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Tropical Agricultural Research

Journal Home Page: https://tar.sljol.info

RESEARCH

Fostering Stewardship Approach to Promote Technology Transfer among Sugarcane Extension Staff in the Monaragala District, Sri Lanka

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ARTICLE INFO

Article history:
Received: 1 August 2024
Revised version received: 06 June 2025
Accepted: 23 June 2025
Available online: 01 July 2025

Keywords:
Capacity-building
Low-cost ICT platform
Monaragala
Sugarcane industry
Technology stewardship

Citation:
Karunathilaka, A.P., Dissanayeke, U.I., Jayathilake, C.K., Gow, G.A., Pottawela D.P.W. and Gunapala,, K.G.M.J.W. (2025). Fostering Stewardship Approach to Promote Technology Transfer among Sugarcane Extension Staff in the Monaragala District Sri Lanka. Tropical Agricultural Research, 36(3): 225-241.

DOI:
https://doi.org/10.4038/tar.v36i3.8954

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ABSTRACT

The sugarcane industry in Sri Lanka is facing a decline in sugar recovery rates, emphasizing the need for improved technology transfer and capacity building among extension staff. This study explored the use of an ICT stewardship approach to enhance extension services in the Monaragala District through a five-phase action research framework: (i) information needs analysis, (ii) choosing technology, (iii) rapid prototyping, (iv) designing and implementing the communication campaign, and (v) evaluation. Information needs were assessed through four focus group discussions and a semi-structured questionnaire (n=28). WhatsApp Messenger, preferred by users, was selected as the communication platform. Three WhatsApp groups were created for the extension officers of three sugar companies, and a three-week campaign was conducted to disseminate technical content. Feedback was collected through a questionnaire (n=40), and descriptive methods were used to analyze data. Key information needs included cane quality improvement (93%), weed management (82%), and water management (82%). WhatsApp was the most commonly used platform, followed by Facebook (71%), and SMS (64%). ICT tools were mainly used for sharing curated content (96%), accessing expertise (79%), and facilitating meetings and conversations (75%). Video-based messages were rated the most effective (85%), and 38% of respondents regularly re-shared the information with farmers. Most participants rated the campaign as highly successful (75%) or successful (25%). Challenges included time constraints, poor network access, and data limitations. The study concludes that the ICT stewardship approach is an effective strategy for strengthening technology transfer and capacity building among extension officers in the sugarcane industry.

INTRODUCTION

Incorporating technology into agriculture extension services has become increasingly pivotal in recent years, shaping how agricultural knowledge is disseminated, practices are adopted, and challenges are addressed within farming communities (Ejiaku, 2014). In this context, the Technology Stewardship (TS) concept has emerged as a strategic framework for managing and utilizing Information and Communication Technologies (ICTs) to enhance the effectiveness and impact of agricultural extension initiatives (Gow et al., 2019). TS embodies the responsible and proactive management of ICT resources, with the overarching goal of fostering innovation, sustainability, and inclusivity in agriculture extension (Bowonder and Yadav, 2005; Gow et al., 2019).

The agriculture sector is inherently dynamic, characterized by evolving challenges such as climate change, resource constraints, market fluctuations, and shifting consumer preferences (Rodrigue et al., 2024). In response to these challenges, agricultural extension services play a crucial role in providing farmers with access to timely information, technical expertise, and support systems to improve their productivity, resilience, and livelihoods. Traditionally, extension services have relied on face-to-face interactions, field demonstrations, and printed materials to deliver agricultural knowledge and facilitate technology transfer (Ardichvili et al., 2003). However, with the rapid advancement of digital technologies, there is a growing recognition of the potential of ICTs to revolutionize extension approaches and overcome longstanding barriers to knowledge dissemination and adoption.

The TS approach in agriculture extension represents a model shift towards binding the power of ICTs to enhance the reach, relevance, and responsiveness of extension services. At its core, TS needs the strategic management and utilization of ICT resources to support the goals and objectives of agriculture extension programs. This approach involves not only the deployment of digital tools and platforms but also the cultivation of a conducive ecosystem that fosters collaboration, innovation, and capacity building among stakeholders (Gow et al., 2020).

The sugar recovery rate refers to the percentage of sucrose extracted from sugarcane during the milling and processing stages. A higher sugar recovery rate indicates greater efficiency in converting sugarcane into sugar. The decline of sugar recovery rates is one of the main problems faced by sugar mills in Sri Lanka (Keerthipala, 2016). As of recent data, Sri Lanka's sugar recovery rate is typically around 5-7% (SRI, 2021), while the global average sugar recovery rate stands at approximately 11-13% (Ram and Ramaiyan, 2021). This indicates that, on average, sugar mills in Sri Lanka extract sugar from sugarcane *(Saccharum officinarum)* at a lower efficiency compared to the global average. The sugar recovery rate of a plantation is mainly dependent on several key factors such as sugarcane variety, climate conditions, mill performances, and management practices (Keerthipala, 2016). Proper cultivation and post-harvest management practices are crucial to maintaining a higher sugar recovery rate (Chandra, 2020). It is necessary to educate and train the farmers, through the extension staff, on the proper management practices to increase sugar production.

Even though sugar recovery in sugar mills can be considerably improved through proper post-harvest and cultivation-related management practices, it is evident that many sugar factories stagnate without any improvement (Keerthipala, 2016). Then, there are other limitations such as difficulties of re-planting with new improved varieties due to the time it takes to provide harvest. The factory management is hesitant to determine re-planting as it is difficult to recover the expenses incurred during the process (Kumar et al., 2014). This is because they have to bear the high initial costs for land preparation, providing seed cane and transportation, as well as establishing the seed cane on the land (Keerthipala, 2016). Thus, educating and training the growers remains one of the alternative options for

improving a sugar recovery rate. Strengthening extension and technology transfer mechanisms has thus become essential in mobilizing knowledge in sugarcane production systems for enhanced productivity.

Therefore, the sugar industry must apply updated knowledge of best management practices at critical times. However, conventional technology transfer methods have proven inadequate in delivering up-to-date knowledge and best management practices at the critical times they are needed (Chandra, 2020). This has created an urgent need for new approaches to ensure timely and efficient knowledge transfer to extension staff. To address this gap, the sugar industry may adopt new stewardship concepts that influence modern Information and Communication Technology (ICT) solutions. Strengthening extension and technology transfer mechanisms with these updated methods is vital to improve productivity and increase the sugar recovery rate in the Monaragala District.

Accordingly, this study attempts to design and implement an ICT stewarding solution for capacity building among sugarcane extension staff in Monaragala District to answer research questions such as i) what are the information needs of extension staff attached to the Sugar industry in the Monaragala District? ii) how to choose and implement a low-cost ICT solution for technology transfer through rapid prototyping methods? and iii) what is the effect of ICT is stewarding approach in technology transfer?. The objectives of the study were to determine the information needs of extension staff attached to the Sugar industry in the Monaragala District, facilitate information exchange through Rapid Prototyping of a low-cost ICT platform to develop capacities of extension staff, and evaluating the effectiveness of the training. Finally, this research seeks to foster an innovative, sustainable method to educate extension staff on sugarcane management practices in the Monaragala district.

Literature review

Technology stewardship (TS) for agriculture extension

In the field of agricultural extension, stewardship of Information and Communication Technology (ICT) has become a pivotal paradigm. This has reshaped the dynamics of disseminating knowledge, adopting technology, and implementing sustainable agricultural practices. With the arrival of digital technologies, there has been a notable shift towards utilizing ICT tools to enhance agricultural productivity, improve livelihoods, and ensure food security in diverse agro-ecological contexts (Paterson, 2023). TS captures the responsible and strategic management of these technologies within the agricultural extension framework, emphasizing not only their placement but also their effective utilization to empower stakeholders including both farmers and extension officers, facilitate decision-making, and foster inclusive rural development (Paterson, 2023).

TS in agricultural extension represents a multifaceted approach, surrounding various elements such as the design and deployment of ICT solutions tailored to the specific needs and capacities of officers/farmers, the provision of training and capacity-building initiatives to enhance digital literacy and skills among agricultural stakeholders, and the establishment of strong support mechanisms to ensure the sustainability and scalability of ICT interventions (Ejiaku, 2014). ICT stewardship seeks to bridge the digital divide, empower marginalized communities, and catalyze agricultural transformation by connecting the potential of digital innovations.

Capacity building and extension in the sugarcane sector

Capacity building is a cornerstone of effective agricultural extension programs, enabling extension workers to acquire the knowledge, skills, and competencies necessary to deliver high-quality services and support to farmers and rural communities. The potential for sustainability is significantly increased by Training of Trainers (ToTs) due to its ability

to rapidly and inexpensively up-skill the workforce by developing local educators (Mormina and Pinder, 2018). Among the various approaches to capacity building, the ToT model has gained prominence as an effective strategy for cascading knowledge and expertise throughout extension systems (Mormina and Pinder, 2018).

Sustainable growth of the sugarcane industry needs the effective adoption and integration of modern agricultural technologies. Technology transfer, therefore, emerges as a critical factor in driving the sector forward. The infusion of innovative practices, can enhance productivity, improve yield quality, and streamline the sugarcane production process (Keerthipala, 2016).

Technology transfer stands out as a hub for the advancement of the sugarcane sector as it bridges the gap between traditional farming practices and modern, science-driven methods. The adoption of cutting-edge technologies not only boosts efficiency but also paves the way for sustainable agricultural practices, aligning the industry with global standards. Weather data, information on diseases and pests, and other important information that is essential for cultivation are also essential at the right time (Batchelor et al., 2003). Therefore, by getting this information to the relevant community on time, their productivity can be enhanced (Batchelor et al., 2003).

Technology transfer equips the extension staff of sugar companies with in-depth knowledge and understanding of the latest research findings, technological innovations, and best practices relevant to sugarcane cultivation. Furthermore, training enhances the capacity of extension staff to effectively communicate and transfer this knowledge to the farmers and other stakeholders they interact with (Perera and Sivayoganathan, 2002).

Technology transfer contributes to enhance the technical skills, communication abilities, and pedagogical techniques of extension staff through workshops, seminars, field demonstrations, training sessions, and other capacity-building initiatives. This empowers the EOs to serve as effective trainers and facilitators in disseminating research-based information to farmers and other stakeholders. Training programs, field demonstrations, farmer meetings, and outreach programs are the most commonly used teaching methods in the sugarcane sector to reach out to the target audience and to impart valuable insights on improved agricultural practices, sustainable technologies, and market opportunities.

Technology steward (TEs)

A technology steward is someone who works with a community of practice (CoP) to encourage the adoption and use of digital technologies for communications, training, and knowledge transfer (Gow et al., 2019). A Community of Practice (CoP) is a group of individuals who share a common interest or profession and work together to exchange knowledge, learn from one another, and develop their skills (Wenger, 1998). Extension and Development officers can assume such a role by understanding the needs of the community, identifying the convenient ICT tools and then designing and implementing extension campaigns for knowledge sharing. According to literature, there are three primary roles of the TS concept including, community engagement, technology support (Choosing the technology, configuring, and testing), and implementation leadership (Gow et al., 2019). This study aims to explore the applicability of technology stewardship approach within a CoP, comprised of sugarcane extension staff, in developing and implementing ICT-based information-sharing platforms for knowledge sharing.

Action research

Considering the nature and requirements of the study, an action research approach was employed. The study design requires making a planned intervention in a study community and observing the changes happening over a period of time. Action research can be defined as a process of “learning by doing" which addresses the practical needs of people in problematic situations (O'Brien, 1998).

Furthermore, in action research, the researcher systematically studies the problem and ensures that the intervention is guided by theoretical considerations. Much of the researcher's time is spent filtering methodological tools to fit the needs and collecting, analysing, and presenting data on an ongoing, and cyclical basis (O'Brien, 1998). Especially, people learn best and apply what they learn most willingly when they do it themselves. The research process takes place in real-world situations and aims to solve real-world problems. This type of research is facilitated by the participation and collaboration of several individuals with a common goal (Dudovskiy, 2018). Through this type of research, it is possible to gain in-depth knowledge of the problem.

A significant advantage of action research in agricultural extension is its inclusive nature. Traditional agricultural research often follows a top-down model, where scientists conduct studies and then relay findings to farmers. This method can sometimes result in a gap between research outcomes and their practical use. In contrast, action research involves farmers in every stage of the research process, from identifying problems to implementing and evaluating solutions (Stringer, 2014). This inclusive approach ensures that solutions are rooted in the actual experiences and conditions of local farming practices, making them more likely to be adopted and maintained by the farming community.

Action research also creates a collaborative learning environment, which enhances the capabilities of all participants. Farmers gain new knowledge and skills through their active involvement in the research process, empowering them to play a significant role in problem-solving and decision-making (Stringer, 2024). This empowerment is critical for promoting sustainable agricultural development, as it boosts the confidence and competence of farmers to manage their farms effectively. Extension workers and researchers, in turn, benefit from the insights and experiences of farmers, which can improve their methods and approaches (Chambers, 1994). The collaborative nature of action research encourages knowledge sharing and innovation. By bringing together diverse stakeholders, including farmers, extension workers, researchers, and policymakers, action research facilitates the exchange of ideas and experiences (Pretty, 1995). This collective approach to problem-solving can lead to innovative solutions that might not be discovered through traditional research methods. Furthermore, the shared ownership of the research process and its outcomes fosters a sense of community and mutual support, enhancing the overall effectiveness of agricultural extension services.

MATTERIALS AND METHODS

Study area

The study was conducted in the Monaragala District of Sri Lanka, focusing on three major sugar companies actively involved in the cultivation and processing of sugarcane. They are located in Sevanagala, Pelwatte, and Siyambalanduwa areas. The grower and extension officer capacities of the three companies are given below (Table 1).

Study population

The study population encompassed all agriculture extension staff (n=195) within the plantation division of three sugar companies in the Monaragala district. (Table 2). A stratified random sampling method was employed to select participants for the study.

Research approach - Action research

Action research serves as a dynamic method in agricultural extension, offering a collaborative and cyclical approach to problem-solving that engages farmers and other stakeholders directly. By combining scientific research with practical applications, it tackles real agricultural challenges in a way that is both context-specific and sustainable (CRISP, 2015).

Table 1: Growers and extension staff capacities of three sugar companies

Name of the sugar Company	Established year	Capacity (Tones Crushing per Day)	Cultivate land area (ha) by 2021	Number of farmer families	Number of Extension staff
Sevanagala	1986	1,250	4,250	3,920	35
Pelwatta	1986	3,300	10,666	5,200	132
Ethimale	2020	1,250	5,854	3,000	28

Table 2: Study Population

Sugar Company	Field Assistants	Assistant Superintendents	Superintendents	Agriculture Officers	Managers	Total
S	26	-	-	04	05	35
P	97	16	14	-	05	132
E	15	05	04	-	04	28
Total	138	21	18	04	14	195

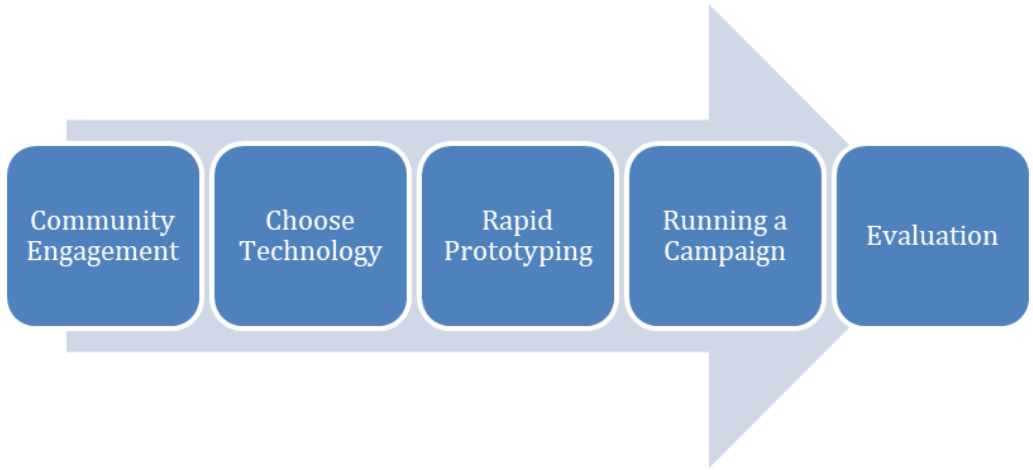

Figure 1: Research Design (Adapted from Gow *et al.,* 2019)

The cyclical process of action research—comprising planning, acting, observing, and reflecting—enables continuous learning and adaptation. This cycle is particularly beneficial in agriculture, where environmental and socio-economic factors can vary significantly and change rapidly. By repeatedly going through these phases, action research allows farmers and researchers to refine their practices based on real-time feedback and observations (Stringer, 2024).

Moreover, action research is well-aligned with the goals of sustainable development. Sustainable agriculture seeks to increase productivity while preserving the

environment and ensuring social equity. Action research supports these objectives by promoting practices that are economically viable, environmentally sound, and socially just (Pretty, 1995). Through its participatory and iterative nature, action research helps develop farming practices that are not only efficient but also sustainable in the long term.

Research design

This study adopted the Action Research model proposed by Gow *et al.* (2019), which includes five phases (Figure 1) including community engagement, choose technology, rapid prototyping, running a communication campaign and evaluation.

Community engagement

Community engagement refers to the process of identifying issues/ problems in the selected community, prioritizing them, and selecting one key problem by working collaboratively with the community (Gow et al., 2019). In this stage, the information needs of extension staff were determined and prioritized using Focus Group Discussions (FGDs) (n=4), key informant discussions and semi-structured questionnaire (28 nos), (Figure 2).

Choosing technology

In this stage, a low-cost ICT platform was selected to facilitate information exchange through Rapid Prototyping. A semi-structured questionnaire was used as the data collection instrument, gathering information from 28 respondents representing the three sugar companies. The sampling method employed was stratified random sampling. Samples were chosen to ensure a balanced and unbiased representation of the population.

The technology acquisition strategy was guided by the "Use what you have" principle (Gow et al., 2019) that suggests selecting low-cost ICT strategies that are readily available for the target community. Next, a community consultation approach was use to choose the ICT platform among Facebook, WhatsApp, Twitter, Skype, YouTube, and Instagram. The "WhatsApp" platform technology was chosen as the preferred low-cost ICT platform as the majority of the members preferred it.

Rapid prototyping

Rapid prototyping is an approach that allows technology stewards to develop, test, and refine technology solutions quickly and iteratively (Gow et al., 2019). This process enables stewards to align technologies with the community's needs by allowing users to interact with early versions of a product, gather feedback, and implement adjustments before finalizing the design.

Figure 2: Engagement with extension staff of Sevanagala and Pelwatte

Table 3: The number of FGD and the number of respondents in each sugar company

Sugar Company	Number of FGDs	Number of Participants per FGD
Sevanagala (S)	01	07
Pelwatte (P)	02	07
Ethimale (E)	01	07

It helps to design and test a technology implementation in real-time with the direct involvement of the officials of the sugar sector. Further, it enabled participants to immediately the opportunity to obtain direct feedback. Three separate WhatsApp groups were formed for the campaign and Snowball Sampling was employed to recruit up to ¾ of participants from the particular company. Campaign materials were prepared based on the findings of stages 1, 2 and the campaign was implemented for 3 weeks.

Running a campaign

This stage involved the actual implementation of the ICT platform, where WhatsApp campaigns were run with the community for a specific duration. Technical messages were disseminated among the communities of practice for three weeks. There were three phases of the campaign process including the pre-campaign Phase (determined timeline, created an evaluation plan, and finalized the campaign plan), campaign phase (promotional activities, Sharing main messages) and evaluation.

Data Collection, Evaluation and Analysis

The summery of the materials and methods used in each stages mentioned below table 4.

RESULTS AND DISCUSSION

Characterizing the community of practice

The community, was stable and adaptive, indicating satisfaction with current practices. The community was willing to adopt new ideas if they present clear benefits. The community is not spread apart geographically, indicating a localized and cohesive group with no geographical or time barriers. Members of the community speak a single language, indicating linguistic homogeneity within the group and low diversity in terms of gender, age, and other cultural factors. The community values privacy and security, indicating a preference for maintaining a degree of independence from external influences. Despite this leaning towards independence, there is an interest in ICTs, with a high level of engagement and expertise among users. The community also demonstrates a capacity for learning and adopting ICT tools and platforms effectively. The possibility of conflict within the community when introducing new ICT practices was low. This suggests a harmonious and cooperative environment conducive to innovation and technological advancement (Wenger et al., 2009).

According to the findings, the demographic composition of the survey respondents were a diverse in terms of age, gender, educational background, and experience. Notably, 64% of the respondents belonged to age 20–40 years, while the remaining 36% belonged to the age group 40–60 years. Gender distribution indicated a significant disparity, with 96% of the participants identified as male officers and the remaining 4% as female officers, resulting in a male-to-female ratio of 24:1. Educational attainment displayed an even distribution among the respondents, with 36% of officers possessing A/L or diploma qualifications, mirroring the percentage of graduates. Postgraduates and graduates contributed 28% each of the participant pool. Furthermore, 61% of the officers had less than 14 years of experience in the extension profession, while 25% had accrued between 15 and 29 years. There were14% of respondents who had over 30 years of experience in their respective roles. These statistics collectively highlight the diverse nature of the participant demographics, which are paramount for understanding the perspectives and insights presented in this study.

Table 4: The summary of the materials and methods used in each stages

Community Engagement (Stage 01)	Choose Technology (Stage 02)	Rapid Prototyping (Stage 03)	Running a Campaign (Stage 04)	Evaluation (Stage 05)
04 FGDs (1-S, 2-P, 1-E) Survey 01 (Data collection instrument – Semi-Structured Questionnaire N = 28 (Stratified Random Sampling (S-07, P-14, E-07)	Based on the results of Stage 01	Based on the Results of Stage 02	Implemented the campaign for 03 weeks. Based on the information need of the stage 01	Logged data in ICT Platform Survey 02 (Data collection instrument – Semi-Structured Questionnaire N = 40 (Stratified Random Sampling (S-10, P-20, E-10)

Information needs of extension staff of three sugar companies

Capacity-building training for extension staff (ES) should consider the specific training needs of the community. Understanding the information needs is one of the important areas in a training needs analysis. Figure 3 shows the information needs of the CoP. based on the survey results. Cane quality improvement, (93%) water management (82%), weed management (82%) were identified as the high-priority areas, Moderately interesting areas include soil nutrition management (75%), mechanization technology (75%), ratoon management (71%), pest and disease management (68%), new sugarcane varieties (64%), and production (50%). Finally, information related to intercropping was seen as interesting by nearly one-third (36%) of the community. These findings highlight the demand for information by the CoP.

These findings shows the importance of providing targeted support and information to extension staff, focusing particularly on high-priority areas such as water and weed management, and cane quality improvement, to enhance sugarcane farming practices effectively in the Monaragala district.

Information-seeking methods of extension staff

Figure 4 shows the distribution of respondents based on their information sources. . All of the extension personnel from the three sugar companies depended on in-person communications and interactions, with research and extension staff (ES) of the SRI (100%) to get the necessary information. Additionally, they were dependent on web-based resources (89%), and printed media (82%) to get updated knowledge. Seventy-five percent of the staff rated field demonstrations as important for gaining hands-on learning experiences. Similarly, 71% of the extension staff considered field training programs important. However, television and radio are less favored for information, with only 7% of staff members using these media platforms.

Smart-phone availability

Almost all ES members (96%) had access to smartphones, indicating a high level of technology adoption within the workforce. With the widespread availability of smartphones, these ES can easily access digital resources, communicate with their colleagues and stakeholders, and stay updated with the latest developments in their field.

This high level of smartphone availability suggests that ES are well-equipped to influence technology for their work, potentially enhancing their efficiency and effectiveness in delivering extension services to farmers and stakeholders within the sugar industry.

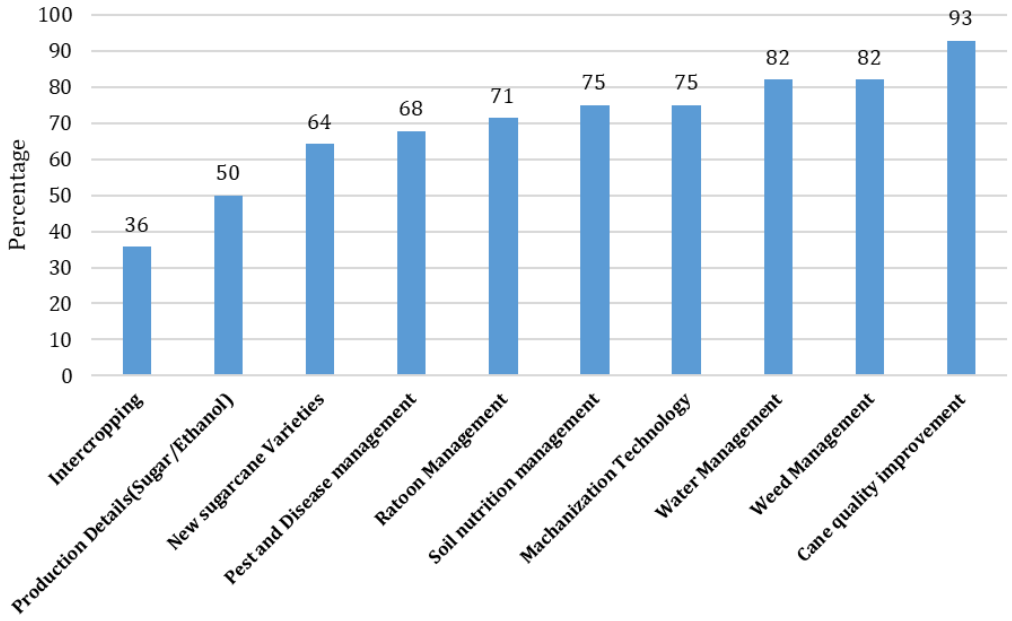

Figure 3. Information needs of CoP

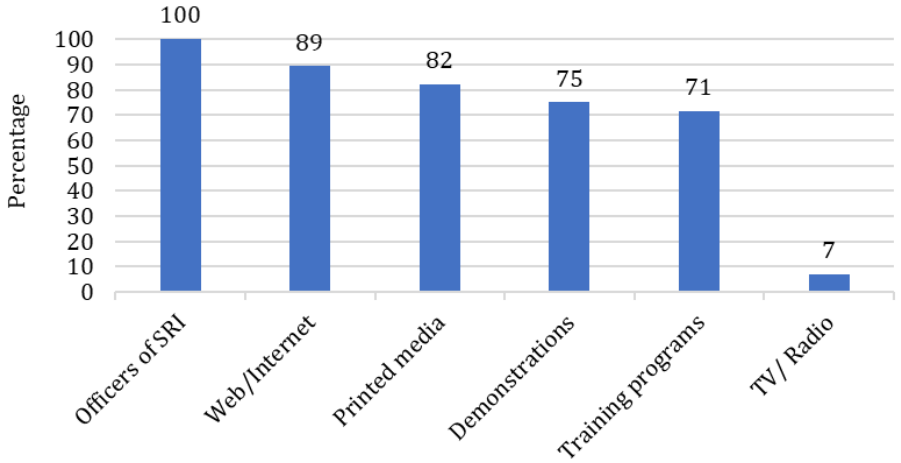

Figure 4: Preferred information sources of extension staff across three sugar companies

Current usage of ICT tools

The multifaceted ICT landscape for ES was characterized by a diverse collection of tools employed to facilitate communication efforts (Figure 5). WhatsApp emerged as the predominant platform, being utilized by the majority of ES (96%), thus we identified it as the low-cost ICT tool for rapid prototyping. Facebook was utilized by 71% of respondents while SMS remained a significant mode of communication, being employed by 64% of ES.

YouTube and Messenger shared a similar usage rate of 54%. Email maintained a substantial presence, although with a slightly lower usage rate of 46%. Also, Viber and Telegram were utilized at 18% and 7%, respectively. Meanwhile, Instagram and Twitter were utilized at rates of 7% and 4%, respectively. The preferences of ES and needs were addressed using ICT tools to enhance collaboration, communication, and outreach activities in their professional roles.

Tasks performed using ICT tools

In the area of ICT-enabled task performance among extension personnel (Figure 6), various activities were undertaken, demonstrating different levels of utilization. Most of the respondents (96%) used curated content, such as sharing photos of diseased sugarcane clumps, new sugarcane varieties,

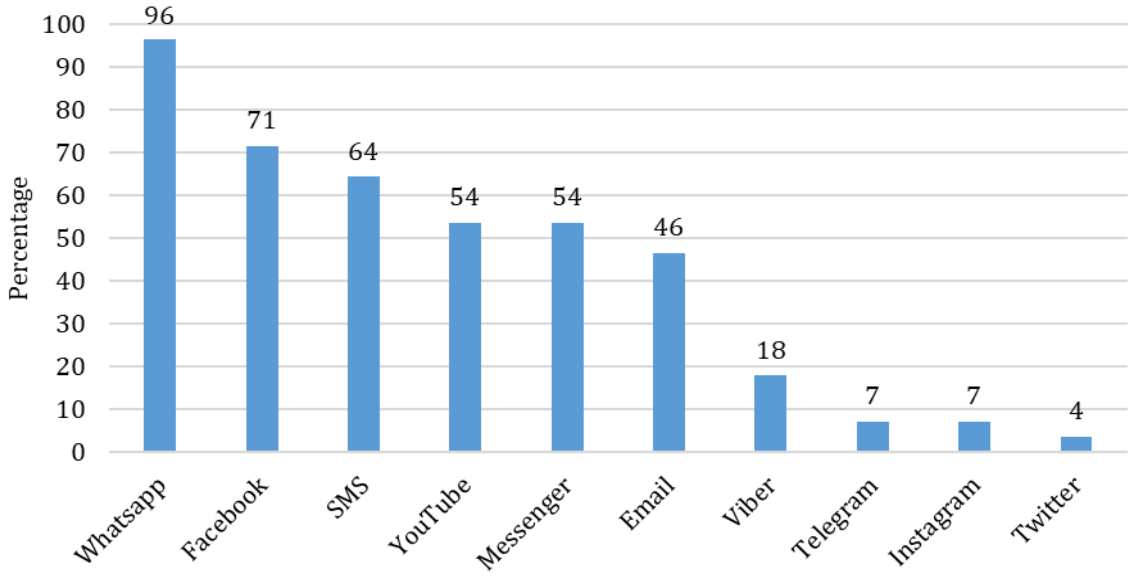

Figure 5: Current usage of various ICT tools by extension staff

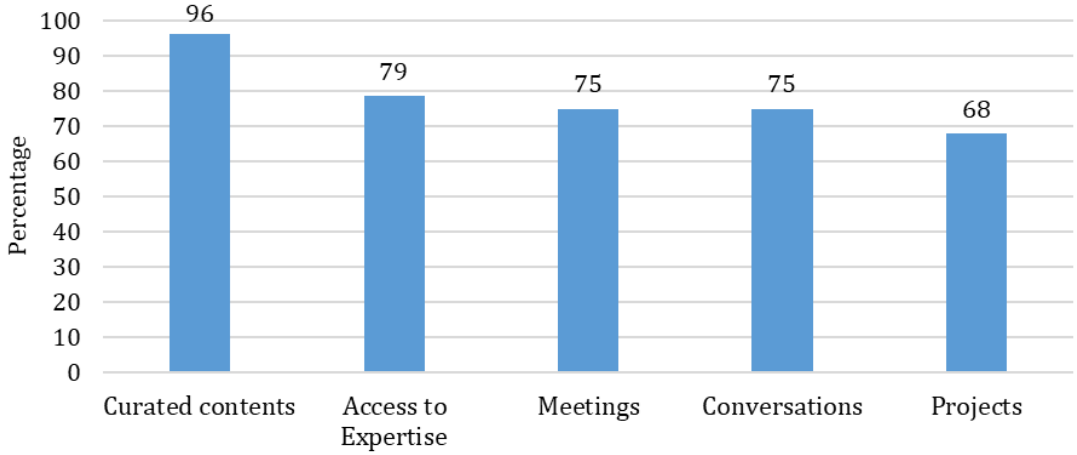

Figure 6: ICT-enabled task performance among extension staff

and other good management practices followed by farmers. Access to expertise was used by the majority (79%), highlighting a significant reliance on ICT platforms for accessing specialized knowledge. For this purpose, they regularly contact Development Officers (DOs), Pathologists, Entomologists, and other subject experts at SRI. Additionally, ES reached out to their managers for advice and guidance. Both meetings and conversations exhibited comparable levels of engagement, each accounting for 75% of tasks performed, indicating a substantial utilization of digital platforms for formal and informal communication purposes. They distributed all the information related to staff meetings and farmers' meetings among them. Also ES maintained open-ended discussions related to the management decisions, incentives, and job-related matters. Projects, although prominent, exhibited a slightly lower utilization rate (68%), indicating a prevalent yet somewhat less intensive involvement in project-related activities facilitated by ICT tools. These initiatives encompass sharing project details initiated by the institute among ES, signifying important but potentially underutilized aspects of ICT-enabled project management within the organization. This explains the decline in the percentage utilization, as projects are not a constant feature and may occur infrequently within the context of operations.

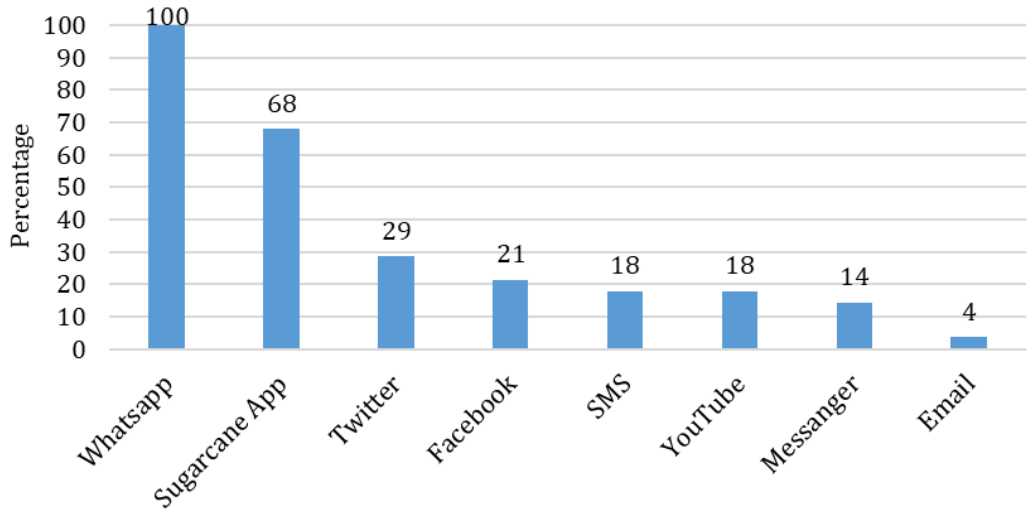

Figure 7: Selected ICT platforms for the communication campaign

Respondents' preference for ICT platforms for the communication campaign

Figure 7 shows the distribution of selected ICT platforms for the communication campaign. The WhatsApp forum was rated as the most favoured ICT platform for the prospective communication campaign with all respondents (100%) indicating its suitability.

Additionally, the Sugarcane App gathered considerable support, with 68% of participants believing it was appropriate for future communication requirements. Platforms such as Twitter (29%) and Facebook (21%) received somewhat lower preference. Furthermore, the relatively reduced endorsements for SMS (18%) and YouTube (18%) implied a diminished preference for conventional text-based messaging and video-centric platforms compared with limited facilities for interactions and immediate messaging options.

Campaign

Based on the results indicating a common preference for WhatsApp among the options provided, it is evident that this platform holds significant promise for rapid prototyping. Extensive usage of WhatsApp and familiarity among users make it an ideal choice for rapidly developing and testing prototypes. For the rapid prototyping initiative, three distinct WhatsApp groups were created, tailored to the specific units within Sevanagala, Pelwatta and Ethimale sugar companies.

Running the campaign

Fifteen messages were distributed, and 183 extension officers participated in three groups during the campaign. The Campaign plan is given in Table 5.

Evaluation of the effectiveness of the campaign

The effectiveness of the campaign was determined based on the contributions of campaign outcomes in achieving the goals.

Message reading status

Among the extension staff surveyed, 52.5% reported having read all the messages, indicating a proactive engagement with the educational content shared over the WhatsApp platform. Meanwhile, 42.5% acknowledged reading only a few messages, and a small percentage of respondents (5%) have not read any messages due to challenges such as technological limitations or access barriers (Table 6).

Appropriate methods for message dissemination

Respondents preferred video and photo-based content over voice or text-based content (Figure 8), with 85% of the participants believing video messages as highly suitable to being aware on sugarcane cultivation best practices. Video-based content is perceived as particularly effective and engaging. Furthermore, 78% rated text messages as suitable (48%) or highly suitable (30%) suggesting that SMS may be seen as less engaging or informative compared to video content. Photo messages garnered a slightly higher rating of 55% in the suitable dimension, indicating that visual content is generally well-received but may not be as preferred as video messages. Voice messages received the lowest rating among these options, with only 45% considering them suitable. These findings highlighted the importance of considering audience preferences and selecting message formats that align with their preferences and communication needs to maximize engagement and effectiveness.

Table 5: Campaign Plan

No	Date	Topic	Format
01	16.08.2023	Welcome message	Text
02	17.08.2023	Explaining the objectives of the groups	Text
03	19.08.2023	Introduction about TS and TEs	Text
04	21.08.2023	Quality cane yield from a fertile sugarcane plantation	Video
05	24.08.2023	Importance of land preparation	Text
06	24.08.2023	Land preparation in sugarcane plantations	Video
07	27.08.2023	"How can sugarcane field soil fertility be improved?"	Text
08	29.08.2023	"How can sugarcane field soil fertility be improved?"	Video
09	31.08.2023	How to select a suitable sugarcane variety?	Text
10	04.09.2023	How to select a suitable sugarcane variety?	Video
11	04.09.2023	Weather forecast for Monaragala Ampara district	Image
12	05.09.2023	Use seed-cane efficiently	Poster
13	05.09.2023	Use seed-cane efficiently	Text
14	06.09.2023	Weed management and pest and disease management	Video
15	07.09.2023	New sugarcane verities improvement program	Video

Table 6: Message reading status

Message Reading Status	Percentage (%)
Read all the messages	52.5
Read only a few messages	42.5
I could not read any messages	5

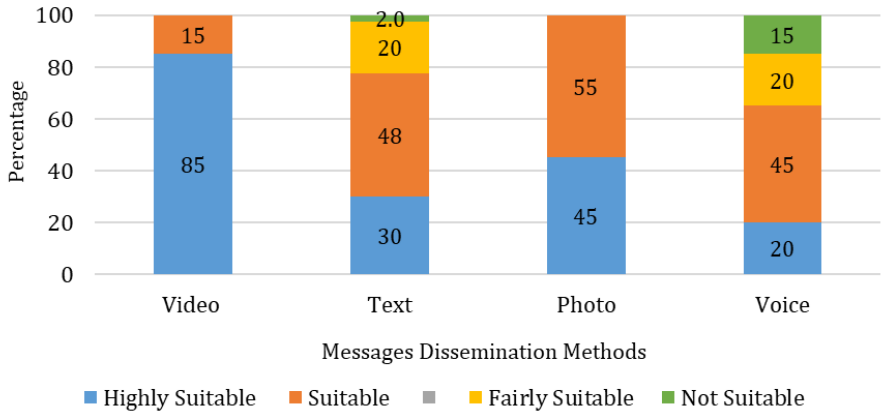

Figure 8: Appropriate methods for message dissemination

Problem-solving ability through the group

85% of the extension staff view the WhatsApp forum as an appropriate platform to discuss and resolve issues related to sugarcane cultivation. This indicates a strong level of confidence among the majority of respondents in their ability to address challenges related to sugarcane cultivation effectively. The high percentage of respondents who believe they can solve such problems suggests a well-equipped and knowledgeable workforce within the extension staff.

Conversely, the 15% who expressed uncertainty about their problem-solving abilities, stated that they may require additional support or training to enhance their skills and confidence in addressing sugarcane cultivation challenges. These findings reflect a generally positive outlook among the extension staff regarding their problem-solving capabilities in the context of sugarcane cultivation, with potential areas for further development and support identified among a minority of respondents.

Constraints faced by the respondents

The respondents faced several constraints that hindered their engagement with ICT tools effectively. These constraints included busy schedules, making it challenging for them to allocate time for utilizing ICT platforms. Additionally, respondents encountered issues such as the temporary unavailability of WhatsApp, which limited their ability to communicate and access information during crucial periods. Poor network coverage further exacerbated the situation, leading to unreliable connectivity and difficulty in accessing online resources. Moreover, respondents cited insufficient data as a barrier, as it impeded their ability to utilize ICT tools to their full potential.

Experience in using other WhatsApp groups

78% of respondents had experience in other WhatsApp groups for social work, while 22% had not. This reflects that the majority of respondents have been involved significantly in WhatsApp groups dedicated to social initiatives.

The high percentage of respondents with prior experience suggests a level of familiarity and active engagement with social activities facilitated through the WhatsApp platform. Conversely, the 23% of respondents who lack experience in such groups may indicate potential limitations in their involvement in social initiatives or networks facilitated by WhatsApp.

Sharing group contents with the farming community

It was observed that some of the extension officers had shared the best practices posted in the forum with their respective farmer communities (Figure 9). Many of the respondents (38%) reported always sharing, 50% of respondents indicated sharing sometimes, and 15% stated not sharing at all. This distribution indicates varying levels of engagement among extension staff in disseminating group information to the farming community.

The majority of respondents, including 88%, either always or sometimes shared the sugarcane cultivation best practices with the farmers, suggesting a dominant practice of communication outreach. However, 12% of respondents who did not share indicate a subset of staff members who may not prioritize or actively engage in disseminating information to the farming community.

Effectiveness of the campaign

According to the data, the communication campaign was perceived by extension staff as highly successful by 75% and successful by 25%. This indicates a significant level of success achieved by the campaign in resonating with the target audience and achieving its objectives. The absence of negative feedback suggests that the campaign was well-received and effectively communicated its intended message to the extension staff. These findings underscore the campaign's efficacy in engaging and satisfying its audience, demonstrating its success in reaching its objectives and effectively

conveying its message. Since ESs are educated personnel, the support of the management for the implementation of the campaign and ownership of this project were highly affected the success of the campaign.

Limitations of the Study

This study encountered several limitations that may have influenced the overall effectiveness of implementing the Technology Stewardship approach to promote technology transfer among sugarcane extension staff in the Monaragala District of Sri Lanka.

A key constraint was the limited engagement of respondents with ICT tools due to their demanding work schedules. Many extension staff members reported difficulty allocating sufficient time to engage with digital platforms, since the campaign run in the peak of the harvesting period.

Additionally, the issue of insufficient mobile data further constrained respondents' ability to fully utilize ICT tools. Many participants expressed concerns about limited data packages, which restricted their online activity and, consequently, their participation in digital knowledge-sharing platforms.

Furthermore, technological and infrastructural challenges significantly impacted the study.

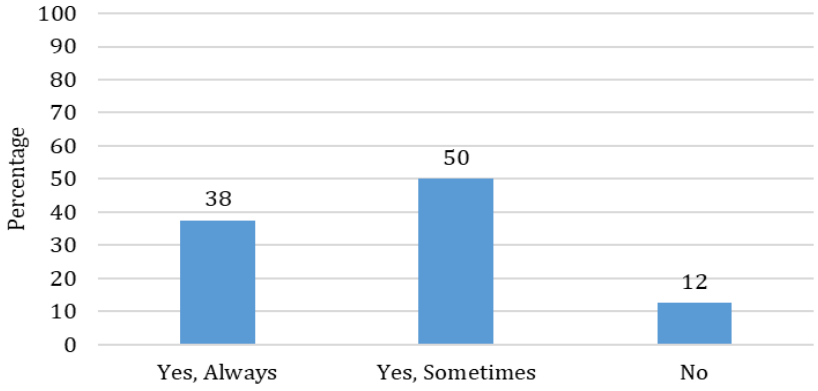

Figure 9: Disseminating the best practices to the Farming Community

For instance, temporary unavailability of WhatsApp during critical periods disrupted communication and limited access to timely information. Poor network coverage, particularly in the Ethimale area and certain parts of Pelwatte, emerged as a major barrier. Unstable internet connections in these regions made it difficult for participants to access online resources and stay connected through digital means.

CONCLUSIONS

The sugarcane industry in Sri Lanka is currently facing serious challenges, particularly a decline in sugar recovery rates. Strengthening the capacity of extension staff and improving technology transfer mechanisms have become critical to addressing these issues. This study aimed to design and implement a technology stewardship approach to promote technology transfer among sugarcane extension staff in the Monaragala District. Using an action research methodology, the study was conducted in five phases: (i) information needs analysis, (ii) technology selection, (iii) rapid prototyping, (iv) implementation of a short-term communication campaign, and (v) evaluation. Focus group discussions and surveys revealed that the extension officers' primary information needs included cane quality improvement, weed and water management, soil nutrition, mechanization, and ratoon management. Based on user preferences and accessibility, WhatsApp was selected as the primary ICT platform. Three dedicated groups were formed corresponding to the three major sugar companies in the district, and a three-week communication

campaign was conducted. Evaluation data indicated that WhatsApp was widely accepted and effectively used, particularly for sharing curated content, accessing expertise, and facilitating conversations. Video-based messages emerged as the most effective communication tool. A significant portion of the extension staff also re-shared the information with farmers, extending the campaign's reach. Despite the positive outcomes, several limitations were noted, including respondents' busy schedules, occasional unavailability of the WhatsApp platform, poor network coverage (especially in the Ethimale and parts of the Pelwatta areas), and limited mobile data access. The success of the communication campaign, as perceived by extension staff, indicates the potential for introducing ICT platforms like WhatsApp for disseminating information and engaging stakeholders. By tailoring messages to suit audience preferences and communication needs, campaigns can effectively reach and resonate with extension staff, driving behavior change and knowledge uptake.

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