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# Adoption of Agronomic Practices in Coffee: An Evaluation on Farmers' Perspectives

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***ABSTRACT.*** *The central province is the main coffee-growing region of Sri Lanka. The mean coffee yield in the country is less than the maximum possible yield. This situation is attributed to poor adoption of agronomic practices which are associated with satisfactory plant growth and yield.*

*In this study attitudes of coffee farmers on three main agronomic practices in coffee, namely,: fertiliser application, pruning and shade regulation were evaluated and associations between variables were examined in order to understand whether there is a relationship between attitude of farmers and their adoption of innovative agronomic practices in coffee. Data were collected from two main coffee growing districts Kandy and Nuwara Eliya, in the Central province of Sri Lanka. The Extension Officers (EO) of the Department of Export Agriculture are responsible for the extension activities of the coffee farmers. An EO is usually assigned a Divisional Secretariat area. Kandy district contains 17 EO ranges and Nuwara Eliya district contains six EO ranges. Farmers were selected proportionately and randomly from the two districts. Equal number of subsidized and non-subsidized farmers (total of 140) were included in the sample.*

*Perspectives on the above mentioned practices were assessed for the two groups of farmers. Results revealed that the attitudes of coffee farmers on the innovations were generally positive. The attitudes of farmers were affected by their situations rather than contacts with the EO's. A significant association was observed among attitudes on the practices studied and adoption, knowledge and coffee yield. Therefore, emphasis should be given in changing farmers' attitudes in order to increase adoption of agronomic practices and ultimately coffee yield.*

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## INTRODUCTION

Coffee (*Coffea arabica* L.) is a beverage crop grown in wet and intermediate zones of Sri Lanka. Coffee is mainly used for domestic consumption and as an export product has earned foreign exchange amounting to Rs. 93.1 billion (Department of Export Agriculture, 1997). A substantial yield gap has been observed between the average national production and the potential yield even with optimal plant density. The national average yield was calculated to be 154.4 kg $ha^{-1}$ whereas research stations' yield was 809.1 kg $ha^{-1}$. De Silva (1993) related low yield levels with poor adoption of technological recommendations.

The attitude that an individual farmer holds towards an innovation has a significant influence on accepting or rejecting the said innovation (Jha and Singh, 1973). On the other hand, an attitude may be thought as a disposition towards overt action (Feaster, 1968). Therefore, this study was conducted to examine whether poor adoption of innovations in coffee has any relationship to attitudes of farmers. An attempt has been made to identify associations between attitudes and other variables.

## METHODOLOGY

The study was carried out in Kandy and Nuwara Eliya districts in the Central Province of Sri Lanka. Kandy, a district that traditionally grows Export Agricultural Crops (EAC), shows a high potential for productivity levels for EAC. Kandy is also the major coffee growing district in Sri Lanka with a cultivated extent of 2430 ha (Department of Export Agriculture, 1995). The main EAC in Nuwara Eliya district is also coffee, with a total cultivated extent of 753 ha.

The numbers of Extension Officer ranges (EO ranges) in Kandy and Nuwara Eliya districts are 17 and 6, respectively, representing 3:1 ratio of EO ranges between districts. By maintaining the above ratio six EO ranges from Kandy district and two ranges from Nuwara Eliya district were selected randomly for the study. Alawatugoda, Kundasale, Katugastota, Galagedara, Gampola and Udunuwara EO ranges were included from Kandy district, and Walapane and Kotmale ranges were chosen from Nuwara Eliya district. Hundred and five farmers from Kandy district and 35 farmers from Nuwara Eliya district were randomly selected from the above selected EO ranges. The sample farmers of each district comprised of more or less randomly selected, equal numbers of subsidized and non-subsidized farmers. The subsidy

scheme is the main extension tool for reaching EAC growers by the Department of Export Agriculture (DEA), Sri Lanka.

Attitude has been defined as the degree of positive or negative affect associated with some psychological object (Seneviratne, 1997). In the present study, the psychological object was considered as the messages about management practices of coffee. Three important management practices, namely, fertiliser application, pruning and shade regulation were considered for measurement of attitudes as they were the main influences on coffee yield.

Among the techniques available for construction of scales, Thurstone's equal appearing interval scale and the Likert's summated rating scale are well known (Oppenheim, 1978). While the Thurstone technique makes use of objective judgement in the selection of items, it requires a large number of judges and is time consuming. The Likert technique obviates these difficulties. Reliability of Likert scales tends to be good, partly because of the greater range of answers permitted to respondents, and is often higher than that of corresponding Thurstone scales. Reliability coefficient of 0.85 is often achieved. Likert scales also provide more precise information about the respondent's degree of agreement or disagreement (Oppenheim, 1978). Hence, a five–point Likert scale was selected for the present study.

The objective of the study was to select a set of items in such a manner that the acceptance or rejection of each one will imply a different degree of favourable or unfavourable attitude towards fertiliser application, pruning and shade regulation of coffee. A large number of statements on each aspect of attitudes were collected from relevant literature, experts in the field, technical bulletins, administration reports and research papers published by the DEA. Each statement was studied in relation to the aspect it referred to. The number of statements selected for three management practices were; fertiliser application 31, pruning 33 and shade regulation 31.

The next phase consisted of determining the relevance of a particular statement and eliminating those which did not discriminate well between persons holding different attitudes. For analysis, the items were first administered in random sequence to a random sample of 70 farmers almost similar to the survey group under study. Of them 50 farmers were from Kandy district and the rest from the Nuwara Eliya district. The farmers were requested to give their reactions to each statement on the five rating points namely, strongly agree, agree, undecided, disagree or strongly disagree. If the item was positive (favourable to the subject under study), 'strongly agree' was given the numerical value of 5.0 and 'strongly disagree' was given 1.0. If the

item was negative (favourable to the object under study) 'strongly agree' was given 1.0 and 'strongly disagree' was given 5.0.

An item analysis was performed to decide the best statements for the study. Correlation coefficient for each item was calculated with the total score, and items with the highest correlation were retained.

In measuring adoption levels an innovation was sub–divided into a number of items. The items of the three innovations (fertiliser application, pruning and shade regulation) were selected by consulting various sources as indicated above. Precaution was taken to include every possible item under each agronomic practice concerned. The number of items correctly applied in the farmers' coffee cultivation were recorded.

Each innovation contained eight components; (a) fertiliser application comprised of fertiliser mixture, time of application, area of application, quantity of chemical fertiliser applied, quantity of organic fertiliser applied, thickness of mulch, area of mulching, weed control; (b) pruning consisted of pruning method, pruning height, time of pruning, removal of water shoots, mulching, spacing between horizontal branches, fertiliser application and weed control; and (c) shade regulation included spacing and species for temporary shade, species and spacing for permanent shade, removal of high shade, lopping height, lopping time, frequency of lopping, plant spacing, and the way of utilising lopping materials.

General knowledge on coffee planting, knowledge on the three innovations (fertiliser application, pruning and shade regulation), subsidy scheme, measures related to coffee prices and marketing aspects were considered for knowledge measures. Farmers' overall knowledge of the six knowledge measures was examined by pooling all the knowledge items. Each knowledge measure had a score maximum of 10. Thus possible range of total knowledge is 0–60.

A qualitative estimate was made on the shade condition of the sample lands. The shade was recorded as high, medium and low. In order to eliminate interviewer's bias, enumerators were excluded from the study. Organic matter content of the lands was also observed.

## RESULTS AND DISCUSSION

### Attitudes of the farmers towards the innovations

On the basis of the ratings of group of farmers similar to the survey group, some items were eliminated. Twenty one items which had the highest correlation were retained for each attitude subset as the final instrument. Thus each attitude subset namely fertiliser application, pruning and shade regulation, contained 21 statements.

As the score range given to each statement lies between 1–5, the minimum possible score that each farmer can obtain for the statements is 21 and the maximum possible score would be 105. The scores obtained for fertiliser application are between 44–96 with the mean and standard deviations of 68.5 and 9.6 respectively. In the case of coffee pruning the range declined to 54–97 with a mean of 71.4 and standard deviation of 8.8. The attitudes on shade regulation varied between 55–99 and the mean and the standard deviation were 72 and 8.7 respectively.

The neutral point of the 1–5 continuum can be regarded as 3 and thus the hypothetical neutral score would be 63 for each innovation. The means of all the attitude subsets exceeded 63 indicating attitudes of the farmers towards innovations are mostly positive. Attitude scores, based on the associations, were grouped as low, medium and high representing one third of the sample in each group for analytical purpose.

### Shade condition of the sample lands

A mature coffee cultivation requires 40% of shade for optimum performances. Therefore, in the present study a shade between 35–50% was assumed as optimum, below 35% as low and above 50% as high shade. Frequencies of low, optimum and high were 10 (7.1%), 17 (12.1%) and 113 (80.7%), respectively, in the survey lands. Soils of the lands with high shade contained high organic matter than those with low shade.

#### *Total adoption*

As there are 24 items included in the three innovations a farmer could score a maximum of 24 and minimum of zero. The mean of the frequency distribution is 5.057 and standard deviation is 5.216. Farmers at zero score

level were grouped as non–adopters, within 1–5 score range as low adopters and between 6–30 as high adopters. The frequencies for non–adopters, low–adopters and high–adopters were 31 (22.1%), 55 (39.3%) and 54 (38.6%), respectively.

*Total knowledge*

The mean, median and mode of the frequency distribution of total knowledge are 20.65, 20, 17, respectively, with a standard deviation of 10.53. Farmers within the frequencies between zero and standard deviation was considered as low knowledge group; between standard deviation and mean were categorised into medium knowledge group and the rest were included in the high knowledge category. Frequencies of low, medium and high knowledge categories were 21 (15.0%), 58 (41.4%) and 61 (43.6%), respectively.

**Associations of attitudes on fertiliser application and other variables**

Scores between 44–64, 65–71 and 72–96 were regarded as low, medium and high attitude groups, respectively, for the analysis. Each group consists of one third of the sample. Significant associations were observed with district, source of advice, yield, cultivation age, attitude on shade, total adoption and total knowledge (Table 1).

*Association between attitudes on fertiliser application and the district*

Only 20% of the farmers in Kandy district had high attitudes on fertiliser application on coffee whereas approximately 33% of farmers from Nuwara Eliya district showed high attitudes on the same practice. About 44% of farmers in Kandy and 8.5% from Nuwara Eliya had low attitudes towards fertiliser application.

The significantly low attitudes on fertiliser application may be due to that most cultivations in the Kandy district are home garden type and their soils rich in organic matter. Therefore, farmers do not see the necessity for applying fertiliser. Nuwara Eliya district is a vegetable growing district vulnerable to soil erosion. Therefore, farmers always experience low soil fertility in their soils and resulting in positive attitudes on fertiliser application.

**Table 1. Associations between attitudes on fertiliser application and other variables.**

| Variable | Chi-square | P-value | Degrees of freedom | Level of significance |
|---|---|---|---|---|
| District | 32.82 | 0.0000 | 2 | s |
| Education | 2.05 | 0.3583 | 2 | ns |
| Subsidy scheme | 1.06 | 0.5889 | 2 | ns |
| Source of advice | 9.38 | 0.0092 | 2 | s |
| Cultivation age | 8.76 | 0.0126 | 2 | s |
| Yield | 9.81 | 0.0074 | 2 | s |
| Attitudes on pruning | 8.00 | 0.0914 | 4 | ns |
| Attitudes on shade | 29.94 | 0.0000 | 4 | s |
| Total adoption | 11.75 | 0.0193 | 4 | s |
| Total knowledge | 20.26 | 0.0004 | 4 | s |

*Association between attitudes on fertiliser application and source of advise*

A significant relationship was observed between attitudes on fertiliser application and the source of advice. About 41% of the farmers, who sought advice from EO, had high attitudes on fertiliser application whereas the corresponding figure for the farmers who relied on other sources for advice is about 28%. Only 20% of the former farmers had low attitudes on fertiliser application and nearly half of the sample showed low attitudes on the same practice. These results indicate that EOs have been successful in changing attitudes of their clients towards fertiliser application.

However, in the case of subsidized farmers, a significant association could not be observed between attitudes on fertiliser application and source of advice. The EO is expected to pay more visits to subsidized farmers. Shanker (1990) indicated that cognitive component of the attitude can be changed by intervention. Results of the present study indicate that EO's intervention has not yielded desirable effects on the subsidized farmers. These unexpected results may be due to the inadequate number of visits by EO's to subsidized farmers as the visits of EO to both subsidized and non-subsidized farmers were of equal frequency.

*Association between attitudes on fertiliser application and age of cultivation*

Farmers who owned cultivations more than 15 years old have low attitudes on fertiliser application (42.3%) compared with the new owners of cultivations (23.3%). This can be expected, because most of the old cultivations are Kandyan home garden type and contained more leaf–matter in their soils. Therefore, the necessity for fertiliser does not arise compared to new cultivations.

*Associations of attitudes on fertiliser application with total adoption, total knowledge and crop yield*

Results of this study showed highly significant associations between attitudes, and adoption and knowledge. The favourable attitudes of the farmers on fertiliser application have been reflected through knowledge, adoption of the practice and eventually through yield figures.

About 47% of farmers who bear high attitudes on fertiliser application had a better knowledge on the same innovation. It is interesting to note that none of them were in the low knowledge category. Even though nearly 33% of farmers have low attitudes towards fertiliser application, they have a good knowledge on fertiliser application. This could be due to the higher fertility levels of the cultivated lands of these farmers. As described earlier, fertiliser application seems to be irrelevant to farmers who own Kandyan home gardens as they have sufficient organic matter in their holdings.

Among the high adopters of fertiliser nearly 50% have high attitudes towards it. About 40% of low adopters have low attitudes on fertiliser application. It is also notable that 27.27% farmers have high attitudes towards the innovation though they were low adopters. The reason for low adoption may be lack of finance for purchase of fertiliser or fertiliser scarcity in their locality. Association between attitudes on fertiliser application and yield is highly significant, showing more than half of the high yielding cultivations belonged to the farmers of high attitude bearers on the innovation. Whereas one– third of the low yielding cultivations are owned by farmers belonging to low attitude group. On the other hand slightly more than half the farmers of high attitude group obtained low yield indicating that they did not adopt innovations that contribute towards high yield.

A highly significant relationship was observed between attitudes on fertiliser application and that of shade regulation. About 61% farmers who have high attitudes on fertiliser application also bear high attitudes on shade regulation. Half of the low attitude bearers on fertiliser application also have low attitudes towards shade regulation. However, such association could not be seen between attitudes on fertiliser application and that of coffee pruning.

*Associations among attitudes on pruning and other variables*

Total attitude scores of the respondent for the attitude on coffee pruning varied from 54 (minimum) to 97 (maximum). Low attitude category varied from 54–65, medium category group from 66–74, and the high category group from 75–97. Associations of total attitudes on pruning of coffee and other variables are presented in Table 2.

**Table 2. Associations among attitudes on coffee pruning and other variables**

| Variable | Chi-square | P-value | Degrees of freedom | Level of significance |
|---|---|---|---|---|
| District | 2.81 | 0.2455 | 2 | ns |
| Subsidy scheme | 9.90 | 0.0071 | 2 | s |
| Source of advice | 0.58 | 0.7496 | 2 | ns |
| Cultivation age | 3.33 | 0.1892 | 2 | ns |
| Yield | 6.34 | 0.0420 | 2 | s |
| Attitudes on shade | 33.73 | 0.0000 | 4 | s |
| Total adoption | 16.23 | 0.0027 | 4 | s |
| Total knowledge | 20.29 | 0.0004 | 4 | s |

Highly significant associations of attitudes on pruning of coffee were observed with subsidy scheme, attitudes on shade, total adoption and total knowledge. A significant relationship was also found between pruning and the coffee yield.

*Association between attitudes on pruning and the subsidy scheme*

Approximately 24% subsidized and 47.8% of the non–subsidized farmers have a higher level of attitudes on coffee pruning. Higher level of attitudes can be expected from subsidy farmers, because frequent contacts are expected from EO's with this group of farmers. However, it has been found that extension contacts were inadequate (Seneviratne, 1997). About 88% of subsidized lands are less than 15 years old whereas 66.7% of non–subsidized lands were older than 15 years. New coffee cultivations require relatively less pruning activities compared to older cultivations. The latter needs to be pruned in order to control plant height when harvesting is difficult. Therefore, owners of new coffee cultivations can have low attitudes for pruning since it is less relevant for most of them.

*Association between attitudes on pruning and shade*

A positive relationship was observed between pruning of coffee and shade. About 58% of high attitude bearers on pruning of coffee were also highly in favour of shade regulation whereas 56.8% of low attitude bearers on pruning had low attitudes towards shade regulation. About 81% of the sample lands contained high shade. Coffee grown under high shade is characterised by tall plants which usually need to be pruned in order to control plant height and easy harvesting. On the other hand such pruning is not required when plants grow under low shade conditions, as the plant height is usually low.

*Association of attitudes on pruning with total adoption and knowledge*

Among high adopters nearly half of the farmers bear high attitudes on pruning of coffee whereas among low adopters 40% of farmers have low attitudes on pruning. One–third of the low adopters bear high attitudes on coffee pruning. These farmers may be the ones who received income without pruning their coffee. Approximately half of the farmers who belonged to high knowledge group have high attitudes towards pruning. Although 15% of them have a good knowledge on pruning of coffee, they have low attitudes on the same practice. These farmers can be included in the category of farmers who received income from coffee in the Kandyan home gardens without adopting any innovations. Among the farmers with low knowledge, 57.1% belonged to low attitude group on pruning.

*Associations of attitudes on pruning and coffee yield*

Attitudes on pruning and yield show a significant relationship at 5% probability level. Results indicate that farmers with high attitude on pruning obtained similar proportions of high and low yield. One-fifth of the farmers with low attitudes received higher yields and the remaining 80% obtained low yields.

*Associations among attitudes on shade regulation and other variables*

Total attitude score ranging from 55–67, 68–74 and 75–99 was categorised as low, medium and high, respectively for analytical purpose. The lowest score obtained by the coffee farmers was 55 and the highest was 99. Results of statistical analysis are given in Table 3.

**Table 3. Associations among shade regulation and other variables.**

| Variable | Chi-square | P-value | Degrees of freedom | Level of significance |
|---|---|---|---|---|
| District | 12.52 | 0.0019 | 2 | s |
| Subsidy scheme | 6.92 | 0.0314 | 2 | s |
| Land area | 4.74 | 0.0937 | 2 | ns |
| Source of advice | 5.20 | 0.0743 | 2 | ns |
| Cultivation age | 2.05 | 0.3589 | 2 | ns |
| Yield | 7.52 | 0.0233 | 2 | s |
| Total adoption | 18.42 | 0.0010 | 4 | s |
| Total knowledge | 16.13 | 0.0029 | 4 | s |

Table 3 shows highly significant associations of attitudes on shade regulation with district, total adoption and the total knowledge. Variables such as subsidy scheme and yield also showed significant relationship with attitudes on shade.

*Association between attitudes on shade regulation and district*

About 25% of the farmers in Kandy district and 50% from the Nuwara Eliya district have high attitudes on shade regulation. On the other hand, about 39% of farmers from Kandy and 15% from Nuwara Eliya have low attitudes on the same practice.

Almost all the coffee cultivations of the sample in the Kandy district have high shade, characterising Kandyan home gardens. Farmers received income from coffee without lopping their shade trees. Therefore, these farmers may have negative attitudes on regulating shade. Coffee lands in the Nuwara Eliya district contained relatively low shade and consequently the importance of shade has been recognised by the farmers in the district.

*Association of attitudes on shade with total adoption and knowledge*

Among the high adopters, about 50% have high attitudes and 18.5% have low attitudes on shade. In the case of low adopters, the high and low attitudes bearers are found in equal proportions. Cross tabulation of the total knowledge and attitudes on shade shows that 47.5% farmers in the high knowledge category have high attitudes on shade, however, 18.7% of them have low attitudes on shade. In the low knowledge category, 14.3% have high attitudes towards shade and 61.9% have low attitudes toward this innovation.

*Association of attitudes on shade and subsidy scheme*

Both subsidized and the non–subsidized farmers have high attitudes on shade in same proportion (35%). However, 39.5% of subsidized and 21.7% of the non–subsidized farmers have low attitudes towards shade. About 25.4% of subsidized and 43.5% of non–subsidy farmers have medium attitudes towards the same innovation.

These results show that subsidized farmers have relatively low attitudes on shade. Extension Officers are supposed to make log–book entries when they visit coffee farmers. Reviewing of the log–book entries revealed that none of the EOs of the survey area have entered complete instructions on shade regulation. Incomplete instructions have been given at least on twelve occasions. Same number of occasions of non–entries were also found. These results showed that EOs of the survey areas have failed to convey messages on shade management successfully in order to change the attitudes in favour

of the innovation. Insufficient extension contact may also have contributed to this failure. On the other hand, non–subsidized lands contained high shade affecting coffee yield. Therefore, non–subsidized farmers may have experienced adverse effects on shade and thus developed positive attitudes on the shade regulation.

*Association between attitudes on shade and yield*

High and low attitude farmers obtained high and low yields in equal proportions. Only 18.6% of low attitude farmers received high yields while the rest obtained low yield.

## CONCLUSIONS

The study revealed that farmers' attitudes are associated with their locality. Farmers in Kandy district believe that fertiliser is not required for coffee as their soils are rich with organic matter. The opposite is true for farmers from Nuwara Eliya. It is evident that subsidized farmers do not have significantly higher attitudes on pruning of coffee and shade regulation. As subsidized farmers have relatively new cultivations which do not require much pruning activities, their attitudes on this innovation are lower than the non–subsidized counterparts. Similarly, the farmers who own Kandyan home garden type lands have experienced that their coffee yield has been affected by excessive shade. The subsidy assisted lands are relatively new and have low shade (Seneviratne, 1997). Owners of these lands felt that shade control was not necessary. The high attitude bearers on pruning of coffee were also in favour of shade regulation supports the above findings.

A strong association could be established for the attitudes of all three innovations with total knowledge, total adoption and the coffee yield. Therefore, in order to achieve high yield levels it is important to change farmers' perspectives. This would help to increase their knowledge and adoption of innovations and finally the coffee yield.

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