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Profitability Level and Determinants of Tea Intercropping in Taraba State

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ABSTRACT

Intercropping involves the cultivation of more than one crop on a plot of land at a particular time. Tea intercropping with other crops can increase the profitability of farmers and the development of tea plants. The study estimated the profitability level of intercropped tea farms and determined the factors affecting the profitability of tea intercropping systems in the study area. Information was obtained from two hundred and four tea farmers using a well-structured questionnaire. The analytical techniques used in the study were descriptive analysis and linear regression. The results revealed that the majority (95.6%) of the farmers are from Kakara and Nyiwa towns. There are few (2.9%) women involved in tea farming in Taraba State. 29% of the tea farmers are young less than 30 years and old above 60 years. Fifteen percent of the farmers are single, 83.8% are married and 1.5% are divorced. About 40% of the tea farmers had no formal education, 21% have between 1-6 years of education, 19% had 7-12 years of education and 21% had greater than 12 years of education. The gross margin is ₦289,900,581.9 and the gross margin per farmer is ₦1,421,081.28. The net income is ₦2,879,055,533.3 and the net income per farmer is ₦1,411,301.63. The amount of profit tea farmers make in Taraba State is ₦1,425,001 and the profit per farmer is ₦6,985.30. Labour costs (weeding, pruning, application of insecticide, watering) and cost of materials (cutlass, file, chemical, bag and others) are significant determinants of the profit level of the tea intercropping system in Taraba State. Tea intercropping farming is profitable in Taraba State Nigeria.

Keywords: Determinants; Intercropping system; Profit; Tea

1. Introduction

Tea (*camellia sinensis*) is cultivated as a cash

crop. The profitability of tea depends on whether the types of tea use cultivated for consumption have the right quality to make it acceptable to the consumers.

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ARTICLE INFO

Received: 4 May 2023 | Revised: 31 May 2023 | Accepted: 7 June 2023 | Published Online: 16 June 2023

DOI: <https://doi.org/10.30564/mmpp.v5i2.5702>

CITATION

Oladokun Yetunde, O.M., Oluyole Kayode, A., 2023. Profitability Level and Determinants of Tea Intercropping in Taraba State. *Macro Management & Public Policies*. 5(2): 45-51. DOI: <https://doi.org/10.30564/mmpp.v5i2.5702>

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As for people that cultivate tea, good quality tea is the one that provides the highest output for maximum profit with minimum cost. From the consumer point of view, good quality tea is one with correct tasting attributes the one that can buy and sell at very high prices. Tea intercropping with other crops can increase the profitability of farmers and the development of tea plants [1-3]. Moreover, it can reduce the cost of fertilizing and weeding [4].

Generally, plantations of tea are handled using monoculture cropping or intercropped with other crops (arable and biennials) and they serve as protection for tea plants. The intercropping system has been a long-time practice in tea plantations in countries abroad such as Indonesia. The obstacle in the intercropping system is the contest for scarce resources among the plants limiting production [5]. The production of tea involves a lot of activities some of which are discussed below:

1.1 Planting material

Tea plantations grown from seed produce heterogenous vegetable material because of the allogamy of the species [6]. The greatest progress has been achieved in a few years with vegetatively propagated clones. Though tea plant is well suited to other vegetative propagation methods such as layering, grafting and root cutting clone production (i.e., vegetatively propagated material from a selected plant) is carried out mainly through propagation by cuttings which is the simplest and most widespread method. The cutting consists of a leaf, a bud and a stem 3-4 cm long. The cuttings are placed in buckets of water and are then transported to the platforms, which are sprayed before planting out [7].

The cuttings are planted out with the stems straight or slightly bending towards the whole mother leaf, so that this does not touch the ground. The stem is held in the upper layer of the substrate, which is made up of subsoil. Tea seeds lose viability fairly rapidly and fresh seeds must therefore be sown immediately after they become available. Seed less than 10 cm in diameter must be rejected. The largest are immersed for one to two hours in order to elim-

inate the floating and semi-floating seeds. They are sown in seed boxes and after germination, the young plants are transferred into polythene bags.

1.2 Land clearance

Land covered by forest should be opened up at least two years before the tea plants are put in and one year before planting on savannah, grassland or land already under cultivation [8]. Land clearance should ensure the removal of all woody materials together with its roots to avoid the spread of root-rot.

1.3 Layout, holing and planting out

Field layout must be done with ranging poles and mark out the stand for each tea stand depending on the spacing to be used [7]. Hole-making takes place after the first rains preferably just before the tea plant are planted. The holes should be 20 cm wide for the stumps and double the width of the ball or pot for the plantlets. The depth of planting of tea should be 30 cm during the beginning of the rainy season preferably it should be done when the weather is overcast and even slightly damp, but planting should be avoided when it is raining heavily [9]. The different spacing types for tea across selected countries in Africa is as revealed in **Table 1**.

Table 1. Different spacing types across selected countries.

Country	Type of row	Spacing (cm)	Density
Malawi	Single	120/60	13888
		120/90	7692
		150/75	8888
		120/90	9259
Burundi	Single	120/80	10400
		130/75	10250
		140/70	10250
		120/60	10200
Cameroon	Single	120/60	13888
*Nigeria	Single	100/61	16393
		122/61	13437
		122/82	9996

Source: TEA The Tropical Agriculturist (CTA 1990).

*Suitable spacings by Cocoa Research Institute of Nigeria (CRIN).

1.4 Pruning

Pruning of tea plantations majorly serves two goals: Firstly, to encourage fresh development, because the tea production regularly declines quantitatively and periodically when pruning is done ^[10]. Secondly, to maintain the required height needed to harvest tea, the shrub needs to be cut to a certain level (cut across pruning).

1.5 Weeding

Weed control is significant to enable easy harvesting of clean produce ^[7]. Manual weeding with holes and only superficial disturbance of the soil to a depth of 2-3 cm. Chemical weeding starts as soon as young plants have sufficient well-established root stems. Hand weeding is costly; it is about one-fifth of the running costs. Hence, the use of herbicides is inevitable. However, the effectiveness of an herbicide depends on its active ingredient and on the way in which the product is applied.

1.6 Fertilization

Fertilizer known for nitrogen that can promote vegetative growth of plants need to be supplied as soon as the main produce from the tea bush is formed. The application of sulphate of ammonia is a recognised practise in many tea growing areas. The rate of fertilizer application should be based on the result of soil analysis. Most macronutrients that are of importance to tea are phosphorus, potassium, magnesium, sulphur, and calcium. The trace elements most important to tea are iron, manganese, boron, copper and zinc ^[11]. Organic manure is also used for tea. This is in the form of green fertilizer or decomposed organic matter. Organic matter restores the fertility of the field, and improves the soil structure (porosity), the layer of humus and the micro fauna.

1.7 Plucking

Plucking is the periodic harvesting by hand or mechanically of the young shoots, which appear above the plucking table ^[12]. These generally consist

of a bud and two or three leaves. This two and a bud method is the model process in many tea-producing regions as it maintains good standards. Plucking could be fine or coarse. The fineness or coarseness of plucking depends upon the number of leaves taken and the time the plant is allowed to grow between plucking rounds. The aim of plucking is to strike a balance between yield and quality.

Tea is an important tree crop for local consumption and export. Planting tea with other crops is of great benefit to tea and tea farmers. This study therefore seeks to provide answers to the following research questions: What is the profitability of tea intercropped farms? What factors influence the profitability level of tea intercropped farms?

This study therefore assessed the profit level and its determinants in tea intercropping production in Taraba State, Nigeria, with these research objectives: Estimate the profitability level of intercropped tea farms; to determine the factors affecting the profitability level of intercropped tea farms in the study area.

2. Empirical review

In Zimbabwe, over the years tea farmers have witnessed a drastic reduction in their production. Most tea farmers have deserted tea production and ventured into her businesses. These farmers have attributed their leaving to viability problems. This study by Dube et al. ^[13] assessed the profitability of tea farmers in Zimbabwe and the factors influencing it. A simple random sampling procedure was used to obtain information from tea farmers using a structured questionnaire. The analytical techniques used were descriptive statistics, gross margin analysis and multiple regression. The average gross margin per hectare in the study area was \$14.50. The lowest gross margin was -286.25 and the highest was 135.35. The determinants of tea farmers' profitability are access to extension, education, labour, tea yield, tea hectarage. Small holder out-grower tea farmers are averagely marginally profitable.

Furthermore, the study by Van Ho et al. ^[14] assessed the profit efficiency of tea production in Vietnam. Stochastic profit frontier function and pro-

pensity score matching were used for analysis. In the study area, the average profit efficiency was 74% indicating that 26% was lost as a result of inefficiency. In the study area, the average profit efficiency was 74% indicating that 26% was lost as a result of inefficiency. In the study tea farmers with big farms, good irrigation, and access to extension services would adopt safe tea practices compared to others. The study recommended that government policies should focus on improving profit efficiency and access to extension services and irrigation systems, and increasing farm size.

3. Methodology

The study area was Taraba State (**Figure 1**), for being mostly a producer of tea. A well-structured questionnaire was used to obtain information from 204 respondents. Most of the respondents in Taraba state are on the mabilla plateau.



Figure 1. Map of Mabilla Plateau, Taraba state Nigeria.

Source: www.bbc.com.

Analysis of the study was done using descriptive statistics and linear regression:

1) In Descriptive analysis means and frequencies were used.

2) Profitability analysis was used to estimate production cost, revenue, and profit generated from tea intercropping system.

The equation used is as shown below:

$$\text{Total Cost (TC)} = \text{Total Fixed Cost (TFC)} + \text{Total Variable Cost (TVC)} \quad (1)$$

$$\text{Gross Revenue (GR)} = \text{Total Output (total number of tons of tea sold)} \times \text{unit price} \quad (2)$$

$$\text{Gross Margin (GM)} = \text{GR} - \text{Total Variable Cost (TVC)} \quad (3)$$

$$\text{Net Income (NI)} = \text{GR} - \text{Total Fixed Cost (TFC)} \quad (4)$$

$$\text{Profit } (\pi) = \text{GR} - \text{Total Cost} \quad (5)$$

A linear regression model was used to analyse objective 2. The implicit model is:

$$Y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} + e_i \quad (6)$$

where: Y = revenue from tea and other crops; e_i = error term; x_i s are labour cost of land clearing, labour cost of planting tea and other crops, labour cost of weeding, labour cost of pruning, labour cost of application of insecticide, labour cost of fertilizer application, labour cost of watering, labour cost of harvesting tea and others, labour cost of others, cost of material (cutlass), cost of material (file), cost of material (plant material of tea seedlings), cost material of fertilizer, cost of material of chemical, cost of material of basket, cost of material of bag and cost of other materials.

4. Results and discussion

In **Table 2** as shown below, the majority (95.6%) of the farmers are from Kakara and Nyiwa towns. There are few (2.9%) women involved in tea farming in Taraba State. 29% of the tea farmers are young less than 30 years and old above 60 years. 15% of the farmers are single, 83.8% are married and 1.5% are divorced. About 40% of the tea farmers had no formal education, 21% have between 1-6 years of education, 19% had 7-12 years of education and 21% had greater than 12 years of education. Education plays a key role in how farmers adopt new technologies to boost their production ^[15].

About 51.5% of the farmers are members of a cooperative society. 91% of the farmers planted between 1-3 species of tea while 9% cultivated ≥ 4 species. The majority of the farmers planted tea with ≤ 2 crops while the others planted more than two crops. Twenty-five percent of the farmers cultivated between 2.1-5 hectares. The mean age of the farms was 22 ± 8 years. The age of farms could adversely affect the yield of crops cultivated on them. Farmers need to adopt new technologies and use fertiliser to boost their production. Also, the mean years of experience was 22 ± 9

years. The experience in tea business has a great role to play in tea production as farmers know the ‘in and out’ of tea production and this could also limit them in adopting new technologies ^[16].

Table 2. Socio economic characteristics of tea farmers in Taraba State.

Variables	Frequency	%
Town		
Kakara and Nyiwa	195	95.6
Others	6	4.4
Gender		
Male	198	97.1
Female	6	2.9
Age		
> 30	33	16.1
31-60	144	70.5
> 60	27	13.4
Marital status		
Single	30	14.7
Married	171	83.8
Divorced	3	1.5
Years of education		
No formal education	81	39.7
1-6	123	20.6
7-12	39	19.1
> 12	42	20.6
Membership of cooperative Society		
Yes	105	51.5
Variety of tea planted		
1-3	186	91.2
≥ 4	18	8.8
Crops planted with tea		
≤ 2	162	79.5
> 2	42	20.5
Size of farm (has)		
≤ 2.0	153	75.0
2.1-5.0	51	25.0
Farm age		
Mean	22 ± 8 years	
Years of experience		
Mean	22 ± 9 years	
N = 204		

Source: Field survey, 2021.

The profitability analysis of tea intercropped

farms is presented in **Table 3**. The total variable cost of tea intercropped farms in Taraba State was ₦1,099,661, while the average total variable cost per farmer was ₦5,390.50. The total fixed cost was ₦3,094,710 while the average fixed cost per farmer was ₦15,170.15. Also, the total cost was ₦4,194,371 and the average total cost per farmer was ₦20,560.64 in **Table 3**. The gross revenue for tea farmers is ₦2,910,000,243.3 and the gross revenue per farmer is ₦1,426,471.78. The gross margin is ₦289,900,581.9 and the gross margin per farmer is ₦1,421,081.28. The net income is ₦2,879,055,533.3 and the net income per farmer is ₦1,411,301.63. The amount of profit tea farmers make in Taraba State is ₦1,425,001 and the profit per farmer is ₦6985.30. Tea farming is profitable in Taraba State Nigeria ^[17].

Table 3. Profitability analysis.

S/N	Item	Amount (Naira)
1	Total Variable cost	1,099,661
2	Average Variable Cost/farmer	5,390.50
3	Total Fixed Cost	3,094,710
4	Average Fixed Cost/farmer	15,170.15
5	Total Cost	4,194,371
6	Average Total Cost/farmer	20,560.64
7	Gross Revenue	2,910,000,243.3
8	Average Gross Revenue/farmer	1,426,471.78
9	Gross Margin	289,900,581.9
10	Gross Margin/farmer	1,421,081.28
11	Net Income	287,905,533.3
12	Net Income/farmer	1,411,301.63
13	Profit	1,425,001
14	Profit/farmer	6,985.30

Source: Field survey, 2021.

Table 4 presented the determinants of the profit level of tea intercropped farms in Taraba State. In **Table 3**, $R^2 = 0.6068$ and F value was 16.89, significant at 1%. Also, labour costs (weeding, pruning, application of insecticide, watering), and cost of materials (cutlass, file, chemical, bag, and others), were all significant at various levels. Labour costs (weeding, others) and cost of materials (file, chemical, bag) has a positive effect on profit inferring their significance in tea intercropped production system. Labour

costs (pruning, application of fertilizer, watering) and cost of materials (cutlass, other materials) were negatively related to profit. The variables mentioned above though negative showed that as the cost of these activities decreases, then the revenue generated increases. The factors that influenced the profitability of subsistence tea production in Zimbabwe were the level of education, labour, yield/hectare and land area and extent of commercialisation^[13].

Table 4. Determinants of profit level of tea intercropping.

Variable	Coefficient	Standard error	T
Labour costs			
Land clearing	-8.31	8.58	-0.97
Planting tea and others	-2.44	2.08	-0.12
Weeding	7.26**	2.91	2.49
Pruning	-1.82***	5.21	-3.49
Application of insecticide	-8.92**	4.02	-2.22
Fertilizer application	3.18	3.39	0.94
Watering	-1.82**	6.49	-2.81
Harvesting tea and others	4.61	9.38	0.49
Other costs	196.4**	9.66	2.03
Cost of materials			
Cutlass	-1.89*	9.80	-1.92
File	6.06***	3.85	15.74
Planting material	-1.20	9.01	-0.13
Fertilizer	7.23	1.28	0.57
Chemical	3.57**	1.86	1.92
Basket	1.76	5.09	0.35
Bag	1.31**	5.92	2.22
Other cost of materials	-1.97***	1.93	-10.21
Constant	2.15***	2.90	7.44
R-squared	0.6068		
Prob > F	0.000		
N	204		

Source: Field survey, 2021 *** P < 0.01 significant at 1%, ** P < 0.05 significant at 5%, * P < 0.1 significant at 10%.

5. Conclusions

The study estimated the profitability level and factors influencing tea intercropping system in Taraba State. The majority of the farmers intercropped with tea between 0 and 2 crops while the others inter-

cropped with more than 2 crops. The total fixed cost is ₦3,094,710 while the average fixed cost per farmer is ₦15,170.15. Also, the total cost was ₦4,194,371 and the average total cost per farmer is ₦20,560.64. The gross revenue for tea farmers is ₦2,910,000,243.3 and the gross revenue per farmer is ₦1,426,471.78. Labour costs (weeding, others) and cost of materials (files, chemicals, bags) are also positively related to profit. Labour costs (pruning, application of fertilizer, watering), and cost of materials (cutlass, other materials) are negatively related to profit. The tea intercropping system is profitable in Taraba State.

Author Contributions

Oladokun Yetunde O.M: Methodology, data analysis, result and discussion.

Oluyole Kayode A: Introduction, empirical review and review of the whole write up before sending it out for publication.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The data used for analysis were primary data collected by the authors. Data can be made available if requested.

Funding

This research received no external funding.

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