level 1 (continued): Course Evaluation

Participants completed a course evaluation (n=22) at the end of the classroom session on day two. Overall results show that the quality of the course was rated "excellent" by most participants, course material added to their knowledge, the quality of instruction was rated highly, and that most participants were motivated to take additional courses related to the subject. Comments on the general rating of the course were mostly positive and included the following remark:

I gained lots of new theories I never touched; presenters were well prepared & clearly instructed all the parts; supportive staff also provide well & friendly support during this course; thank you very much Dept of Extension [University of Peradeniya] for providing this course

A few participants commented on what they felt were oversights in the course design and suggested general improvements for future offerings:

Overall the course was designed well. Well done all instructors and facilitators. More practical actions on ICTs are needed

According to course objective lesson plan should be rearranged

Duration if can be extended it's better

Overall reactions to the course objectives, teaching style, and levels of satisfaction of participants are summarized in Figure 3 below.

Level 1 reaction to the course was generally positive in terms of initial response to the invitation sent out to potential participants as well as from the course evaluation. Based on attendance and on feedback received from participants, the course material appears to have aligned with their interests, the quality of instruction and course materials were rated highly, and most participants expressed the view that it had been a worthwhile, productive learning experience over the two days.

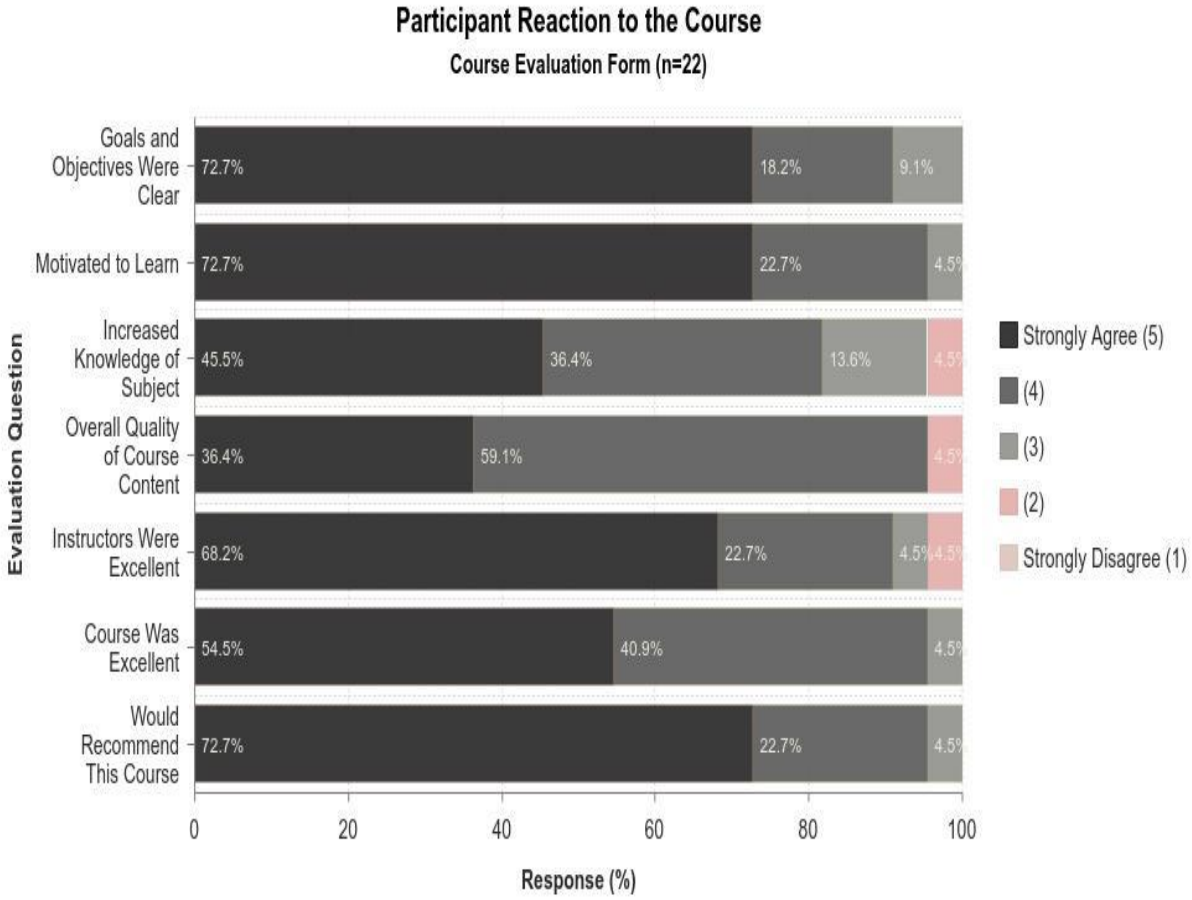

***Figure 3**:* Summary of participants' reactions from course evaluation forms

Level 2: Learning

Based on classroom observations and artifacts produced and shared by the groups, the training material and activities appear to have supported the learning objectives. Participants had been organized into four small affinity groups, each with 6 members. Each group was able to draw on the course material to identify and select a community of practice, to create a campaign objective based on a problem tree analysis, and to identify and match an appropriate ICT tool set for a hypothetical campaign. Table 1 provides a summary of outcomes for the stewardship planning activities for each of the four participant groups.

As indicated in Table 1, each of the four groups of participants were able to identify and agree upon a community of practice for the classroom activities. The "priority actions" are generated from a set of categories of "community orientations" detailed in Wenger, White & Smith (2009, p. 70) that each group identifies as part of a campaign goal setting activity.

Table 1**:** *Outcome of group planning activities carried out in the classroom*

Community of Practice	***Priority Action***	***Campaign Objective***	***Identified ICT needs***
Beekeepers in Kandy District	Instructional project	Introduce new beehive box	Group messaging; video tutorials
"Para Team" members of Hatton Plantations (tea cultivation)	Organize and schedule meeting among members	Improve awareness of and attendance at training events	Individual/group messaging; photo sharing
Small scale coconut growers in Dankotuwa ASC Division	Access to expertise (Q&A)	Reduce cost and improve timeliness of responses to questions from growers	Individual/group messaging; photo sharing
Organic vegetable farmers in Ipalogama DS Division	Attendance at meetings; access to expertise and information	Improve awareness of gov't employment opportunities; increase attendance at training programs;	Microblogging

While this was intended as a tabletop exercise for the course, each of the groups indicated that these priorities represented real and pressing concerns in those communities. If applied outside of the classroom, this activity would involve the technology steward facilitating direct community engagement with members to identify and validate priorities.

In keeping with the stewardship principle "keep it simple", all of the groups opted for a "use what you have" technology acquisition strategy, identifying ICT requirements and platforms suitable for their first campaign. Other possible technology acquisition strategies are presented in the course, including free/commercial platforms, patching pieces together through API integration, and building custom applications. It should be emphasized that the course material focuses on low cost and other "use what you have" choices as a preferred starting point for technology stewardship efforts.

Level 3: Behaviour

All of the participants completed an IAP, with 87.5% (n=21) indicating that they intended to undertake a capping project to obtain advanced standing in the course. Of those, 90% (n=18) indicated they would like assistance from the research team with their capping project. When asked what type of assistance they would find most helpful, 16 participants responded with an even split between "evaluation planning and reporting" and "technology support and prototyping" (37.5% each; n=6 each), followed by community engagement techniques (18.8%; n=3) and "campaign planning" (6.3%; n=1). When prompted to request "other" types of assistance, 10 responses emphasized "funding" and practical support for technology implementation.

The IAP included two self-assessment questions, asking participants to report on their learning in the course. Most participants indicated that they felt "confident" (54.2%; n= 13) or "very confident" (33.3%; n=8) that they could "carry out some or all of the activities of a technology steward" after completing the course. When asked more specific questions about various types of skills covered in the course, participants' responses indicated that they felt least confident on their own in "testing an ICT platform," "creating and managing a campaign" and "collecting data and evaluating a campaign". These results are presented in Figure 4 below.

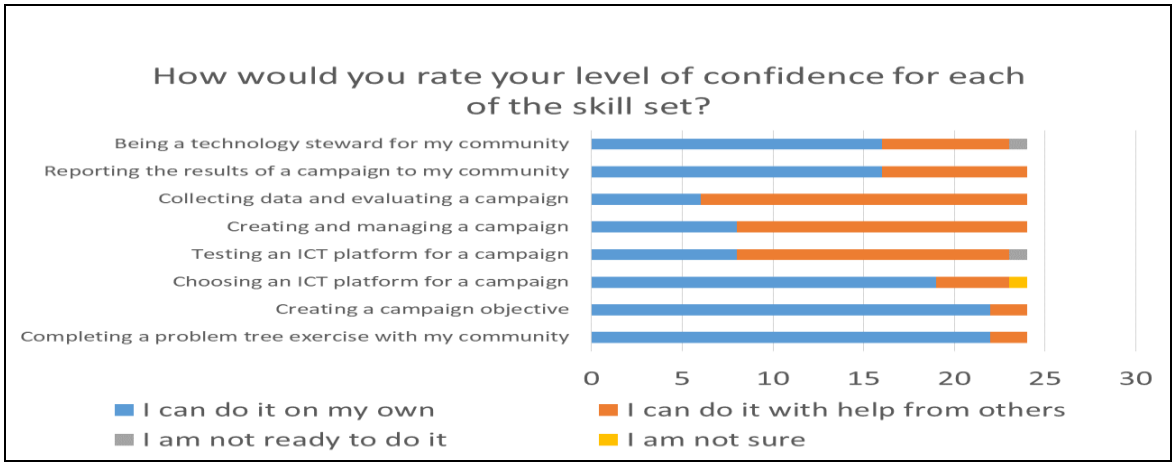

Figure 4: Reported levels of self-confidence among participants at course completion

The deadline for submitting a report to fulfill the advanced standing option was initially set at four weeks following the course but was later relaxed in response to requests from some of the participants. A total of 13 participants were interviewed one month after the training to determine their level of progress with implementing their IAP. Of those, 9 participants responded "yes" to making progress with their IAP, with 6 participants (24%) eventually completing their capping projects as planned. The other participants reported difficulties which delayed the implementation of their planned action, including scheduling, resource, and staffing constraints. Table 2 summarizes the capping projects completed by participants within two months of course completion.

Table 2: *Summary of completed capping projects led by participants*

Community of Practice	***Campaign Objective***	***ICT Platform/tools***	***Technology Steward***
Seed paddy producers from Galle District	Share agriculture related information	Text messaging (SMS)	Agriculture Extension Officer
Advisory/Extension staff of the Tea Research Institute	Scheduling maintenance activities of the Tea Techno-Park	Google Services (email, shared calendar, group chat, photo sharing)	Extension Officer
Ipalogama Divisional Secretariat in the North-Central Province	Evaluating effectiveness of a Twitter-based SMS service for rural development	Twitter-to-SMS messaging	Science and Technology Officer
New recruits of tea factory-based extension officers from Matara District	Testing the effectiveness of voice messages for a forthcoming extension campaign	Google services (email, Google Forms, voice messaging)	Tea Extension Officer
Extension Officers from the Sugarcane Research Institute	Sharing information related to pest and disease problems in sugarcane	Viber messenger app	Technology Transfer Officer
Facebook users interested in Sri Lankan agriculture	Conduct an issues awareness competition among the user community	Facebook	Community member

DISCUSSION AND CONCLUSION

Results from research on ICT adoption in the Caribbean (Ganpat, *et. a*l., 2016) shows a positive correlation between education, social influence and levels of self-efficacy among extension officers, as have other studies (for example, Khamoushi & Gupta, 2014). Following Bandura's (1991) definition, self-efficacy is defined as "an individual's belief in their personal capabilities and access to sufficient resources to accomplish a given task" and is linked to the confidence and motivation to take up and continue a specified task or initiative. This suggests that certain leadership aspects of technology stewardship may be closely connected with levels of self-confidence across a range of skills and competencies.

Responses on the IAP provide initial evidence to suggest that the technology stewardship training contributed to a heightened sense of self-efficacy among participants in this cohort, with most participants reporting they felt confident "being a technology steward for [their] community"; however, a more detailed look at the data from the IAPs indicates that participants expressed greatest levels of self-confidence in conducting community engagement activities, creating a campaign objective, and choosing an ICT platform for a campaign. Participants expressed lower levels of self-confidence in testing an ICT for a campaign, creating and managing a campaign, and evaluating a campaign.

What do these results mean? When evaluated using the Kirkpatrick model, the study shows strong positive results with respect to reaction to the course and learning taking place in the classroom. The overall course concept appears to meet a demand from agricultural extension practitioners, the design and delivery of the training material appears to have well served learning objectives in the classroom setting. These results are consistent with a comparator study in Trinidad (Gow, *et. al.*, 2018b).

Going forward, the research team will aim for continuous improvements to the course through subsequent offerings, but findings from this study provide evidence to show that the course serves a need and desire for in-service training in leadership skill development among Sri Lanka's agricultural extension practitioners.

The study shows more modest results with respect to the influence of training programs on behaviour (Kirkpatrick [level 3], 1994). On the one hand, most participants did express an intent to undertake a capping project and to apply their learning in practice, as indicated in their Individual Action Plans. However, only six participants submitted a completion report to the research team to receive advanced standing in the course.

Evaluating results (Kirkpatrick [level 4], 1994) of the technology stewardship training on the ICT-related practices of the communities of practice will require ongoing data collection and continued engagement between future course participants and members of the research team. Based on results from the IAP, this support should focus on ICT support, campaign and evaluation planning with the participants.

Various forms of support and engagement are now being considered by the research team. One possibility is to train graduate students from the Postgraduate Institute of Agriculture (PGIA) in technology stewardship and assign them to a support role with one or more course participants as a form of community-service learning to assist with completion of the capping projects.

Additional training could also be provided to participants, including a series of self-guided online courses offered by the PGIA that build on and further apply the introductory material presented in the technology stewardship course. For example, participants might benefit from a follow up

workshop that provides more in-depth training on choosing and configuring appropriate ICT platforms, or on campaign planning and evaluation methods.

A more ambitious approach might be to incorporate the introductory course from this study into an expanded technology stewardship certification program that requires participants to complete a series of in-depth short courses in community engagement, rapid prototyping and campaign management, followed by a mandatory capping project.

Experience gained from this study also points toward the need to better inform senior decision makers and extension administrators about the technology stewardship approach and learning objectives of the course. A number of motivated participants expressed difficulty in securing internal approvals and organizational support for their IAP, suggesting that the research team needs to establish greater awareness and understanding at the organizational level as part of ongoing engagement efforts.

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