



RESEARCH

Alternative and ICT-based Advisory and Extension Approaches in the Tea Sector in Sri Lanka: An Explorative Study

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ABSTRACT

The present study evaluated the usage level of alternative and information communication technology-based advisory and extension approaches, factors affecting the usage behavior, and limitations for implementing such approaches among advisory and extension officials in the tea sector in Sri Lanka during 2020-2022. An online survey was conducted with 72 officials. The majority were male (61%) and the mean age was 41 years. Most (47%) had up to diploma level education with a mean experience of 13 years. The government-imposed restrictions on public gatherings have significantly influenced the advisory and extension in the tea sector during 2020-2022. Respondents mainly connected with growers using mobile phone calls (76.6%) and WhatsApp messages (50%). Lack of communication infrastructure (62.5%), poor ICT knowledge and skills (51.6%), connection issues (57.8%), and inability to observe field conditions (68.8%) are the main barriers encountered by respondents. The main barriers faced by the farmers included lack of communication infrastructure (64.1%), poor ICT knowledge and skills (65.6%), connection issues (68.8%), inability to share quality photos (67.2%), and data cost (60.9%). The Majority of respondents (> 50%) showed positive perceptions towards these approaches and are willing to use them (73.4%) in the future. The results of Spearman's correlation test showed relationships between the usage frequency of alternative approaches with education ($r=0.455$, $p=0.000$) and age ($r=-0.267$, $p=0.033$). There was a relationship between officials' perception of alternatives and their usage frequency ($r=0.504$, $p=0.000$). In conclusion, the usage of ICT-based methods was higher among young and educated Officials.

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INTRODUCTION

Advisory and extension services (AES) provide stakeholders with the access to technology and information required to increase the productivity and sustainability of their production system and thereby improve their quality of life and livelihoods. Extension officials are a trusted source of information (Narine and Meier, 2020) and they are the partners who provide evidence-based practices for farming communities (Sampson et al., 2020). Extension is a method of information dissemination *via* communication. This can be done either for individuals or as group discussions but in a systematic or focused manner (Prabasini et al., 2021). Hence, advisory and extension services in the tea industry play a vital role.

The tea industry plays a vital role in the economic development of Sri Lanka. As one of the major sources of foreign exchange, tea represents 14% of the total export earnings in the country. According to the Tea Small Holdings Development Authority (TSHDA) Annual Report 2018, the field-level extension officer to tea farmer ratio is 1: 2958, whereas the effective ratio is 1: 1000 (Wanigasundera, 2015). Therefore, the extension officer has to cover is too large and cannot be managed effectively. Hence, their efficiency is low due to the huge costs, time, and extent to be covered (Dlamini, 2021). Most of the conventional advisory and extension approaches are face-to-face, top-down, and conducted at the field level. Likewise, the amount of extension activities that can be covered within a certain time frame is low compared to alternative and ICT-based (Information Communication Technology) advisory and extension approaches.

Alternative and ICT-based advisory and extension approaches are the novel way of disseminating technology and knowledge to stakeholders using ICT-based tools. Moreover, factors such as cost-effectiveness and timeliness are comparatively low with conventional approaches. The majority of the tea smallholders did not receive advisory and extension services at the right time (Samansiri and Wanigasundera, 2014). Therefore, there is a need to seek alternative approaches.

In addition, the recent developments related to the economic crisis situation, and travel restrictions imposed due to COVID-19 outbreak had greatly affected the implementation of AESs at field level. For instance, restrictions imposed to prevent public gatherings have negatively affected field-level advisory and extension services such as farmer training, field visits, and demonstrations (FAO, 2022). Furthermore, farmers did not receive timely extension services during the COVID-19 pandemic (Chander and Rathod, 2020). On the other hand, the recent economic crisis experienced in Sri Lanka has led to a fuel shortage in the country. This has further disrupted transportation and thereby the field-level advisory and extension services. However, it is important to make efforts to continue advisory and extension services during times of uncertainty and crisis in order to safeguard the tea industry in Sri Lanka from which Sri Lanka earns substantial proportion of foreign exchange. Because of the rapid growth rate of the ICTs, and their ability to the networking of all the stakeholders together, incorporating alternative and ICT-based approaches to conventional approaches may have a greater possibility to solve the problem identified.

Most of the conventional advisory and extension approaches are top-down and in-person. Meanwhile, ICTs play a key role in the development of agricultural advisory and extension services (Herath et al., 2021). Communication is vital to agricultural extension and ICT is an effective communication tool. Moreover, ICT is the best method to accelerate transferring of technical information from research institutes to farmers (Peng et al., 2021). Virtual communication has emerged as a new behaviour in today's context (Ramadhani et al., 2021). ICTs are the well-established method that today's world is used to share and disseminate information (Wijekoon and Rizwan, 2011). Therefore, advisory and extension officials can deliver their services more effectively by using ICTs and this helps to enhance farmers' accessibility to relevant information. ICTs in advisory and extension services can provide timely and related information to farmers throughout the country. Thus, farmers will make the right

decisions at the right time. Moreover, ICTs will support the provision of urgent information needs of stakeholders (Rathnayaka et al., 2021). This allows the transfer of information, products, and human capital all over the world in an efficient and cost-effective manner (Herath et al., 2021). Nevertheless, ICTs facilitate reaching a large number of stakeholders while keeping the quality of the information (Samansiri and Wanigasundera, 2014). ICTs will fill the information gap between farmers and service providers (Hashem et al., 2021). Further, ICT can be used to collect, store, retrieve, process and disseminate a wide range of information that could be requested by the farmers. Alternative and ICT-based advisory and extension approaches allow advisory and extension officials to send information as various forms including text, audio and/or video recording, downloadable files/documents, movies, *etc.* (Samansiri and Wanigasundera, 2014). The level of usage of ICTs continued to expand because of the factors such as relatively low cost and expansion of communication infrastructure (Wijekoon and Rizwan, 2011). Integration of ICTs into conventional advisory and extension services is a primary need in today's changing world and globally. Extension experts and research institutes are now promoting ICTs (Peng et al., (2021). Therefore, many previous researchers argued that conventional advisory and extension services should be altered with ICTs. With time ICTs might replace conventional advisory and extension approaches.

There are several challenges in access to digital advisory and extension services including low awareness of digital services availability, limited technical support to use digital services, lack of ownership and control of digital devices, lack of affordable internet services, and low digital literacy levels (Wijekoon and Rizwan, 2011). All these listed challenges can be experienced by both advisory and extension officials and stakeholders at different levels when implementing alternative advisory and extension methods, especially when incorporating ICTs tools.

To promote digital advisory and extension, there is a need to develop telecommunication

infrastructure. To increase the use of ICTs in the field of advisory and extension, it should enhance awareness, technical support, digital literacy, and, ownership and control of stakeholders towards digital devices and their services (Bonnie et al., 2021). Likewise, both advisory and extension officials and stakeholders need to be empowered and mobilized to take ownership of digital tools and their usage (CABI, 2021).

According to the literature, all known extension models are being partially transitioned to digitalization at present (Siankwilimba et al., 2022). However, the question is if these alternative and ICT-based measures are sustainable or temporal. Based on several studies, it was found that both service providers and their clients have a set of barriers to using alternative and ICT-based advisory and extension approaches in an effective and sustainable manner. Therefore, this study was carried out to i) explore the perception of officials of the effect of COVID-19 based travel restrictions on the field level extension program implementation, ii) explore the different types of ICT tools that can be used in AES, iii) determine the level of usage of alternative and ICT-based AES, and iv) explain the barrier for implementing alternative and ICT-based advisory and extension approaches.

METHODOLOGY

The study population consisted of advisory and extension officials (AEOs) of the tea sector in Sri Lanka. This study was carried out with Extension officers (EOs) of the TSHDA in three administrative districts viz. Ratnapura, Kegalle, and Kandy and, AEOs of the Tea Research Institute (TRI) in all tea-growing regions of Sri Lanka. A descriptive research approach was followed to determine the level of usage of ICT-based methods when providing extension and advisory services, and factors affecting, and limitations/ barriers to implementing such approaches in the tea sector in Sri Lanka during 2020-2022. Initially, Primary data were collected through a focus group discussion with AEOs from the TRI (n=8), and an online survey (n=72). A multistage sampling method was performed to select 50 EOs from the TSHDA while all the

TRI AEOs (N= 22) were included in the survey. Secondary data were collected from published research articles, online documents/internet, and books. Data were tabulated and analyzed by using MS Excel and SPSS 16.0 software. Descriptive methods were used to understand the background information of the study sample. User perception of the effect of COVID-19-based travel restrictions on the field-level extension program was measured using the percentage of the degree of agreement for each identified negative impact. Here a three-point Likert scale (1=never/rarely, 2=sometimes, 3=many times) to mark the degree of agreement on given statements was used for the participants. The level of usage of eleven identified ICT-based alternatives to conventional methods was measured using the percentage of the degree of agreement for given usage levels. Here a three-point Likert scale (1=never, 2=sometimes, 3=many times) to mark the degree of agreement for given usage levels was used. Barriers to implementing ICT-based alternatives were identified using the percentage of the degree of agreement on identified factors that have the possibility to act as barriers (a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree) was used to mark the degree of agreement on identified factors). User perception towards alternative and ICT-based advisory and

extension approaches was measured using the percentage of the degree of agreement for given statements (a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree) to mark the degree of agreement for given statements was used). The Mann–Whitney U test was used to compare the results of two populations. The Spearman’s correlation test and the Chi-square test were conducted to identify relationships between demographic factors and usage frequency and usage frequency and level of perception.

RESULTS AND DISCUSSION

General information of study sample

The study sample (n = 64) consisted of 61% male and 39% female advisory and extension officials. Their education qualification varied from Diploma level to PhD. level. The majority (47%) had diploma-level education and officials with M.Phil. and PhD. qualifications were rare (3%) in the study group (Figure 1).

According to the results of descriptive analysis, the mean age of the sample was 41 years ranging from 28 to 60 years. Similarly, for the experience in the advisory and extension field, the mean was 13 years and the distribution lay in between 2 years to 35 years (Table 1).

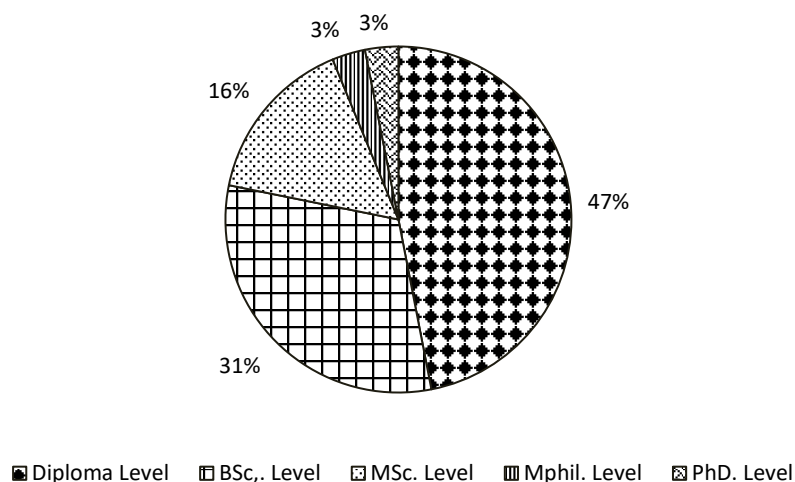


Figure 1: Distribution of respondents by the education level

Table 1: Summary of the age and experience in the advisory and extension field of the study sample

	N	Minimum	Maximum	Mean	Std. deviation
Age (Years)	64	28	60	41.03	10.006
Experience (Years)	64	2	35	13.15	10.554

Effect of COVID-19 on the advisory and extension services of the tea sector

Results indicated that government-imposed restrictions on public gatherings made the biggest impact to the AES of the tea sector in Sri Lanka (Table 2). According to the descriptive frequencies, 62% of the respondents indicated this as a difficulty that they faced many times during the period of 2020-2022 when implementing the advisory AES at field-level. Most of the traditional advisory and extension methods were based on face-to-face interactions and participatory in nature and restrictions on public gatherings made it difficult to carry out routine duties of the advisory and extension workers. WHO's COVID-19 guidelines such as lockdown, quarantine and social distance measures worsened agricultural extension in most of developing countries (Siankwilimba et al., 2022). Furthermore, Bereir (2020) found that extension activities such as field visits, pest and disease investigations were weakened in developing countries due to the travel restrictions. Therefore, the COVID-19 pandemic and consequent lockdown demand a change of conventional extension approaches (Undiandeye and Ayi, 2021).

More than 50% of the respondents indicated that lockdown-induced curfew/travel restrictions, transportation problems,

reduction of the number of requests to the institute and closure of the institute are other difficulties that they experienced either as many times or sometimes during the COVID-19 pandemic.

Level of usage of alternative and ICT-based advisory and extension approaches during the period from 2020 to 2022

According to the results, the majority of respondents mentioned that they mainly used phone calls (77%) and WhatsApp messages (50%) to connect with the farmers (Table 3). Similar results were observed and reported by other scholars worldwide. A study by Singh et al. (2020) found that WhatsApp groups and personal calls are the most used ICTs to deliver advisory and extension services to farmers in India. Furthermore, WhatsApp were the most preferred ICT tools of Caribbean extension service providers during the pandemic according to Joseph and Barry (2021) and Hashem et al. (2021). Modern extension approaches increasingly rely on mobile phones for disseminating information (Alvi et al., 2021). This is because the ownership rate of mobile phones is high. In Kenya, extension services were provided to farmers via WhatsApp as it can be used for messaging, sending voice recordings and short videos (Bonnie et al., 2021).

Table 2: Distribution of the respondents by their perception of the effect of COVID-19 on AES of the tea sector

Difficulties faced by the AEOs	Frequency (%)		
	Many times	Sometimes	Never/rarely
Lockdown induced curfew/ travel restrictions	39	41	20
Transportation problems	31	44	25
Government lifted restrictions on public gatherings	62	30	8
Disease infection	6	11	83
Quarantine process	6	27	67
Unable to participate field level advisory and extension activities because of the fear of contact with disease	6	34	60
Felt the need to have personal protective equipment	12	33	55
Reduction of No. of request came to the institute	48	42	10
Closure of the institute	16	47	37

The usage of other available forms of ICTs was quite low among the AEOs. For instance, Majority mentioned that they have never used webinars/virtual events (56%), e-posters, infographics (69%) or YouTube videos/Facebook (73%). However, Facebook was found to be one of the most popular ICTs for disseminating agriculture information according to Hashem et al. (2021). Such ICT tools have been effectively used to conduct farmer training, exchange documents, photographs and to deliver timely and relevant information in providing AES. Further, knowledge sharing and social networking can be done with social media easily. Chander, 2020 and Raj et al. (2020) also reported use of these alternative approaches during the time of COVID-19 pandemic.

Two groups of extension officers participated in the study; AEOs from the TRI those who serve mainly the corporate sector and the Tea inspectors/ Extension officers from the TSHDA those who cater to tea smallholders. The Mann-Whitney U test was performed to see if there was any significant difference between the usage of ICT-based extension methods among the two groups, and there was a significant difference between the two groups. In particular, the results indicated that there was a significant ($\alpha = 0.05$) difference between the two populations for level of usage of e-mails ($p=0.000$), Webinar/virtual events ($p=0.000$), e-posters/info graphics ($p=0.006$), and use of institute's websites ($p=0.000$) (Figure 2).

Table 3: Distribution of respondents by their usage level of alternative and ICT-based advisory and extension approaches

Alternative approach	% (n=64)		
	Frequently	Sometimes	Never
Online training programs via Zoom, Microsoft teams	14	73	13
Phone calls	77	23	0
Webinars/ Virtual events	5	39	56
WhatsApp messages	50	48	2
e-posters, Infographics	5	26	69
Facebook pages	16	48	36
Video clips	9	53	38
SMS	37	58	5
Mobile applications/ Android applications	17	36	47
Institute's Websites	13	48	39
YouTube/ Facebook live	2	25	73

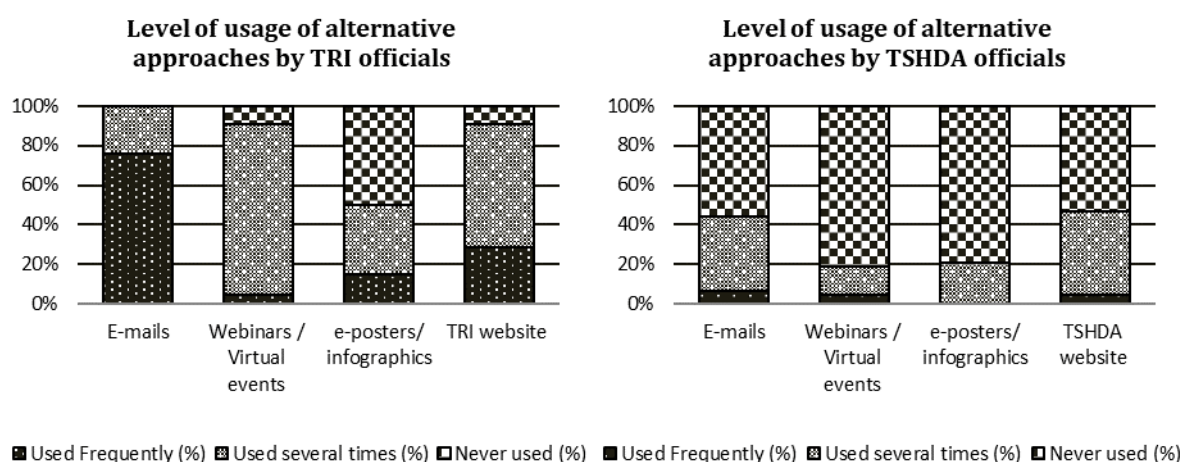


Figure 2: Distribution of usage level of alternative approaches by TRI and TSHDA officials

The results showed that over half of AEOs catering to the corporate sector have used e-mails (100%), webinar/virtual events (90%), and the institute’s website (90%) either frequently or several times. In contrast, the majority (>50%) of the EOs serving the tea smallholders have never used these alternative approaches. Possible reasons for this significant difference could be due to the nature of the clients of each group. A study by Gunapala et al. (2022) revealed that corporate sector clients have used mobile phones as the easiest communication channel. Along with the findings of other scholars (Samansiri and Wanigasundera, 2014; Disanayake et al., 2020), the findings of this study also revealed that still smallholder farmers are having set of barriers to access and use alternative and ICT-based advisory and extension approaches.

Barriers for implementing alternative and ICT-based advisory and extension approaches

Officials perception on barriers to implementing ICT-based methods for AES was studied using a Likert scale (Table 4).

According to the results, the majority (50%) agreed that all listed factors were barriers that they faced when implementing alternative and ICT-based advisory and extension methods (Table 4). These results also tested for the Mann-Whitney U test and results revealed that there was a significant ($\alpha = 0.05$) difference between the two groups’ percentage distribution of the level of agreement of respondents on poor ICT knowledge and skills ($p=0.001$) and high communication/ data cost ($p=0.049$). Figure 3 shows the percentage distribution of respondents by the level of agreement on these two factors in two populations.

Table 4: Distribution of respondents by their level of agreement on factors that act as a barrier to implement ICT-based alternatives

Factor	%				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Lack of communication infrastructure	16	63	3	9	9
Poor ICT knowledge and skills	8	52	12	22	6
Network errors/ connection failures/poor network connection	22	58	6	8	6
Difficult to provide advice without observing field conditions	11	69	14	3	3
High communication/data cost	14	48	13	17	8

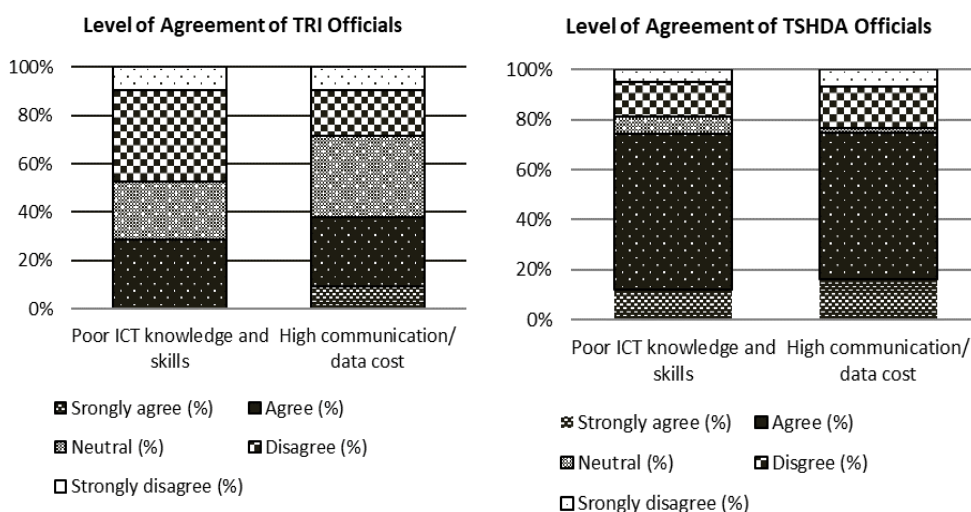


Figure 3: Distribution of respondents from the TRI and the TSHDA by the level of agreement on significant factors

Accordingly, there was a significant difference among the opinions of AEOs and EOs regarding data cost and ICT skills. The latter believed data cost and poor ICT skills as main barriers to implementing ICT-based extension. There are 307 regional plantation company estates (corporate sector) (Rajasinghe and Samansiri, 2010) and about 399,313 tea smallholders in the country (TSHDA, 2018). Therefore, AEOs have a lesser number of clients to communicate with and this facilitates them to use low-cost ICT-based communication channels such as emails and Short Message Services (SMS). Sending emails or SMS to a large number of individuals is not possible and because of that EOs have to use group messaging platforms like WhatsApp which will be costlier than sending emails or SMS.

Majority of the respondents agreed that lack of communication skills (94%), poor ICT skills (94%), poor network connections (89%), and poor-quality photos or images (86%) as possible barriers for their clients to receive AES through alternative and ICT-based methods (Table 5). Literature showed that many other studies also identified these factors as limitations/barriers in the implementation of alternative and ICT-based approaches. Africa, India, and Indonesia like several developing countries experienced factors such as low communication facilities and infrastructure as limitations/barriers in implementing ICT-based alternatives (Prabasini et al., 2021). A study by Peng et al. (2021) mentioned that the availability of connectivity issues and lack of ICT skills resulted in low usage of the internet in rural areas of Malaysia. Moreover, Paudel et al.

(2018) reported that illiteracy and inadequate ICT skills to use ICTs as the main limitations/barriers.

The two groups had divided opinions related to data cost and poor photo quality ($\alpha=0.05$). The Mann-Whitney U test results further revealed that there was a significant difference between the two population's percentage distribution of respondents by the level of agreement on two factors, i.e., poor quality pictures/ photos shared by the clients ($p=0.024$) and data cost is too high for the farmers ($p=0.013$). Figure 4 shows the percentage distribution of respondents from two populations by the level of agreement on these two factors in two populations.

The majority of EOs who serve the tea smallholders believed that mobile data cost can be a barrier for their clients to use ICTs-based extension methods. Low productivity, leaf rejection and loss of profit are the main issues associated with the majority of tea smallholders in Sri Lanka (Perera, 2014). These factors indirectly affected their capability to bare the data cost.

The results showed that more than 60% of the AEOs agreed or strongly agreed poor quality pictures/ photos shared by the clients as a barrier. For the EOs, it was more than 90%. Less than 50% of the AEOs disagreed or strongly disagreed with the factor that the cost is too high for farmers while the majority (more than 60%) of the EOs marked as they agreed or strongly agreed. Possible reasons for this difference could be due to the nature of the clients of each group.

Table 5: Distribution of respondents by their level of agreement on factors that have possibility to act as a barrier for their clients to receive AESs through ICT-based alternatives

Factor	%				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Lack of communication infrastructure	30	64	5	1	0
Lack of ICT skills among the clients	28	66	3	3	0
Network errors/ connection failures/poor network connection at field level	20	69	3	3	5
Poor quality pictures / photos shared by the clients	19	67	11	3	0
Data cost is too high for the farmers	12	61	11	14	2

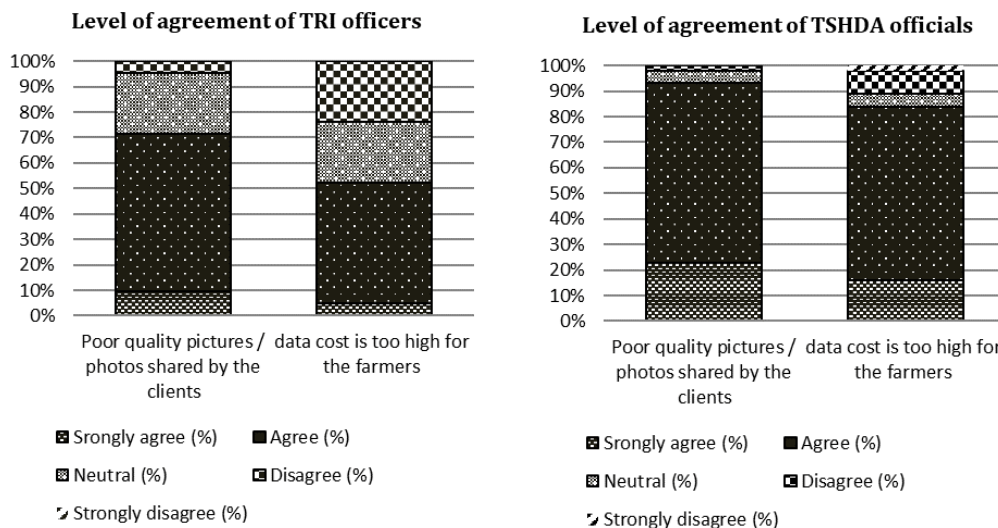


Figure 4: Distribution of respondents from the TRI population and the TSHDA population by the level of agreement on significant factors

Many other studies also have identified these factors as limitations/barriers in the implementation of alternative and ICT-based approaches. Prbasini et al. (2021) found that Africa, India, and Indonesia like several developing countries experienced factors such as low communication facilities and infrastructure as limitations/barriers in implementing ICT-based alternatives. The current cost of internet data packages should be reduced in order to make it more affordable both for extension officials and farmers (Izuogu et al., 2020). The availability of connectivity issues and lack of ICT skills resulted in low usage of the internet in rural areas (Peng et al., 2021). Moreover, lack of ICT policies, language issues, and poor bandwidth are some other factors that influence the use of mobile phones in India (Ganpat and Ramdwar, 2021).

Perception towards alternative and ICT-based advisory and extension approaches

The participants used a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree) to rate their level of agreement on given statements.

The ‘Theory of Planned Behaviour’ suggests that subjective norms have an effect on technology adoption behaviour (Yapa et al., 2019). The study revealed that majority (55%) of the respondents used alternative approaches mainly because their superior officers suggested they do so (Table 6).

Many respondents mentioned that they have the necessary ICT skills and knowledge to use ICT-based methods (78%), and they are competent in developing required teaching material, for instance, video, infographics etc (57%).

The Technology Acceptance model suggests the decision to adopt a given technology is affected by the user’s opinion on the ease of use of the same. 77% of respondents agreed that alternative and ICT-based methods are user friendly and easy to carry out. However, many respondents stated that they need more training (89%), facilities (65%), and resources from their institutes (55%) to implement certain approaches effectively.

74% agreed that AES organizations should incorporate digital technologies as much as possible in future extension programs. Interestingly 58% of EOs acknowledged that there is a chance for misinformation due to the use of certain alternative measures. 66% of respondents mentioned that, ICT-based advisory and extension approaches may not be convenient for each and every stakeholder while 77% still prefer face-to-face advisory and extension services.

The results of the Mann–Whitney U test revealed that six statements out of eighteen showed a significant ($\alpha=0.05$) difference between AEOs and EOs (Table 7).

Table 6: Distribution of participants' perception towards alternative and ICT-based advisory and extension approaches

Factor	%				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. I used ICT-based methods mainly because my institute strongly encouraged me to do so	2	36	23	34	5
2. I used alternative measures because my superior officers suggested me to do so	2	53	17	23	5
3. I had to use alternative measures, because my peers also use the same	0	34	22	36	8
4. I think ICT-based extension methods are more user friendly & easy to carry out than conventional measures	16	61	14	8	1
5. I could not use ICT-based methods due to lack of ICT knowledge of stakeholders	3	37	16	33	11
6. I wish to continue these alternative measures that I practiced during the pandemic, for the future also	14	73	8	3	2
7. I have enough skills and knowledge to implement ICT-based extension methods	5	73	5	15	2
8. I need more trainings to implement certain alternative measures	17	72	6	5	0
9. ICT-based Extension methods can address stakeholders' problems effectively almost always	6	11	20	50	13
10. I am competent in developing contents (Video, info graphics, pictures <i>etc.</i>) that can be used on ICT platforms	5	52	20	17	6
11. I prefer face to face advisory and extension services than alternative methods	16	61	14	9	0
12. I believe ICT-based extension tools are not convenient for each and every stakeholder	17	66	9	6	2
13. It is hard for me to carry out alternative advisory and extension services than conventional measures	0	31	17	41	11
14. I believe advisory and extension services can be digitalized by using technology driven methods	8	55	20	14	3
15. I think there is more chance for misinformation due to the use of certain alternative measures	6	52	25	16	2
16. I believe currently available telecommunication infrastructure in the country should be uplifted	26	64	5	3	2
17. I believe that the institute should incorporate digital technologies as much as possible in future extension programs	19	55	12	11	3
18. I need more facilities and resources to implement certain alternative measures	27	65	3	5	0

Table 7: Significant values for statements that show significant differences between two populations

Factor	Asymp. Sig. (2 tailed)
I used alternative measures because my institute strongly encouraged me to do so	0.014
I had to use alternative measures, because my peers also used the same	0.004
ICT-based Extension methods can address stakeholders' problems effectively almost always	0.007
I prefer face-to-face advisory and extension services than alternative methods	0.025
It is hard for me to carry out alternative advisory and extension services than conventional measures	0.037
I believe that the institute should incorporate digital technologies as much as possible in future extension programs	0.027

Table 8: Summary of respondents by the level of agreement

Factor	EOs who serve the corporate sector Mean (SD)	EOs who serve the tea smallholders Mean (SD)
I used alternative measures because my institute strongly encouraged me to do so	3.38 (0.590)	2.74 (1.071)
I had to use alternative measures, because my peers also use the same	3.33 (0.856)	2.58 (0.982)
ICT-based Extension methods can address stakeholders' problems effectively almost always	2.95 (1.071)	2.26 (0.978)
I prefer face-to-face advisory and extension services than alternative methods	3.52 (0.873)	3.98 (0.740)
It is hard for me to carry out alternative advisory and extension services than conventional measures	2.29 (0.784)	2.88 (1.096)
I believe that the institute should incorporate digital technologies as much as possible in future extension programs	4.14 (0.655)	3.56 (1.076)

According to the results of the descriptive analysis, the mean of the level of agreement for the statement the institute encouraged them to use alternative approaches was 3.38 for AEOs (Table 8) and 2.74 for EOs. For the statement that is saying officials had to use alternative measures because their peers did the same, the mean was 3.33 for AEOs and 2.58 for EOs. When they were asked to rate their level of agreement with the statement "ICT-based Extension methods can address stakeholders' problems effectively almost always", the mean was 2.95 for AEOs and 2.26 for EOs. AEOs was rated that they prefer face-to-face advisory and extension services over alternative methods with a mean of 3.52 and this was 3.98 for EOs. According to the results the mean for the level of agreement for the statement "It is harder for me to carry out alternative advisory and extension services than conventional measures" was 2.29 for

AEOs and 2.88 for EOs. Furthermore, AEOs were rated as they believe their institute should incorporate digital technologies as much as possible in future extension programs with a mean of 4.14 and this was 3.56 for EOs. These results were plotted in a radar diagram (Figure 5) to visualize the difference between the two populations.

According to the literature, Prabasini et al. (2021) found that in India and Indonesia, extension officials received more training regarding access to the internet and ICT tools during the pandemic in order to enhance their capability to provide the information needed by farmers. The capacity of advisory and extension services should be strengthened by Training of Trainers (TOT) to use of innovation platforms (Izuogu et al., 2020). It would be more beneficial if they receive more training on how to conduct training programs

via an online platform (Israel et al., 2020). A study by Elkashef et al. (2022) revealed that some organizations were involved with the development of several digital platforms in Nigeria. Further, mentioned that the extension staff of the country received digital empowerment opportunities to enhance their performance. The development of extension officials' competence in ICTs is a needed practice (Ramadhani et al.,2021). Results of the present study also revealed that they need more training and facilities to use alternative and ICT-based approaches effectively in the future.

The relationship between demographic factors of advisory and extension officials and usage frequency

According to the findings of Spearman's correlation test, there was a positive significant ($\alpha=0.01$) relationship between education qualification and usage frequency of alternative approaches ($r=0.455, p=0.000$). On the other hand, there was a negative significant ($\alpha=0.05$) relationship between age and usage frequency of alternative approaches ($r=-0.267, p=0.033$). However, there was no significant association between experience and usage frequency. The results of the Chi-square test revealed that there was no

significant association between gender and usage frequency. According to the literature, extension workers' age and work experiences showed a negative relationship with the use of some alternative and ICT-based approaches (Samansiri and Wanigasundera, 2014). Another study by Jimenez's that is carried out in Nigeria showed a significant relationship between gender, age, education level, and working experience with the level of usage (as cited in Samansiri and Wanigasundera, 2014).

The relationship between usage frequency and level of perception towards alternative and ICT-based advisory and extension approaches

The results of the Spearman's correlation test indicated that there was a positive significant ($\alpha=0.01$) relationship between advisory and extension officials' perception on alternative and ICT-based advisory and extension approaches and their usage frequency($r=0.504, p=0.000$). This shows positive perceptions lead to a higher adoption rate. Possible reasons could be the relative advantage. Perception of the usefulness of alternatives leads to higher adoption of alternative and ICT-based approaches and vice versa.

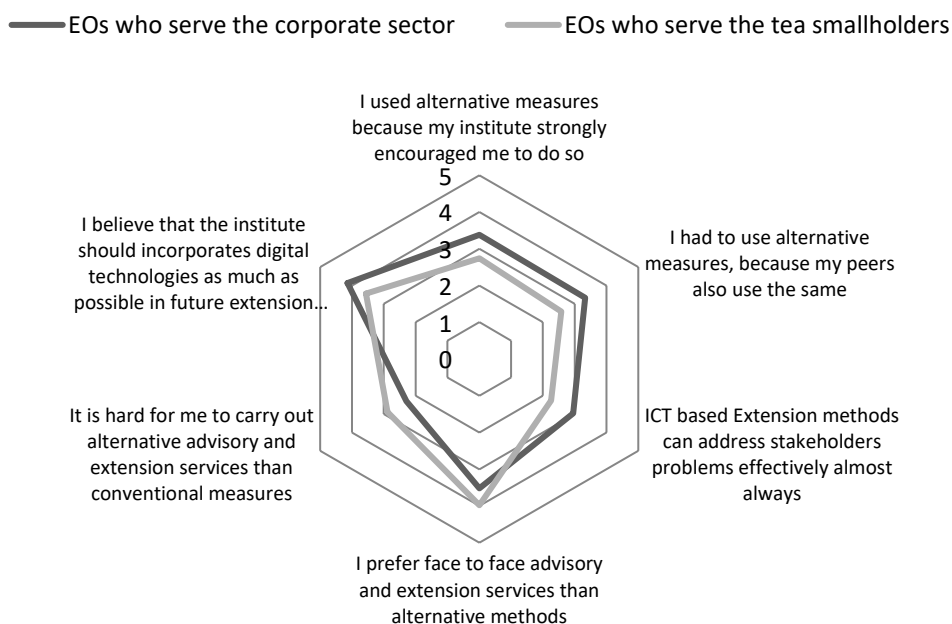


Figure 5: Visualizing the difference in the factors between two populations

CONCLUSION

Travel restrictions imposed due to the COVID-19 outbreak have significantly affected the field-level advisory and extension activities of the tea sector in Sri Lanka. The leading AES organizations have promoted the use of ICT-based extension methods as an alternative measure. The usage of ICT-based methods was comparatively quite low among the EOs those who serve the tea smallholders. Phone calls and WhatsApp messenger forums were the most commonly used methods. Other social media sites have not gained adequate attention of the respondents. Reasons for poor adoption of ICTs-based methods were connection issues, difficult to provide advices without observing field conditions, lack of communication infrastructure, high communication/ data cost and poor ICT knowledge and skills. Furthermore, according to the respondents, the main barriers faced by the farmers when accessing ICTs include lack of communication infrastructure, poor ICT knowledge and skills, connection issues at the field level, inability to share quality photos/pictures, and data cost. Usage of ICT-based methods by respondents were affected by factors such as peer encouragement, senior officers promoting the use, individual's ICT knowledge and skills, user-friendliness and easy handling, training and support as well as facilities and resources given by their Institute. Most of the respondents have a positive perception towards alternative and ICT-based advisory and extension approaches and there is a high chance that they will use these methods in the future too. Perception on the usefulness of alternative and ICT-based approaches leads to the level of usage and *vice versa*. Usage is higher among young and educated officials. The study recommends promoting the use of alternative and ICT-based extension methods to multiply the impact of conventional methods of extension. For example, extension officers can video a method demonstration or a farmer training programs and then share it on a social media platform. Further, it is necessary to provide more training to officers, develop offline and synchronized methods, and introduce peer-to-peer community learning opportunities in the future.

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