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A Public and Private Partnership Extension Approach for Effective Dissemination of Technologies with Special Reference to Tea Smallholding Sector in Ratnapura District

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ABSTRACT

Tea small holding sector in Sri Lanka is making a substantial contribution for the total tea production. The adoption rate of technical innovations is found to be low mainly due to inadequacy of timely dissemination of such technologies. This paper reviews the present status of extension system in tea small holding sector and analyses the effectiveness of a new partnership based extension approach. Tea factory-based partnership extension system was compared with tea factories having high, medium and low partnership categories. Thirty five Leaf Supervisors and 150 small holdings representing six tea factories which have high, medium and low level of partnership were randomly selected and surveyed to assess their socio-cultural background, technical knowledge, adoption level of technologies recommended by TRI and the services offered to smallholders in Ratnapura district.

The level of technical knowledge of Leaf Supervisors on major tea field operations showed a positive relationship with the age and the level of access to information sources. Education level of respondent small holders was positively correlated with the adoption of major field practices. The field productivity was positively correlated with the adoption level of fertilizer application, pest and disease management and overall practices. However, it is interesting to note that the knowledge level on plucking relates only with age of Leaf Supervisor. The participation of smallholders in Tea Small Holdings Development Society activities (*Tea Shakthi*) showed a positive influence on the level of adoption of major field practices. The adoption of main field operations showed an increase with the increased degree of partnership. Adoption level of field operations in high partnership model was well above the adoption level in medium and low partnership models. The results provide evidence to reveal that level of adoption of proven technologies strongly depends on the degree of interaction between smallholders and extension agents. Although the knowledge level of the Leaf Supervisors is satisfactory in the high partnership model, it is low in other two models. Therefore, a mechanism should be introduced to increase the knowledge and skills of the Leaf Supervisors, especially those in the medium and low partnership models

and provide practical knowledge about tea technology and improve their communication skills.

Findings of this empirical study provide sufficient evidence for the need of establishing a linking mechanism of factory-based public-private partnership extension channel in disseminating technologies to smallholding sector. Such a partnership mechanism could be an effective way of disseminating tea technologies to stakeholders rather than individual efforts of the public institutions (Tea Research Institute, Tea Small Holding Development Authority) or private organizations (bought leaf factories, agro-input companies, *etc.*)

Keywords: Leaf Supervisor, Public-Private Partnership extension approach, public sector extension system, private sector services-oriented systems

INTRODUCTION

Tea industry is covering about 222,000 ha and generates direct and indirect employment opportunities for about 2 million. Tea smallholdings sector is considered as the most dynamic segment of the tea sector as it represents 59% of total tea extent of Sri Lanka (Anon, 2005a) and contributes more than 65% to the national tea production (Anon, 2005b).

With the expansion of smallholdings sector, land use pattern has been considerably changed over the last two decades. The expansion of smallholding sector primarily takes place in home gardens and also by *ad hoc* conversion of rubber and coconut lands into tea. There is also a tendency to encroach the buffer zones of the forest cover in the low country for tea cultivation. Use of ill-drained, flood-prone flat lands for new tea planting has also been significantly increased. Hence, haphazard exploitation of lands by the smallholders may cause significant changes in the natural balance of the environment leading to change of weather pattern associated with unexpected and frequent dry and extreme rainy weather conditions. Land degradation is becoming aggravated due to lack of attention for soil conservation. The economically viable life span of low grown vegetatively propagated (VP) tea in the corporate plantation sector varies from 25 -30 years (Amarathunga and Wijeratne, 2000), while in the smallholding sector, it is said to be 10 - 15 years (Rajasinghe, 1999). Replanting in short succession or moving into new lands for tea cultivation result in frequent disturbance to soil and loss of natural balance of the crop environment.

Tea smallholding sector in Sri Lanka is slowly expanding in terms of extent of cultivation and contribution to the total tea production. However, adoption rate of recommended technologies developed by Tea Research Institute of Sri Lanka (TRI) is found to be low in smallholding sector. Formal communication channels presently available between TRI and smallholders are inadequate for the timely dissemination of such technologies.

The knowledge dissemination system to smallholders can be divided into public and private channels. Under the public institutional knowledge dissemination system, the technologies developed primarily by TRI are transferred to smallholders directly by the extension service of Tea Small Holdings Development Authority (TSHDA), which has the mandate of serving the extension needs of tea smallholders. In addition, the Advisory and Extension Service of TRI also involves in training and skill development activities, problem solving, and technology dissemination process of smallholdings sector in order to fulfill growing demands. The above channels can be considered as public extension channels in which, a mechanism is available for the technically qualified extension staff to update smallholders on technological advancements. However, this system is unable to meet the increasing requirements and demands of all tea smallholdings due to limitations such as inadequate field staff (about 15 Advisory and Extension staff of TRI and about 150 Tea Extension Officers of TSHDA). Tea Extension Officers (TEOs) / Tea Inspectors of TSHDA have to serve a large number of smallholders (over 350,000 as per the TSHDA census in 2005) for both extension activities such as conducting farmer group training programmes, field days, demonstration visits, nursery and individual field visits *etc.* as well as tea land development activities such as monitoring of subsidy schemes for replanting and fertilizer, supervision of registered commercial nurseries, attending various tea related meetings, smallholder society activities, *etc.* Therefore, the number of smallholders to be contacted by a TEO varies in the range of 2500 - 3000 depending on smallholding distribution pattern of tea growing districts.

Meanwhile, the existing private extension channels are basically market-oriented and operated through bought leaf factories, agro-input and service-oriented agencies. These channels are limited to providing information to smallholders and less attention is paid to problem solving aspects of tea cultivation, training and skill development of workforce, *etc.* Majority of smallholders in many areas obtain services from the private channels such as bought leaf factories that have closer interactions with smallholders because of their ability to supply inputs such as fertilizer, agro-chemicals on credit basis and provide transport of green leaf. However, most of the field staff of these private channels are not technically qualified to serve as extension workers. Eventhough TRI is mandated to generate and disseminate tea related technologies directly for the corporate sector and indirectly to smallholding sector through the TSHDA, there is no public organizational oriented linking mechanism for monitoring and evaluation of these private channels to ensure proven technologies are effectively disseminated to smallholders. As a result, tea smallholders are faced with complex socio-economic problems which are associated with the adoption of certain field practices that offer short-term benefits but affects adversely on long-term productivity of those tea smallholdings. Under this scenario tea extensionists have to play a significant role in developing an effective linkage mechanism among scientists, public and private extension systems, rural development organizations and tea smallholders. In

this context, a thorough understanding on the nature of these public and private extension channels is necessary to explore the potentials and thereby to develop linking mechanisms among available sources for effective private-public partnership extension systems.

Conceptually, partnership is an extended form of group dynamics where two or more parties establish relationships and leverage resources to work together with the expectation that each of the parties would achieve greater goal than working individually (Morse, 1996). Ojha and Morin (2000) provide a comprehensive definition for partnership. According to them, partnership is a mutually beneficial dynamic relationship between or among two or more persons or organizations having similar vision, goal, objective and interest. Partners leverage their time and resources, experience and expertise, and knowledge and skills to work together complementarily by dividing responsibilities based on comparative advantage and make decision jointly. They recognize each other's contribution, respect each other's culture, and stride to fulfill the assigned responsibilities. While working together, they also maintain autonomy and independence, and attain their individual goals together with those of the other stakeholders. Partnership provides opportunities for all partners to learn new competence. The partnership also makes information available about the methods of accessing and using resources effectively (Fehnel, 1995).

Rogers and Shoemaker (1971) defined adoption as a decision to make full use of a new idea as the best course of action available. Accordingly, the process of adoption or innovation decision is a psychological process in which an individual moves from awareness, interest, evaluation, trial and finally adopt or reject the practice. Trial or testing is defined as practicing of any technology in a "small part" of the farm "once' or one season. There are several factors that have effects on the adoption of a new idea in a social system. These factors are used to measure broad concepts. These concepts are socio-economic status, personal characteristics, information dissemination system, climatic and technology. Hence, this paper attempts to examine the relationship between the level of adoption of recommended agricultural practices with socio-economic status, field experience, knowledge and information dissemination system of tea smallholding sector.

Present knowledge dissemination system of the tea smallholding sector

Three main subsystems such as knowledge generation, knowledge dissemination and knowledge utilization have been identified in the present extension model for tea smallholding sector as shown in Figure 1 (Wanigasundera and Krishnapllai, 1992). The knowledge dissemination system has public and private major components operating through various channels for the transfer of technology to the smallholding sector. It could be argued that both these types have strengths and weaknesses of their own. Each subsystems of this model have been associated with some problems and limitations. Mahaliyanaarachchi (1996) identified major limitations associated with each subsystem. Accordingly, the

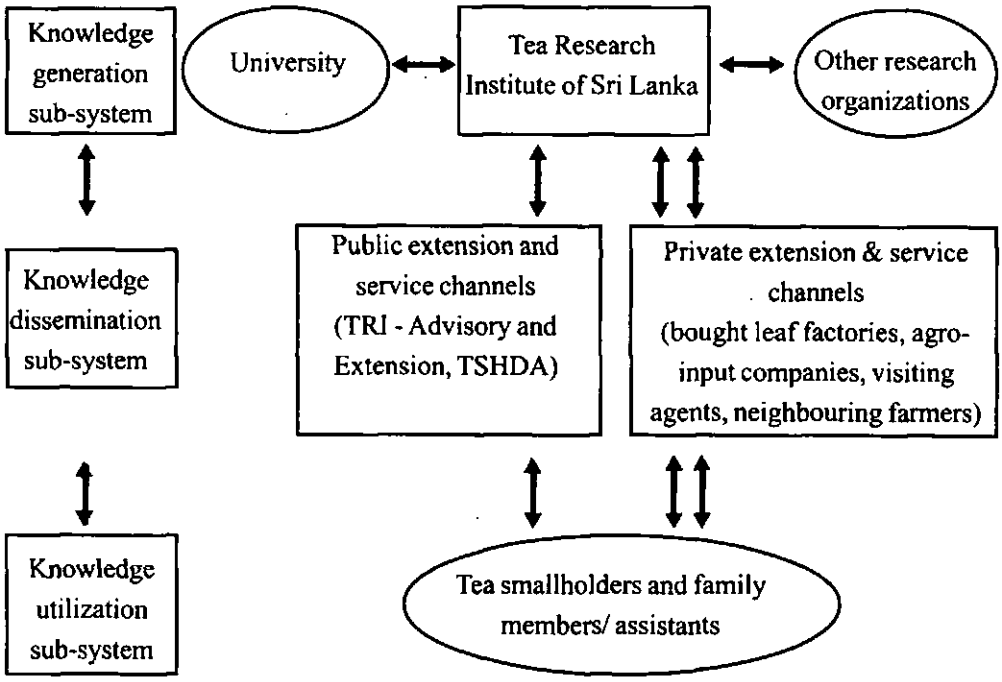


Figure 1. Present knowledge dissemination system of tea smallholding sector

problems and limitations associated with knowledge generation system are as follows: The technologies generated by TRI do not show expected potential under small holding conditions due to various socio-economic limitations. There is no proper monitoring and evaluation committee for the identification of smallholding problems and issues.

The problems associated with the knowledge dissemination system are as follows: Extension staff in the public extension systems is found to be inadequate (number of smallholders to be contacted by a TEO is about 2500 - 3000). Eventhough the private channels (bought leaf factories, agro-input and service-oriented agencies, visiting agents, *etc.*) have more field level staff, they are not technically qualified for technology transfer activities. There is no proper interaction and feedback mechanism in both public and private channels. It was also identified that there is no proper monitoring and evaluation mechanism among the main components of the knowledge dissemination systems.

Problems and limitations associated with the knowledge utilization system are as follows: the dissemination of agricultural information to smallholders in very remote areas and their feedback to the research sector were inadequate. Level of adoption for proven technologies in relation to cultural practices by tea smallholders is very low. Non-availability of materials and inputs at the required time is one of the main limitations for non-use of new technologies. Smallholders have a tendency to replant in short succession or move to new lands for cultivation.

Hence, it is obvious that there is no proper monitoring or evaluation mechanism for the existing extension models relevant to the tea smallholding sector. This paper discusses an empirical study on an extension model which proposes a conceptual policy framework through the identification of comparative strengths of tea related public, private and non-governmental organizations in carrying out technology transfer, development of human resources and social capital.

Private and Public Partnership (PPP) extension model implemented by the major stakeholders in Ratnapura district

Most of the bought leaf tea factories are established in the densely populated tea smallholdings areas. Each bought leaf tea factory has specific routes to collect green leaf from tea smallholdings as there is a big competition among factories for green leaf. While collecting green leaf from tea smallholdings, factories offer services such as transporting leaf to the factory, providing fertilizer and dolomite, agro-chemicals and other needs such as construction material, food items, credit facilities, *etc.* Therefore, in this model the tea factory is considered as a resource center for fulfilling the needs of smallholders. The TRI extension service provided an extensive training to the Leaf Supervisors (LS) of three selected factories in close proximity to its Low country Regional Centre. The extension services of these Leaf Supervisors have been monitored and necessary feedback is given by the TRI.

Leaf Supervisor as an extension agent

Each factory employs 5 - 10 young Leaf Supervisors (in some cases more than 10 based on the factory capacity), who have adequate knowledge to monitor the leaf collection process, green leaf payment, distribution of fertilizer and dolomite and other tea related inputs to smallholders. Leaf Supervisor is one of the key informants for smallholders in most of the remote areas, where other public and private extension channels are inactive due to institutional limitations and poor infrastructure facilities. Tea smallholders depend on Leaf Supervisors for their opinions on field operations such as plucking, pruning, *etc.* as well as on selecting inputs such as type of fertilizers, agro-chemicals, planting materials. In view of recent developments on food safety measures and maintaining quality standards such as Maximum Residual Level (MRL) of pesticides in made tea, maintaining post harvest intervals after pesticide applications and other field operations have to be carefully monitored. Hence, closer interaction among concerned public monitoring organizations *viz.* TRI, TSHDA, Tea Commissioner's Division, Sri Lanka Tea Board (SLTB), is required. The contribution of tea factory owners is also of paramount importance in maintaining such standards.

Objectives of the study

This study aims to explore the strengths and weaknesses of the linking mechanism of knowledge transfer system for smallholders implemented through Leaf Supervisors attached

to bought leaf factories (private sector service system) under the guidance of TRI (public extension system). It also compares the effectiveness of the partnership framework with the existing non-partnership system by investigating the knowledge and adoption gap in tea smallholding sector operated under different systems. Findings of this empirical study will be used to propose a linking mechanism of factory-based private-public partnership (PPP) extension system for effective dissemination of technologies in smallholding sector.

MATERIALS AND METHODS

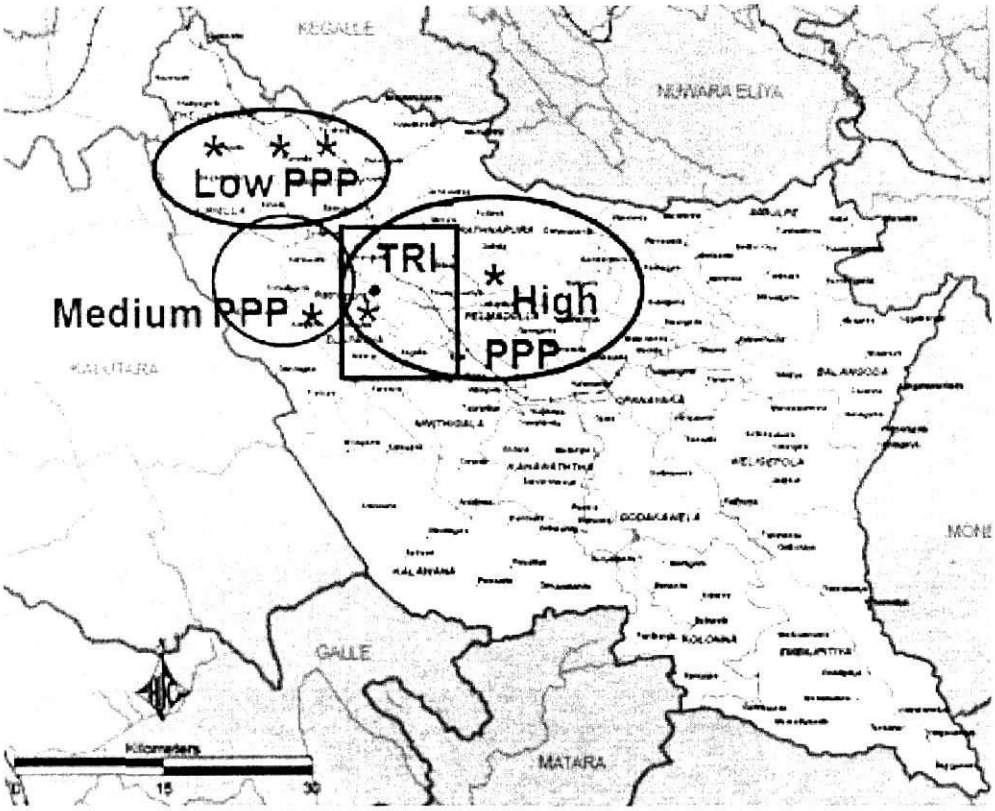
This study was undertaken in Ratnapura district which provides comparatively higher contribution in terms of bought leaf handling in the Low country. Six factories were selected *viz.* KDU - Galpaditenna, St. Joachim, Ratnapura Tea Factory Services Ltd (RTS), Mannapperuma Estate Management Ltd (MEL), Laksakanda Tea Factory and Lakmal Tea Factory. These factories represent three levels of PPP *viz.* high, medium and low based on the frequency of services obtained (*e.g.* staff training on field practices, leaf handling and processing, technical problem solving related to smallholdings, pH testing, collecting publication and planting materials *etc.*) from TRI during past 12 months. A sample of 35 Leaf Supervisors was randomly selected from above factories and was interviewed using a pre-tested questionnaire to assess their socio-cultural background, technical knowledge and the services offered to smallholders. Twenty five smallholders from each of the selected factory were randomly selected using the lists of smallholders who supplied green leaf under the supervision of the particular Leaf Supervisors selected from above six factories. Accordingly 150 tea smallholders were used in the social survey. Distribution of respondents is given in the Table 1 and Figure 2.

Table 1. Distribution pattern of respondents

Factory and location	Partnership category	No of Leaf Supervisors	No of smallholders
KDU, Pelmadulla	High	10	25
St. Joachim, Ranapura	High	05	25
RTS, Ratnapura	Medium	05	25
MEL, Kuruwita	Low	05	25
Lakmal, Kuruwita	Low	05	25
Laksakanda, Erathna	Low	05	25
Total		35	150

Data collection

The necessary primary data on socio-economic status, current status of the tea fields such as extent, age, bush stand and yield, sources of information, inputs and other material, level of adoption of field practices (fertilizer, plucking and pruning policy, pest and disease control *etc.*) were collected from smallholders using a pre-tested questionnaire and by



Low PPP : DS divisions and factories having low public-private partnerships
Medium PPP : DS divisions and factories having medium public-private partnerships
High PPP : DS divisions having high public-private partnerships

Figure 2. Surveyed locations in the Ratnapura district

visual observations of their tea fields. Information on socio-economic status, level of knowledge of the selected major cultural operations and degree of contacts with TRI and smallholders were collected from Leaf Supervisors. Necessary secondary data were obtained from the Census Report on Smallholdings (2005), Central Bank Annual Report *etc.*

Measurement of variables

The primary data collected from Leaf Supervisors and smallholders were measured as per the details given in the Table 2. Composite variables such as knowledge level of Leaf Supervisors on major field practices (plucking, pruning, fertilizer applications and pest and disease management) and level of adoption of above field practices by smallholders were measured by constructing composite indices. Hundred (100) marks were allocated for each field operation. Scores obtained according to the knowledge level of the Leaf Supervisor and the level of adoption by smallholders were separately measured and grouped into three categories namely no, partial and full. "No" refers to less than 33 marks, "partial" if scores between 34 and 66 and "full" if marks greater than 67 out of total marks of 100.

Table 2. Measurement of variables

Type of Variables	Type of Individual		Measurement
	Leaf Supervisor	Small Holder	
Age	"	"	Years
Education	"	"	Grade
Experience in tea sector	"	"	Years
Access to information	"	"	Anytime = 3 Sometime =2 Not at all =1
Source of information	"	"	TRI/ TSHDA/ LS/ peer groups / agro-input companies / other sources
No of contact of small holders/week	"	-	Number
Yield/ ha/year	"	"	kg/ha
Monthly income	"	"	Rs./month
TRI Training Programme attended	"	"	Anytime = 3 Sometime =2 Not at all =1
Social Participation in society		"	Anytime = 3 Sometime =2 Not at all =1
Degree of partnership of the attached factory	"	"	HPPP =3 Medium =2 Low =1

Data analysis

Descriptive analysis and statistical techniques such as Chi Square test and Correlations were used to analyze the data. Data analysis was done by using SPSS package. Levels of significance of 0.05 and 0.01 were used to determine significance of the relationships among variables. Reliability of coefficients shows that the knowledge statements and the adoption components used to measure each of the innovations are adequately reliable. The reliability coefficients for the knowledge statements used to measure the knowledge on plucking, pruning, fertilizer application and pest and disease management varied from 0.66 - 0.77, while that for the adoption components varied from 0.52 - 0.66.

RESULTS AND DISCUSSION

Results of this study are discussed under the following sections: General information of study area, productivity of tea lands, socio-economic characteristics of Leaf Supervisors and tea smallholders, knowledge sources of Leaf Supervisors and their knowledge level, knowledge sources of tea smallholders and their adoption level and relationship of adoption of field practices and yield with socio-economic variables.

General information of study area

Annual rainfall varies between 3500 - 4000 mm per year with two distinguished wet seasons (April - July and October - December) and two dry seasons from January - March and August - September (Anon, 2006). Two distinguished cropping seasons also prevail during the two wet seasons. Gradient of the tea lands studied varied from 30 - 60% and the soil group is classified as great soil series of Red Yellow Podzolic (Panabokke, 1996). The soil depth of 30 - 40 % of tea lands varied from shallow - moderate (30 - 60 cm) while in remaining lands, it varied from moderate - deep (60 - 90 cm).

Socio economic characteristics of Leaf Supervisors

Socio economic characteristics of Leaf Supervisors play a significant role in determining the way of motivation of them and therefore, most relevant information of above were used to identify the relationships. The age of the Leaf Supervisors involved in the extension activities varied from 19 - 43 years. The majority (60%) was young and were 30 years or below. Most of the Leaf Supervisors have more than five years experience in their profession. The majority of Leaf Supervisors have studied up to or above General Certificate of Education (GCE) - Advanced level. Therefore, they have an adequate educational background and potential to undergo skill development and capacity building training programs. The number of smallholders regularly contacted by a Leaf Supervisor varied from 160 – 600 per week and the majority (71%) contacted 300 - 400 smallholders per week. Therefore, this character could be considered as an added feature of this extension channel as Leaf Supervisors can contact large number of smallholders more frequently (four times per month). Table 3 shows variation of knowledge level of Leaf Supervisors on tested field practices with the degree of partnership. These data confirm that the knowledge level of the Leaf Supervisors have been substantially influenced by the degree of partnership maintained by the tea factories with TRI ($p < 0.05$).

Correlation among dependent and independent variables of Leaf Supervisors

The education level did not show any relationship with other variables studied. The level of technical knowledge on major tea field operations showed a relationship with the age and the level of access to information sources of Leaf Supervisors (Table 4). Those who had higher level of access to TRI also had a higher level of knowledge on tea cultivation. However, it is surprised to note that the knowledge level on plucking relates only with age of Leaf Supervisors ($P < 0.01$). This could be due to the experience they obtained on plucking practices by engaging in green leaf production and processing for a long period of time in addition to frequent training on plucking standards. Meanwhile knowledge level on pruning is significantly correlated with the access to information, age of Leaf Supervisors and number of smallholder contacts per week ($p < 0.01$). Knowledge level on fertilizer application and pest and disease management significantly correlated with access to

Table 3. Relationship between knowledge level of Leaf Supervisors and degree of partnership relation

Type of field practice	Degree of PPP	Mean knowledge score	Max	Min	Kruskal wallis chi-square value
Plucking	High	63.3	81	52	1.2 ns
	Medium	61.1	71	49	
	Low	59.3	65	39	
Fertilizer application	High	50.0	61	40	7.6*
	Medium	44.0	56	25	
	Low	36.4	44	19	
Pruning	High	79.2	95	65	6.1*
	Medium	76.4	90	55	
	Low	64.2	80	45	
Pest and disease management	High	58.2	75	40	8.5*
	Medium	50.1	68	17	
	Low	39.8	58	13	

ns: not significant; *: significant at P< 0.05 (two tailed) level

Table 4. Correlation between the knowledge level on field operations and independent variables of Leaf Supervisors

Variables		Knowledge level on field operation				
		Plucking	Pruning	Fertilizer application	Pests and diseases	Total adoption
Access to information	r	0.213	0.530**	0.623**	0.497**	0.784**
Age	r	0.490**	0.514**	0.264	0.296	0.531**
Education	r	- 0.080	- 0.203	- 0.108	- 0.018	- 0.120
Contacts per weeks	r	0.022	0.363**	0.032	0.056	0.198

r: correlation coefficient ; * : significant at P < 0.01 level (two tailed)

information ($p < 0.01$). Therefore, more avenues should be opened up to update the knowledge level of Leaf Supervisors.

Socio economic characteristics of tea smallholders

Van and Hawkins (1988) reported that the adoption of innovations is positively related to socio-economic status of farmers. Therefore, clear understanding of social, cultural and economic background of smallholder would help to examine interactions among above

factors and their overall effect on the degree of adoption. Table 5 shows the variation of socio-economic status of respondent smallholders who have categorized as high, medium and low PPP groups. About 47% of smallholders had studied up to grade 10 and 30% up to GCE (Ordinary Level). The balance 23% had higher levels of education (GCE Advanced Level or higher). The age varied from 22 - 71 years and the mean age was 45. About 25% of smallholders had more than 10 years of experience in tea cultivation while around 46% of them were reported to have 5 - 10 years of experience and 29% have less than five years of experience.

Tea cultivation and yield

The mean land size was 0.55 ha. About 55% have below 0.40 ha and 35% of respondents have lands between 0.4 – 0.8 ha. Balance 10% has more than 0.8 ha up to a maximum of 3.5 ha. The mean annual yield of the respondents was 2584 made tea kg ha^{-1} yr^{-1}. Comparatively higher percentage of smallholders (48%) reported more than 2400 made tea kg ha^{-1} yr^{-1} of annual yield. Meanwhile annual yield of 33% of smallholder lands varied between 1200 - 2400 made tea kg ha^{-1} yr^{-1}. Balance 19% reported less than 1200 made tea kg ha^{-1} yr^{-1}.

Sources of information

Sources of information for tea smallholders on main field operations are shown in Table 6. In this comparison, the response of both high and medium PPP categories were considered as high and therefore, number of individuals responded for this category was 75 while, the number of individuals responded for low PPP category was also 75. The main formal information dissemination channel for smallholding sector of the study area is TEO, and the Tea Development Societies that operates with TSHDA also act as a contributory source. In addition, there are several other extension channels also operate in the study area such as TRI advisory and extension service, Leaf Supervisors, peer farmer groups, agro-input companies.

As shown in Table 6, majority of smallholders in the high PPP category received information from formal sources (TSHDA - 20.3% and TRI - 16.5%). Meanwhile comparatively low percentage of smallholders (9.8%) in the low PPP category received information from the TRI while they receive more information from TSHDA (22.5%). Leaf Supervisors also play a dominant role in disseminating information (16.8%) in the high PPP category when compared to the contribution of same channel in low PPP category (9.9%). Therefore, the role of Leaf Supervisors in disseminating information was also found to be less effective in low PPP category as they have not been sufficiently trained on technical matters. The majority of smallholders in both partnership groups also highly dependent on their own experience built up by receiving information from other informal sources such as peer groups, agents of agro-input companies rather than formal source. Peer groups were a key

Table 5. Distribution of smallholders studied in relation to degree of partnership and socio-economic variables

Socio-economic variables and their categories	High PPP- (N= 50) No.	Medium PPP (N= 25) No.	Low PPP (N=75) No.	Overall No	Overall %	Mean value
Education level						
Up to grade 5	5	6	20	31	21	Up to
6 - 10	12	6	21	39	26	O/L
Up to O/L	22	6	18	46	30	
A/L or higher	11	7	16	34	23	
Age yr						
< 30	3	2	8	13	9	45 yr
31 - 60	42	16	48	106	71	
> 60	5	7	19	31	20	
Experience years						
< 5	12	6	25	43	29	13 yr
5 - 10	29	15	25	69	46	
10 - 15	7	2	5	14	9	
15 - 20	3	3	11	17	11	
> 20	3	2	2	7	5	
Land size ha						
< 0.40	26	16	41	83	55	0.55 ha
0.4 - 0.80	14	8	30	52	35	
0.8 - 2.0	3	0	3	6	4	
> 2.0	7	1	1	9	6	
Annual yield Made tea kg $ha^{-1}year^{-1}$						
< 1200	1	13	13	27	19	2584
1201 - 2400	14	4	32	50	33	kg $ha^{-1}yr^{-1}$
2401 - 3600	22	6	20	48	32	
3601 - 4800	12	2	9	23	15	
> 4800	1	0	1	2	1	

GCE O/L : General Certificate of Education (Ordinary Level)

GCE A/L : General Certificate of Education (Advanced Level)

Table 6. Information source of smallholders according to partnership relation

Source of information	Degree of PPP	No. of respondents*	%
TRI	High	61	16.5
	Low	32	9.8
TSHDA	High	75	20.3
	Low	73	22.5
Leaf Supervisors	High	62	16.8
	Low	32	9.9
Neighbouring farmers	High	62	16.8
	Low	73	22.5
Agro-input companies	High	35	9.4
	Low	2	12.0
Own experience	High	74	20.0
	Low	75	23.0
Total response	High	369	100%
	Low	324	100%

* Multiple responses included

information source for low PPP category (22.5%). Meanwhile, agro-input companies also have been disseminating information to lower percentage of smallholders (9.4% in high PPP and 12% in low PPP).

Table 7 shows the information sources of the smallholders and their relative distribution among types of field operations. The information on key field operations *viz.* plucking, fertilizer application, pruning and pest and disease management, have been received by majority of smallholders from formal sources (TRI, TSHDA) while the information on planting material was mostly received from Leaf Supervisor (30%), neighbouring farmers (30%) or by own experience (21%). Agro-input companies were mainly focusing to deliver

Table 7. Distribution of information sources according to type of information

Source of information*	Plucking (%)	Fertilizing (%)	Pruning (%)	Pest and disease control (%)	Planting material (%)
TRI	25	25	17	20	13
TSHDA	27	24	19	16	14
L S	22	28	13	7	30
Neighbours	16	13	28	13	30
Fert. Comp.	20	37	11	22	10
Experience	21	17	22	19	21

* Multiple responses included

information on their product (37%). Leaf Supervisors deliver the information on plucking (22%), fertilizer (28%) and planting material (30%) aiming at collecting quality leaf, distributing fertilizers from their own factory and nursery plants from their known nurseries. The above distribution pattern of information from different sources show that both formal and informal sources play an important role and hence, it could be used in identifying the sources that need to be promoted by the linking mechanism for effective information delivering extension system.

Relationship of adoption level of field practices and yield with socio-economic variables

The interrelationships between the major variables of smallholders are shown in Table 8. The yield is significantly and positively correlated with fertilizer application, pest and disease management and overall adoption of practices ($P < 0.001$). Education level of respondents was positively and significantly correlated with the adoption of fertilizer application ($P < 0.001$) and overall adoption of above field practices ($P < 0.01$). Positive correlation indicates that adoption level of plucking and pruning techniques are increased with the maturity (age) of smallholders ($P < 0.05$). Social participation of smallholders in relation to tea smallholding society activities (*e.g.* technology dissemination, sharing services and experience, problem solving *etc*) positively influence on level of adoption of fertilizer application, pest and disease management, and overall adoption of practices ($P < 0.01$) and plucking and pruning ($P < 0.05$).

Table 8. Correlation between adoption level of field practices by smallholder, yield, and socio-economic variables

Variables		Adoption level on field operation				
		Plucking	Pruning	Fertilizer application	Pests and diseases	Total adoption
Yield	r	0.083	0.133	0.397***	0.305***	0.373***
Age	r	0.488*	0.485*	0.210	0.219	0.528
Extent	r	-0.099	0.023	0.129	0.163	0.059
Education	r	0.118	0.088	0.289***	0.116	0.208**
Society membership	r	0.213*	0.139*	0.412**	0.425**	0.373**

r: correlation coefficient

***, **, and * : significant at $P < 0.001$, 0.01 and 0.05 level (two tailed)

Relationship between adoption level and degree of partnership

Table 9 shows that relationship between adoption levels of main field practices and degree of partnership. It can be seen that the adoption of main field operations such as plucking, fertilizer application, pruning and pest and disease management increases significantly

with the degree of partnership ($P < 0.001$). Mean adoption score for all field operations in high PPP is very much higher than the average value obtained for same field operations adopted in medium and low PPP. The results confirm that mutually beneficial dynamic relationship between stakeholders and organizations having similar visions, goals, objectives and interests would enhance the adoption level of field operations. The mean comparison shows a significant difference among degree of partnership and level of adoption of recommended field practices such as plucking, pruning, fertilizer application and pest and disease management ($P < 0.001$). This provides sufficient evidence to prove that the levels of adoption of recommended technologies strongly depend on degree of interaction between smallholders and extension agents. Higher the partnership makes stronger the interaction which, stimulates adoption of recommended practices. Moreover, this finding is consistent with the notion of Feder *et al.* (1982) that the probability of adoption of innovation increases with the intensity of interaction with extension agent and increased stock of information with regard to the innovation.

Table 9. Relationship between adoption level and degree of partnership

Type of field practice	Degree of PPP	Mean adoption score	Max	Min	Kruskal wallis chi-square value
Plucking	High	65.92	88	49	39.4***
	Medium	55.32	71	42	
	Low	53.15	71	36	
Fertilizer application	High	47.70	69	30	61.9***
	Medium	35.12	50	8	
	Low	33.25	54	12	
Pruning	High	64.26	90	40	16.7***
	Medium	55.88	75	40	
	Low	55.24	80	21	
Pest and disease management	High	52.74	78	26	29.3***
	Medium	39.36	68	16	
	Low	38.12	62	16	

CONCLUSIONS

The level of technical knowledge on major tea field operations showed a positive relationship with the age and the level of access to information sources. Those who had higher level of access to the TRI also had a higher level of knowledge on tea cultivation. It is interesting to note that the knowledge level on plucking relates only with the age of Leaf Supervisors. Knowledge level on pruning is significantly correlated with access for information, age of Leaf Supervisors and the number of smallholder contacts of Leaf Supervisors per week.

Knowledge level on fertilizer application and pest and disease management also significantly correlates with access for information.

Education level of respondent smallholders was positively and significantly correlated with adoption of fertilizer application and overall adoption of the field practices. The yield obtained is significantly and positively correlated with fertilizer application, pest and disease management and the adoption of overall practices. Positive correlation indicated that adoption levels of plucking and pruning techniques are increased with the maturity (age) of smallholders. Social participation of smallholders in relation to tea development society (*Tea shakthi*) activities such as technology dissemination, sharing services and experience, problem solving *etc.* have a positive influence on level of adoption of major field practices.

The adoption of major field operations increases with the increased degree of partnership. Adoption levels of field operations in high PPP category is well above medium and low PPP categories. The results, therefore, have confirmed that a mutually beneficial dynamic relationship between stakeholders and organizations having similar visions, goals, objectives and interests would enhance the adoption rate of field operations. The results provide evidence to prove that, the level of adoption of recommended technologies strongly depends on degree of interaction between smallholders and extension agents. Higher partnership makes stronger interactions, which stimulate adoption of recommended practices. Although the knowledge level of the Leaf Supervisors is satisfactory in high partnership model, there is very little acceptability of smallholders through this channel. Therefore, a mechanism should be introduced to increase the knowledge and skill levels of the Leaf Supervisors, especially those in medium and low PPP category factories. The TRI should provide proper practical knowledge through its trained extension staff. Also communication skills of Leaf Supervisors should be improved.

Findings of this empirical study provide sufficient evidence for the need to establish a linking mechanism of factory-based public-private partnership extension channel to disseminate technologies to smallholding sector. Such a partnership mechanism could be a more effective approach for dissemination of tea related technologies to tea smallholders than the individual efforts by the public institutions (TRI, TSHDA) or private organizations (bought leaf factories, agro-input companies, *etc.*). Therefore, a greater interaction among key stakeholders and their proactive participation in planning, implementation and monitoring of the partnership programs, co-operation between staff of partners, support from local leadership, mutual respect, appreciation of the contribution of partners, and effective communication are of paramount importance in developing an effective partnership extension approach.

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