Assessing the Factors Affecting Labour Productivity of Tea Harvesters in Up Country Tea Plantations in Sri Lanka A Case Study in Nuwara- Eliya District

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ABSTRACT

Recently tea sector in Sri Lanka has experienced diminishing labour-productivity and profit. Improving profitability by increasing the labourers' efficiency is a way to maintain tea productions for long-term sustainability. The objective of the study was to estimate the current level of labour-productivity and to identify the factors affecting labour-productivity of tea harvesters as it brings paramount importance to the tea sector. The primary data were collected by means of a structured questionnaire based personal interviews carried out with 350 individual tea pluckers and secondary data were collected from administrative units from the tea estate located in Nuwara Eliya district in August 2018. As a core part of the study, five different indices were developed namely; household and Housing (HH), Worker Skills Development (WSD), Individuals' Health Level (IHL), Availability of Finance (AF), Working Environment, and Conditions (WEC), which are bound with their livelihood. Quantile Regression was used to assess the differing impacts of these five indices on labour-productivity with respect to three different quantiles (i.e. 25^{th}, 50^{th} and 75^{th}) and the outcome of the analysis suggested that HH and WSD were able to make a significant effect on all three different productivity levels. The contribution of the HH and WSD were higher with the percentage of labour-productivity. IHL and AF indices were significant only in 25% productivity category and WEC index was significant in 75% productivity group. These results claimed that, different productivity levels should be addressed separately to uplift the labour-productivity since their desires are quite different.

KEYWORDS: Labour productivity, Principal component analysis, Quantile regression, Tea industry in Sri Lanka

Introduction

Tea plantations of Ceylon have a glorious and a proud history and they have been the subject of many controversial, vitriolic, and contentious debates right throughout its existence and continue to be so even now. This is because of the vast numbers of people the plantation industry employs, the large extents of land that is under its cultivation and the high value of assets at its disposal that are being utilized by the industry. It is an acknowledged fact that our country's fortunes have always been closely related to the relative performance of the plantation industry, the foundations for the development of

modern Sri Lanka were built on the gains, the infrastructure, and the systems built up by the plantation economy until about the 1980s.

The Tea plantation industry in Sri Lanka is economically, politically and socially a strategic sector in our country's socio-economic and ethno cultural background. For well over 150 years from its inception itself, plantation agriculture has played a prominent role in the economy of Sri Lanka and has been the backbone and the mainstay of the island's economy. The contribution from the tea industry in the total export earnings declined to 14% by 2011 with the consequent accelerated diversification of the economy to many sectors leading to the rapid development of the manufacturing, industrial, and service sectors. (Central Bank of Sri Lanka, 2011).

By 2016, the Tea industry contributed to only 0.7% of the GDP and accounted for only 12.3% of the total export earnings of the country.

The rapid and consistent growth of the other sectors of the economy, with the introduction of open economic policies of the government in the late 1970s', has considerably reduced the comparative and relative importance of the plantation sector, but nevertheless it continues to play a significant and a pivotal role in the socio-economic and ethno cultural fabric of the country.

Sri Lankan tea is considered as the world's premium tea for quality maintenance through a labour intensive practice of selective plucking. Major concerns in the industry are low labor productivity, absenteeism and migration of young workers, particularly due to poor living conditions, low income and a more complete life outside the rural estate sector (Athauda *et al.*, 2012). These challenges are crucial to industry sustainability of the tea industry, because the tea sector relies on inexperienced resident labour, the industry must develop a robust strategy to attract a steady workforce and retain existing residents.

Snodgrass (1998) stated that an increase in the share of economic surplus generated by the plantation sector had been channeled to other sectors of the economy. Although the plantation sector is the oldest industry in the organized manufacturing sector in Sri Lanka, no other industry in the history of our country has been so controversial and at the same time being so significantly important in the immediate post independent years of our country. Nicholas Kaldor (1959) remarked that, Ceylon owes its present prosperity in comparison with other countries in the region, plantation economy and went on to the extent of even suggesting that, it is the further development of the plantation economy which provides the means for rapid increase in Ceylon's national wealth.

Labor productivity is the amount of goods and services that an employee produces in a specific period. It is one of numerous types of productivity that economists measure. Tea sector is a distinctive sector for productivity research by means of labour productivity is readily measurable as work attendance and weight of the green tea leaves plucked by each worker are prudently recorded daily in order to calculate individual wage packets. Thus, the amount of tealeaves plucked is the best productivity variable to be found in the tea industry.

In today's era, one of the biggest concerns for any organization is to improve their productivity, representing the effective and efficient conversion of resources into marketable products and determining business profitability (Wilcox *et al.*, 2000). Consequently, considerable effort has been directed to understand the productivity concept with different approaches taken by researchers, resulting in a wide variety of productivity definitions (Samson and Lema, 2002).

The mechanism to increase labour productivity will eventually increase labour income and reduce immigration. This study is at least partially motivated by the need to maintain high labour productivity in the major tea sector in Sri Lanka. The tea sector is the most important sector in the economy because it creates opportunities in employment. Among the plantation economies, Sri Lanka has the third largest real estate labor force after India and Brazil. Recent research studies place more than 10% of the active work force in the country being engaged in the tea agro industry (Kodithuwakku and Priyanath 2007).

There is no doubt that labour is the most important factor, which affects the productivity of the tea plantations because labour productivity is highly correlated with total productivity. However, the labour productivity recorded in the tea plantations is low when compared with the competitive labour market both at domestic and abroad. It has shrunk dramatically in the past few decades and Sri Lankan estate workers rank at the bottom of international productivity tables.

The industry faces many difficulties with rising cost of production, declining productivity and an acute labor shortage. On average, the cost of production in labour for Sri Lanka is the highest in the world, which is 57%. This has affected the country's competitive position in the global market.

It is important for the companies to assess labor productivity, find factors that cause low labor productivity, identify the labors who perform with low technical efficiency even with sufficient working conditions and to take necessary actions to overcome low labor productivity.

This study is based on data collected from 350 tea-plucker women selected from five divisions of a tea estate in Nuwara Eliya district, which is the largest tea-growing region in Sri Lanka.

The main objective of this research study was to identify the relative importance of factors including health, experience, skills, training, monthly income, working conditions and working environment which affecting the labour productivity on tea harvesting then estimate productivity levels of the tea pluckers. As a result, to identify which factors affect most for the highest, average and lowest productivity levels. This will be helpful for the policy makers in the tea industry sector to detect the areas, which should be more focused when implementing future programs to improve the labour productivity.

Methodology

Theoretical Framework

Major areas that affect for a labours' productivity can be classified into five. 1; Household and Housing (HH), 2; Worker Skills Development (WSD), 3; Individuals' Health Level (IHL), 4; Availability of Finance (AF), 5; Working Environment and Conditions (WEC). Labourers' productivity of tea plantations has a relationship with HH, WSD, IHL, AF and WEC.

Selection of Indicators

From of a comprehensive survey, of literature and several focus group discussions, the study was able to identify 26 indicators (Table 2) under five major areas, which affect for labor productivity. The 26 indicators are: household size, number of children below 12, type of house living in, years lived in the current house, level of education, years of experience as a tea plucker, days attend for work per month, training programs participated, awards received, Body Mass Index (BMI), level of eyesight, level of hearing, pain in neck, pain in shoulder, pain in hip, pain in leg, number of doctor visits per month, hours of sleep, monthly income from the estate, income from other income sources, monthly loan settlement amount and the level of satisfaction about safety of the workplace, hygiene of the workplace, facilities provided by the estate, rules and regulations of the estate, and the relationship with supervisors. These 26 indicators needed to be classified into categories, for that purpose, a Principal Component Analysis was used.

Principal Component Analysis (PCA)

Principal Component Analysis is the general name for a technique, which uses sophisticated underlying mathematical principles to convert a number of possibly correlated variables into a smaller number of variables called Principal Components (Richardson, 2009). The numerical identification of the most important indicators and the analysis of the key components for calculating the overall indices are supported. In particular, principal component technique slices information contained in a set of indicators into several components.

There are linear weight combinations of the initial variables in every component of the Principal Component Analysis. Hence it can be stated as an example for the following equation, for a set of variables, $X_1, \ldots, X_n$, the principal components, $PC_1, \ldots, PC_m$ is,

$$\begin{aligned} PC_1 &= a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n \\ PC_2 &= a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n \\ PC_m &= a_{m1}X_1 + a_{m2}X_2 + \ldots + a_{mn}X_n \end{aligned} \qquad [1]$$

Where, a_{mn} represents the weight for the m^{th} principal component and the n^{th} variable.

The weights for each principal component (PC) are given by the Eigen vectors of the correlation matrix and the variance (λ) for each principal component is given by

the Eigen value of the corresponding Eigen vector (Vyas and Kumaranayake, 2006). The resultant principal components were used to construct five indices.

Index Construction

The five indices were built using equation 2 with the usage of Principal Component Analysis where Eigen values are greater than 1.

$$Ii = \frac{PC_1\lambda_1 + PC_2\lambda_2 + \cdots + PC_n\lambda_n}{\lambda_1 + \lambda_2 + \cdots + \lambda_n} \quad [2]$$

Where,
I_i – Index score for i^{th} tea plucker
PC_1, PC_2, PC_n – Principal Component values
λ_1, λ_2, λ_n – Eigen values

Normalization

It was essential to express all the five indices in a homogeneous and comparable way in a fitting manner. Hence, each index score was expressed as a value between zero and 1 by using equation 03;

$$Index\ value = \frac{Ii - Min}{Max - Min} \quad [3]$$

Where,
I_i – Index score for i^{th} tea plucker
Min – Minimum index score
Max – Maximum index score

To identify which factors affect most for the labourers' productivity levels a Quantile Regression analysis was used.

Quantile Regression

Linear regression analysis focus on the expectation of variable y conditional on the values of a set of variables x. Quantile Regression (QR) extends this approach as allowing to study the conditional distribution of y on x at different locations thus offering a global view on the interrelations between y and x. It can be said that for regression problems, QR is the classical regression what quantiles are to mean in terms of describing locations of a distribution (Davino *et al.*, 2013). A Quantile Regression enables the study of the effect of covariates on different percentiles of productivity. This is important because where a mean regression is conducted; the impact of covariates on the response may be under or overestimated, given that there are different impacts on the high and low productivity. Three quantiles as 25^{th}, 50^{th} and 75^{th} were used and estimated labour productivity.

Collection and Analysis of Data

The complex phenomenon is best suited for many sources of data and methods, because it improves the validity and consistency of the research. As a result, primary and secondary data were obtained.

Since this is an empirical study, a great attempt was made to collect primary data. The original data were collected from the tea pluckers employed in the estates in the Nuwara Eliya district and 350 randomly selected employees employed in the five divisions of the tea plantation were questioned. Stratified random sampling method was used to select the total 350 pluckers from five divisions of the estate as 102, 91, 68, 50 and 39 from each division. Several methods were used to collect primary data, such as detailed face-to-face interviews with employees and participants of the administration, group discussions, and direct observation. Interrogated interviews were supported by a structured questionnaire. Secondary data of the individual pluckers was obtained from records kept by the estate management.

For the PCA, the data set was analyzed using SPSS (version 25) statistical package. KMO (Kaiser-Meyer-Olkin) and Barlett's tests applied to check the adequacy value and the P value. The KMO test is a measurement, which indicates how data are suited for Principal Component Analysis. It was found that the KMO adequacy and P value were 0 and 0.803 respectively. This value showed that the Principal Component Analysis is suitable for this study, because KMO values between 0.8 and 1 indicated that the sample is appropriate for the analysis (Cerny and Kaiser, 1977).

A quantile regression procedure as available in STATA 14, used to assess the differing impacts of the five indices on the labour productivity. Here the labour productivity was taken as the dependent variable and the five indices HH, WSD, IHL, AF, and WEC were taken as independent variables.

Results and Discussion

Descriptive Statistics of the Sample

Descriptive statistics are given in Table 1. The entire sample of the tea pluckers were female. Socio-demographic characteristics revealed that the 42 % of the tea pluckers were between 36-45 age category. More than half, which is 59 % of the sample had 5-6 members as their household size. Thirty seven percent of the sample had 3-4 children below 12 years. About 34 % of the respondents own single line houses. Forty five percent of the respondents had educated up to grade 5. Forty percent of the tea pluckers had 6-15 years of experience. Majority of the respondents, which is 35 %, attend for work 16-18 days per month. Nearly quarter of the sample (27 %) had participated in training programmes, while 18% of the respondents had received the best plucker award, given by the estate. About 73 % of the respondents earn Rs. 10,000-20,000 per month from the estate and 49 % of the respondents have other income sources while 18 % of them earn Rs. 10,000-30,000 from other income sources. Seventy seven percent of the respondents had obtained loans from the estate while 40 % of them pay Rs. 2375 per month as their loan settlement.

Table 1. Descriptive statistics of the sample

Parameter	Category	Percentage
Age (Years)	>25	02
	26-35	24
	36-45	42
	46-55	27
	>55	05
Household Size	<2	02
	3-4	28
	5-6	59
	>6	11
Type of Housing	Single line	34
	Back to back line house	26
	Single house	22
	Temporary house	18
Level of Education	None	4.5
	Up to grade 5	45
	Up to grade 8	41
	Up to O/L	09
	Up to A/L	0.5
Years of experience	<5	08
	6-15	40
	16-25	34
	26-35	14
	>35	04
Number of days attend for work per month	<12	22
	13-15	27
	16-18	35
	19-21	15
	>21	01
Participated in Training	No	73
	Yes	27
Awards received	No	82
	Yes	18
Monthly Salary from Estate (Rs)	<5000	03
	5000-10000	11
	10001-20000	73
	20001-30000	13
Income from other income sources(Rs)	00	51
	<10000	03
	10001-20000	73
	20001-30000	15
Monthly loan settlement amount(Rs)	00	23
	1000	10
	1375	14
	2375	52

Outcome of the Principal Component Analysis

The results of KMO Barletts' reliability test suggested that the reliability of the samples' PCA analysis was 0.803. Since it was greater than 0.8 it claimed the adequacy of the sample to perform a successful PCA. Finally, 12 Principal Components were obtained. The PCA was conducted on the indicators and the principal component values obtained for the 26 indicators under five major indices HH, WSD, IHL, AF, and WEC were indicated in Table 2.

Table 2. Selected indicators for five major productivity intervention areas and component score coefficient matrix for productivity indicators

Productivity Intervention Areas	Indicators	Component 1	Component 2	Component 3	Component 4
HH	Household size	-0.25	0.62	-	-
	Number of Children below 12	-0.48	0.22	-	-
	Type of house living in	-0.05	-0.44	-	-
	Years lived in the current house	0.26	0.43	-	-
WSD	Level of education	0.04	0.59	-	-
	Years of experience as a tea plucker	0.19	-0.43	-	-
	Days attend for work per month	0.49	0.01	-	-
	Training programs participated	0.35	0.42	-	-
	Received the best plucker award	0.45	-0.02	-	-
IHL	BMI (Body Mass Index)	-0.24	-0.24	0.11	0.40
	Level of eyesight	0.06	0.39	0.39	-0.01
	Level of Hearing	-0.19	0.18	0.21	-0.05
	Pain in Neck	0.55	0.03	0.14	-0.05
	Pain in Shoulder	-0.05	-0.68	0.15	0.02
	Pain in Hip	-0.04	0.14	-0.65	-0.02
	Pain in Leg	0.55	0.04	-0.07	0.13
	Number of doctor visits per month	-0.01	0.22	-0.29	0.59
	Hours of sleep	0.17	-0.06	0.14	0.57
AF	Monthly income from the estate	0.67	-0.31	-	-
	Income from other income sources	0.68	0.31	-	-
	Monthly loan settlement amount	0.01	0.88	-	-
WEC	Safety of the workplace	-0.06	0.54	-	-
	Hygiene of the workplace	-0.10	0.56	-	-
	Facilities provided by the estate	0.36	-0.06	-	-
	Rules and regulations of the estate	0.34	-0.05	-	-
	Relationship with the supervisors	0.36	-0.06	-	-

Note: HH - Household and Housing, WSD - Worker Skill Development, IHL – Individuals Health Level, AF – Availability of Finance, WEC - Working Environment and Conditions

Outcome of the Quantile Regression

A Quantile regression carried out for three quantiles as 25th, 50th, 75th quantiles and the results are shown in Table 3.

Variables used as Household and Health, Worker Skills Development were significant and positive across all quantiles and its impact was greater on higher quantiles. For example, an increase in training or education level or the awards given to the labourers would increase the level of labour productivity also the labourers who has higher work attendance have higher productivity than the others.

Individuals Health Level was significant in lower quantiles, but not in highest. The non-significance of Individuals Health in 50th and 75th quantiles indicated lack of health has become a reason for low labour productivity, which indicates if the when other variables kept constant and labourers' health level increased by one unit, of those who perform in low level, their productivity would increase by 0.29 units.

Availability in Finance also significant in lower quantiles not in the highest which proves when other variables were kept constant if the monthly income level increases by one unit, it will increase the productivity of low productive labourers from 0.18 units. These results show that having extra income sources and the fact that not having any monthly loan settlement amount does not affect for the productive labourers at 50th and 75th quantiles.

However, Working Environment and the conditions were only significant for highest productivity levels. Which means the tea pluckers who do not perform well do not consider about the safety, hygiene, facilities provided to them or the rules and regulations of the estate. Highly productive labourers' productivity (75 %) could be increased in further amount (0.16 units) through increasing working conditions, working environment and their relationship with the supervisors.

Table 3. Results of quantile regression

Variables	25th Quantile	50th Quantile	75th Quantile
Household and Housing	0.30	0.32	0.35
(HH)	(3.34)**	(4.08)**	(2.26)**
Worker Skill Development	0.24	0.27	0.31
(WSD)	(2.52)**	(2.11)**	(3.16)**
Individuals Health Level	0.29	0.21	0.07
(IHL)	(2.60)**	(1.40)	(0.78)
Availability of Finance	0.18	0.15	0.10
(AF)	(2.12)**	(1.31)	(1.51)
Working Environment and Conditions	-0.09	0.01	0.16
(WEC)	(-0.85)	(0.10)	(1.83)*
Constant	1.74	1.83	2.23
	(16.63)**	(12.88)**	(26.4)**

*Note: t values are given in parenthesis; *p < 0.1, **p < 0.05*

Figure 1 shows productivity levels according to Household and Housing. When the housing condition increases the 50% productive labourers productivity increase in an increasing rate and their productivity become closer to the productivity level of the 75% productive level.

Figure 2 shows productivity levels according to Worker Skill Development. When laborers are provided with training and awards, to appreciate & motivate the working capacity, their productivity can be further increased and reach the upper level in a slight extent.

Figure 3 shows productivity levels according to Individuals health level. With the health level improvement, productivity of both 25% group and 50% group become closer to the superior productivity level.

Figure 4 shows productivity levels according to availability of finance, and it is numbered and the productivity of 50% reach the 75% level when the availability of finance is increased.

Figure 5 shows productivity levels according to working environment. It shows that 25% productive pluckers do not consider about the working environment and conditions and the 75% pluckers productivity further increased when the working environment and conditions are increased.

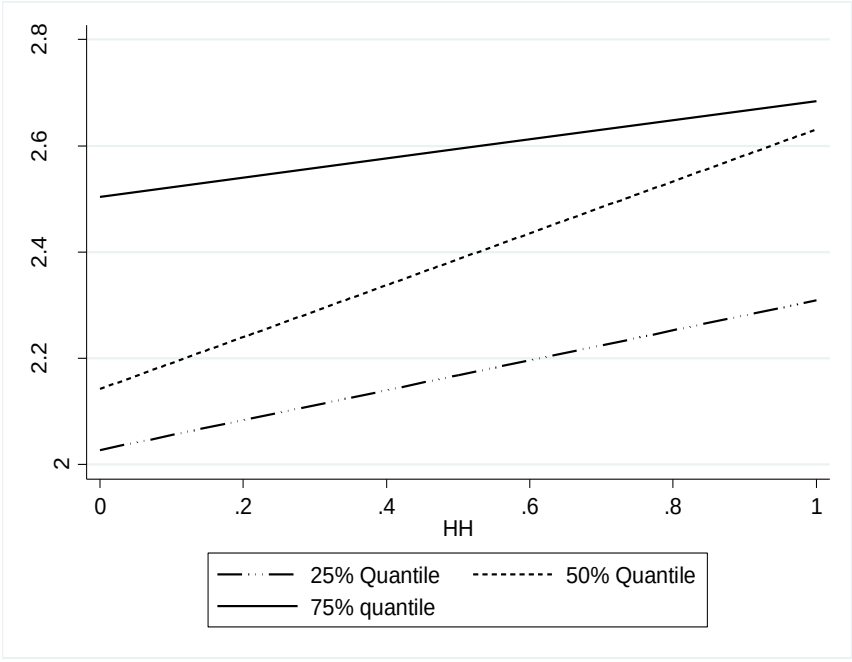

Figure 1: Impact of Labour Productivity with Household and Housing

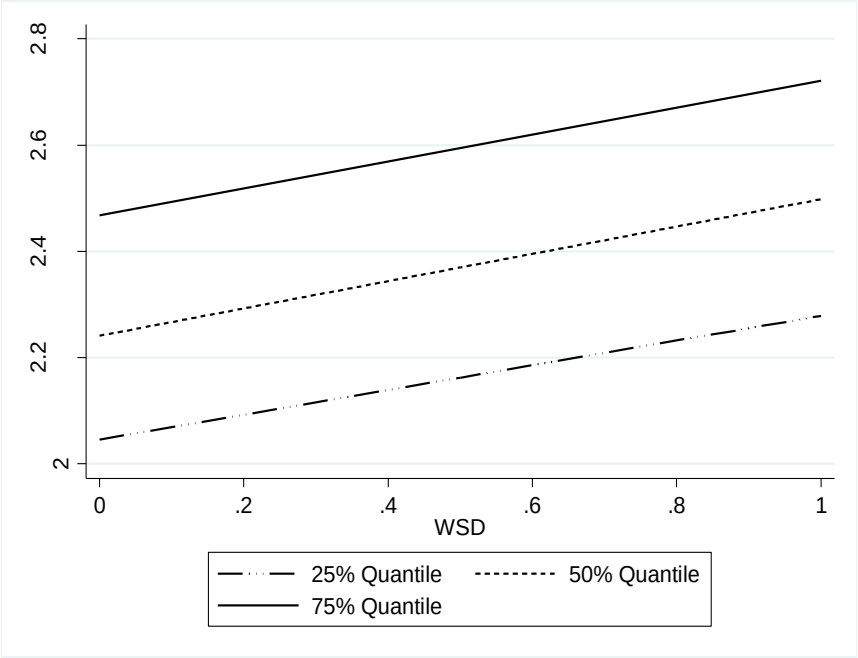

Figure 2: Impact of Labour Productivity with Worker Skill Development

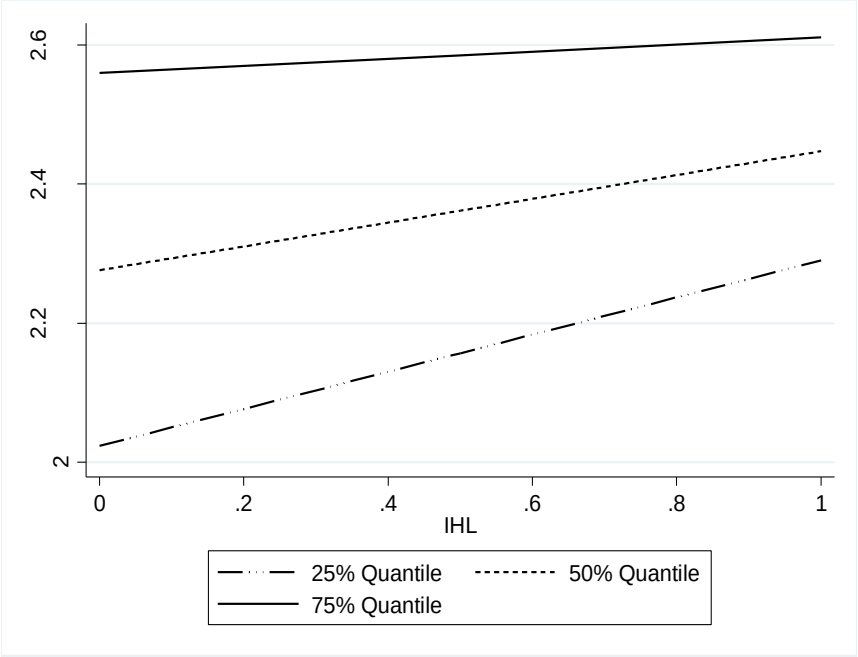

Figure 3: Impact of Labour Productivity with Individuals Health Level

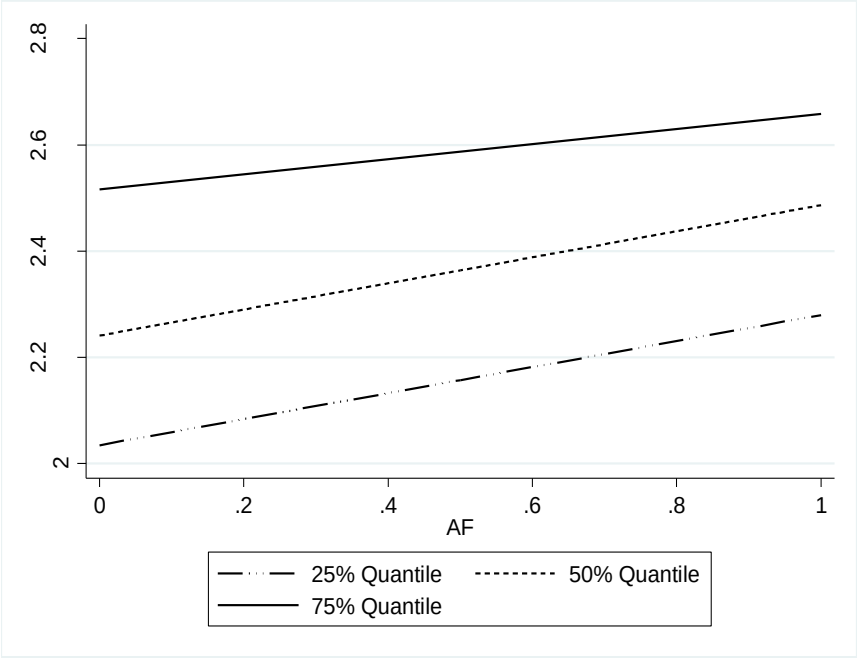

Figure 4: Impact of Labour Productivity with Availability of Finance

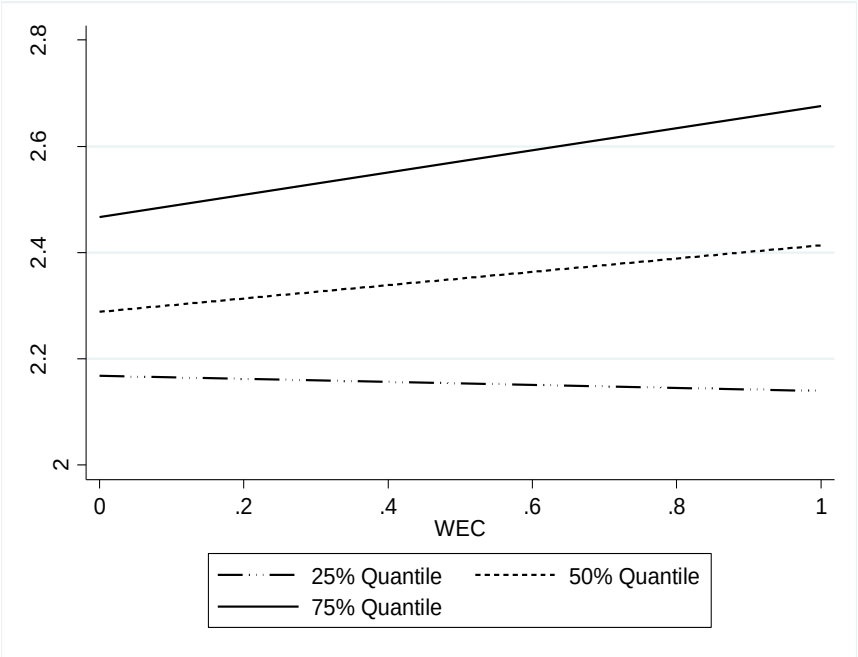

Figure 5: Impact of Labour Productivity with Working Environment and Conditions

Conclusions

Tea pluckers with 25% productivity are more concerned on household and housing conditions, skill development opportunities given by the estate, individuals' health level maintenance by providing medical aids and availability of finance per month. However, their productivity is not affected by working environment and conditions, which mean they do not focus on hygiene, safety or rules and regulations of the estate.

Those with 50% productivity are only concerned on household, housing conditions and skill development prospects therefore their productivity can be further increase by addressing these productivity intervention areas. By uplifting household and housing conditions, worker skill development opportunities and working environment and conditions, 75% productive pluckers efficiency can be further intensified.

Results suggested that the most significant effect was revealed by household and housing condition, as 50% productive pluckers would reach up to the 75% productivity level when they are provided with good household and housing conditions.

In addition, different productivity levels should be addressed to uplift the labour-productivity since their desires are quite different. As a whole, administrative unit of the estate should focus on encouraging labourers' performance by addressing relevant productivity intervention areas as offering an additional payment for the highly productive pluckers, providing training opportunities and encouraging to participate in training programmes, influencing them to obtain medical aids from the estate and to maintain a good health condition etc.

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