

*Original Research Article*

**A Study on the Contribution of *Pipper nigrum* L. to the Livelihoods of the Main Value Chain Actors in Njombe-Penja Sub-Division of the Littoral Region of Cameroon**

**ABSTRACT**

The main objective of this study was to contribute to the sustainable trade of white pepper from the forest area of Njombe-Penja for improved livelihoods of the actors involved in the value chain and poverty reduction. **The author need to identify the main problem/issues of study....**

**The research methodology of study is... (explain the research design, sampling design, instruments, type of data collection, pilot test, reliability & validity)**

To achieve this objective, a market prospection and snowball sampling technique was used to identify the main actors of white pepper in Njombe-Penja sub-division, Mungo Division of the Littoral Region of Cameroon. Data was collected using structured questionnaires and analysed using descriptive and inferential statistics in Statistical Package for Social Sciences (SPSS) version 21.0 and the Microsoft tool (Microsoft Excel 10). The annual profit margins (considering profits from January to December 2022) was calculated for the main actors as well as the contribution of white pepper to their household incomes.

**The result analysis and findings is...**

The results reveal that distributors make the highest annual profit margin (20,250,000 FCFA) followed by wholesalers (2,288,541 FCFA), producers (1,248,692 FCFA) and retailers (305,329 FCFA). According to the sample T test the contribution of white pepper to the total household income was statistically significant for all actors.

**The theoretical and practical implications are...**

**The contribution and recommendations of study are...**

These results suggest that white pepper plays an important economic role in the household economy necessitating the valorization of the Penja white pepper value chain by the government and other development actors.

**Keywords: Value Chain, *Pipper Nigrum* L.,**

## 1.0.INTRODUCTION

The forests of the Congo basin are home to many ecosystems that host a significant biological diversity made up of extremely rich animal and plant species. This plant diversity consists for a large part of non-timber forest products (NTFPs) (Wilkie, 2000). FAO (2003) define NTFPs as products of biological origin other than wood derived from forests and trees outside forests. Non-timber forest products constitute rural industrial raw materials for cottage industries, cultural symbols, ritual artefacts and traditional medicine (Nkwatoh, 2000). These NTFPs play an important role in poverty reduction, sustainable livelihoods, food security, and conservation of natural resources (Mbetid, 2005). In a country where forests cover 39.8% of the land area (FAO, 2015), about 62% of the rural population depends on access to forests to meet daily needs for subsistence, employment and cash income (Tieguhong and Ndoye, 2006). Many Cameroonians, particularly rural inhabitants, depend on NTFPs to provide for subsistence needs and cash income (Ingram, 2014). Markets for non-timber forest products are also significant at the national and international level providing income to the actors directly concerned and the government. At the international level, it is estimated that the annual trade of NTFPs reaches 11 billion US dollars. In Cameroon, it is estimated that the market value of priority NTFPs and special products is € 116.5 million per year, with trade worth € 93.5 million and the value of subsistence consumption worth about € 21.4 million (Eba' a *et al.*, 2013). Cameroon has about 570 plants used as NTFPs (KonziSaramboet *et al.*, 2012). Despite the availability and enormous potential of these NTFPs linked to the diversity of the country's ecosystems, the NTFPs sub-sector remains informal and there is a very low capacity for valorization of some of these plants (KonziSaramboet *et al.*, 2012). Among the non-timbers forests products undervalued is *Piper nigrum* L. locally known as white pepper. White pepper is a spice native to Southwestern India with many properties. The essential oil of white pepper is used in the manufacture of perfumes and also as an alcoholic beverage. Studies have shown that this oil has antibacterial and antifungal properties (Damanhour and Ahmad, 2014). Piperine is used in the flavoring of confectionery and is also an antiseptic in toothpaste. Recent studies on piperine has shown its anti-inflammatory, anticarcinogenic, antioxidant and antimicrobial properties (Nisar Ahmad *et al.*, 2012).

White Pepper is the most widely consumed and traded spice around the world and represents 1/3 of the spice market (Sarma *et al.*, 2010). Currently, the main white pepper producing countries are Vietnam, India, Brazil, Indonesia, Malaysia and China. But it is also produced in African countries such as Cameroon, Madagascar, Kenya, Benin and Zimbabwe (Perrouinet *et al.*, 2014). Global white pepper production has grown over the past 10 years. In 2021, world production was 497,000 tons (IPC, 2022; Faostat, 2022). In Cameroon the production of white pepper increased from 215 tons in 2013 to more than 300 tons in 2015; 60% of this production is consumed locally against 40% intended for export (Petchayo, 2022). Since 2013, Cameroonian white pepper has been one of the most sought-after agricultural products internationally, particularly white pepper that grows in the Penja area. It has an acrid, full-bodied character and unique aroma, all qualities that in 2013 earned it the title of protected geographical indication and recognized under the name of "Penja white pepper" (Petchayo, 2022). Despite the availability and the importance of non-timbers forests products in poverty reduction, sustainable livelihoods, food security, and conservation of

natural resources, the market chain of some product such as white pepper are still poorly understood. Previous studies have been conducted on the medicinal properties (Maryam *et al.*, 2022) and on the value chain (Fonseca *et al.*, 2020) of white pepper in other countries.

However, no study has yet been made on the contribution of white pepper to the livelihoods of the main actors involved in the value chain of white pepper in the forest areas of Njombe- Penja in the Littoral Region of Cameroon. This scarcity of data does not provide a solid base for decision-making at the national level regarding the development of the white pepper value chain in Njombe-Penja sub-division. It is with a view to filling this knowledge gap that the aim of this work was to assess the contribution of white pepper to poverty reduction and the improvement of the living conditions of the actors involved in the value chain of this pepper in Njombe-Penja sub-division. Specifically, the study evaluated the profit margin and the contribution of white pepper to the incomes of the main actors.

## **2.0. THE OBJECTIVES AND QUESTIONS**

### **2.1. Research Objectives**

### **2.2. Research Questions**

### **2.3. Theoretical Framework**

## **3.0. Materials and RESEARCH Methods**

### **3.1. Research Design**

**Which type of research design as applied in this study?**

### **3.2. Research of the Study Site**

The study was conducted in Njombe-Penja sub-division, a locality in the Mounjo Division of the Littoral region of Cameroon. Njombe-Penja sub-division is bounded to the north by Loum sub-division, to the east by Yabassi sub-division, to the south by Mbanga sub-division and to the West by Mombo sub-division (Figure1). According to the delimitation map of the agroecological zones of Cameroon, the Mounjo belongs to zone IV, zone of humid forest with monomodal rainfall. The rains are abundant on average 2500 to 4000 mm. The temperature varies between 22-29°C and the humidity of the air is between 61% to 90% hence the heavy character of the atmosphere. The entire areas have an altitude that varies between 150 m and 600 m with a hot humid climate of the equatorial type. In this area, the soils are volcanic and fertile, eutropic brown, ferralic typical of less evolved type. The Njombe-Penja sub-division area is the main production basin for the famous “Penja white pepper”. The pepper plant finds ideal growing conditions there because of the quality of the soil and the climate (Petchayo, 2022). The Figure 1 below shows the geographical location of Njombe-Penja.

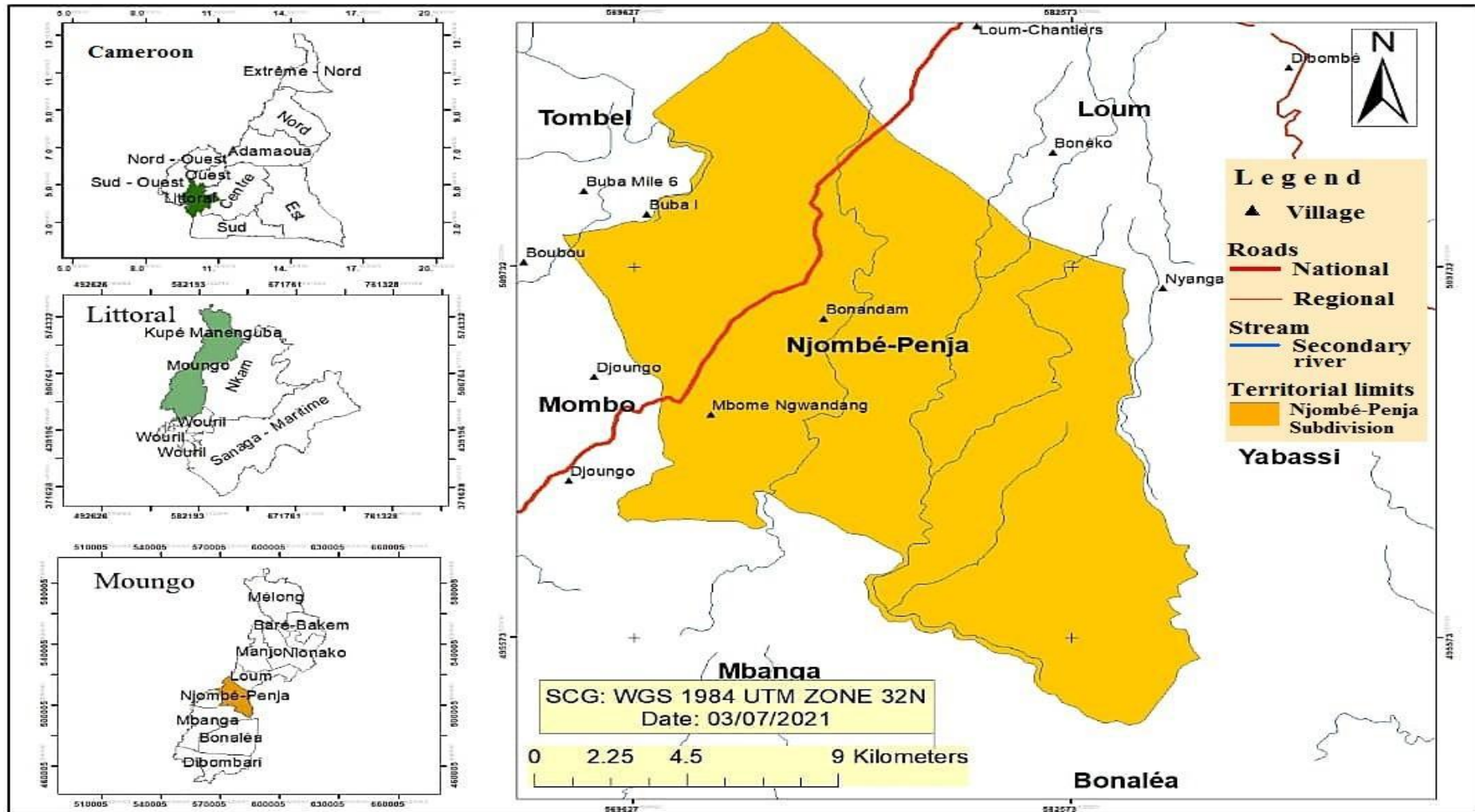


Figure 1: Geographical Location of the Study Area

Source: INC map, (2016)

### 3.3. Population of the study

The study population was made up of both men and women from 25 years to over 60 years, who are the main actors of the white pepper value chain, which include; farmers (producers), distributors; wholesalers (buy'amsellams) and retailers within Njombe, Penja and Douala. A market propection was carried out to identify the population size of the various actors as well as to obtain information from key informants such as the Sub-delegates of the Ministry Agriculture and Rural Development in Njombe-Penja.

### 3.4. Sampling Techniques and Sampling Size

Site selection was made using the purposive sampling technique. This technique was used because Njombe-Penja sub-division has the characteristics sought in this study; it is already known from literature review and key informant interviews that Njombe-Penja sub-division area is the main production basin for white pepper in Cameroon. Penja and Njombe villages were selected based on their importance in terms of production and on their ease of access to markets, as access has been shown to be a factor influencing profits in NTFP marketing and incomes (Ndoye *et al.*, 1997). Type I markets of Njombe and Penja as well as type III Central market of Douala were selected based on their characteristics and importance defined according to Wiersum *et al.* (2014) market typology: small, local markets, close to supply zone (type I), medium-sized markets of regional importance (type II) and large urban markets with national projection (type III). Selection of the respondents was done using snowball sampling technique. To determine the sample size of the population, the Krejcie and Morgan (1970) Table 1 and 2 are used.

**Table 1: Sample Size Determined in the Study**

Item	Population (n)	Sample size (s)	Effective sample size (%)
Producers	1000	278	121 ( )
Distributors	15	14	8 ( )
Wholesalers	90	73	51 ( )
Retailers	400	196	178 ( )
<b>TOTAL</b>	<b>1505</b>	<b>561</b>	<b>358 ( )</b>

*Source:* Krejcie & Morgan Table (1970)

**Table 2: Distribution of Sample Size Within Njombe-Penja Sub-Division and Douala**

Towns	Producer	Distributors	Wholesalers	Retailers	Total
Penja	91	6	28	87	<b>212</b>
Njombe	30	2	11	50	<b>93</b>
Douala	/	/	12	41	<b>53</b>
<b>TOTAL</b>	<b>121</b>	<b>8</b>	<b>51</b>	<b>178</b>	<b>358</b>

Source:

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### 3.5. Data Collection and Types of Data Analysis

#### 3.5.1 Data Collections

Quantitative data was collected face to face through an interview with the respondents using structured questionnaires. Two sets of questionnaires, producers and traders (for distributors, wholesalers and retailers) were designed and administered in the field. The producer and trader's questionnaire collected quantitative data from producers on the profit margins and the contribution of white pepper to harvesters' household incomes. Secondary data was collected from scientific publications, electronic documents (internet), books, journals and documents in some institutions like the Sub-Divisional Delegation of Agriculture and Rural Development of Njombe-Penja. **The interview or questionnaire will be conduct from which time/duration of period?**

#### 3.5.2 Data Analysis

The data obtained was analysed using the Statistical Package for Social Sciences (SPSS) version 21.0 and the Microsoft tool (Microsoft Excel, Microsoft Word 10). Quantitative data collected from the survey was processed and calculated using standard mathematical formula for the mean of grouped data as well as measuring cost, revenue, and the net profit are as follows:

$$\text{Mean} = \frac{\sum xf}{\sum f} \dots\dots\dots \text{equation 1}$$

Where:

$x$  = Midpoint,

$\square$  = Frequency,

$\sum \square$  = Sum of frequencies,

$\sum(\square * x)$  = sum of frequencies and midpoint

$$\text{Net Profit or income (NP)} = \text{Revenue (Net Sales)} - \text{Total cost and expenses} \dots\dots \text{equation 2}$$

Where; Revenue = Total cost of goods sold and

$$\text{Expenses} = \text{Total cost of goods bought} + \text{transport} + \text{tax} + \text{labour} + \text{other} \dots\dots\dots \text{equation 3}$$

The Gross Marketing Margin (GMM) and the Net Profit Margin (NPM) will be estimated using the following formulas (Hussain *et al.*, 2013);

$$\text{GMM} = P_s - P_b \dots\dots\dots \text{equation 4}$$

Where:  $P_s$  represents the selling price

$P_b$  represents the buying price.

$$\text{NPM} = \text{GMM} - \text{TMC} \dots \dots \dots \text{equation 5}$$

Where: NPM represents the net profit margin  
 GMM represents that gross marketing margin  
 TMC represents the total marketing cost.

$$\text{Contribution to households} = \text{profits} / (\text{total income}) * 100 \dots \dots \dots \text{Equation 6}$$

An inferential statistical test (One Sample T test) was used to determine if the contribution of white pepper to the incomes of the actors within the study area is statistically significant.

#### 4.0. RESEARCH RESULTS AND FINDINGS

##### 4.1. Profit Margin and Contribution of White Pepper to the Incomes of Main Actors

###### 4.1.1. Producers

The result from Table 3 revealed that the average quantity harvested per farmers was 293kg. Averagely, each farmer harvesting white pepper makes an average of 2,018,595FCFA annually from the sale of white pepper. For the producers of white pepper, the cost associated with its production is enormous and comes in the form of expenditures on farm inputs, transportation and hired labour. The total average cost of production stands at 769,879.1FCFA. On average each producer of white pepper makes a profit of 1,248,692 FCFA annually and a profit of 4262 FCFA per kg from the sale of white pepper.

**Table 3: Net Profit of White Pepper Sold, and the Total Quantity Sold by Farmers in Njombe-Penja from January to December 2022**

<b>Item</b>	<b>Mean unit selling prize per kg FCFA</b>	<b>Mean annual quantity sold in kg</b>	<b>Mean revenue (net sales) FCFA</b>	<b>Mean expenses on farm inputs and others FCFA</b>	<b>Mean annual profit FCFA</b>	<b>Mean profit margin per kg FCFA</b>
Producers	6890	293	2,018,595	769,903	1,248,692	4,262

**Source:**

As indicated on the Table 4, producers make income from other sources at different rates, on average, producers make 1,822,115 FCFA from other income sources. Adding to the profit made from the sale of white pepper, average total income of producers of white pepper is 3,070,807 FCFA. The results in table 4 revealed that white pepper business contributes 40.7%

to the overall income of producers in Njombe-Penja from January to December 2022. To evaluate the importance of white pepper contribution on producer's households, the sample T test was used to test the significance of the contribution of white pepper with respect to the income from other sources. For producers, the contribution of white pepper to producer's total household income was found to be statistically significant ( $p < 0,05$ ).

**Table 4: Contribution of White Pepper to the Income of Farmers in Njombe-Penja and One-Sample Test for Producers**

<b>Item</b>	<b>Mean annual profit from white pepper FCFA</b>	<b>Annual income from other activities FCFA</b>	<b>Contribution of white pepper to HH income</b>	<b>T-value</b>	<b>d.o.f</b>	<b>Sig. (2-tailed)</b>
Producers	1,248,692	1,822,115	<b>40.7%</b>	14.306	103	0.000

**Source:**

#### 4.1.2. Distributors

Table 5 indicates that, the average quantity sold annually per distributors was 30,000 kg. Averagely, each distributor makes an average of 225,000,000 FCFA annually from the sale of white pepper. For the distributors of white pepper, the cost associated with the business is enormous and comes in the form of expenditures on yearly cost to purchase white pepper, transportation, rent and hired labour. The total average cost stands at 204,750,000 FCFA. On average each distributors of white pepper makes a profit of 20,250,000 FCFA annually and a profit of 675FCFA per kg from the sale of white pepper.

**Table 5: The Annual Net Profit of White Pepper and the Total Quantity Sold by Distributors in Njombe-Penja from January to December 2022 in FCFA**

<b>Indicators</b>	<b>Value (FCFA)</b>
Mean unit selling prize per kg	7,500
Mean unit buying prize per kg	6,667
Mean annual quantity in kg	30,000
Mean revenue (net sales)	225,000,000
Mean annual cost for buying white pepper	200,000,000
Mean annual cost on transport, labor and others	4,750,000
Mean annual total cost and expenses	204,750,000
Mean annual net profit or income	20,250,000
Mean annual net profit or income per kg	675

**Source:**

As indicated on the Table 6, distributors make income from other sources at different rates on average, distributors make 11,000,000 FCFA from other income sources. Adding to the profit made from the sale of white pepper, average total income of distributors of white pepper is 31,250,000 FCFA. The results in Table 6 revealed that white pepper business contributes 64.8% to the overall income of distributors in Njombe-Penja from January to December 2022. To evaluate the importance of white pepper contribution on distributors households, the sample T test was used to test the significance of the contribution of white pepper with respect to the income from other sources. For distributors, the contribution of white pepper to their total household income was found to be statistically significant ( $p < 0,05$ ).

**Table 6: Contribution of White Pepper to the Income of Distributors in Njombe-Penja and One-Sample Test for Distributors**

Item	Mean annual profit from white pepper FCFA	Annual income from other activities FCFA	Contribution of white pepper to HH income	T-value	d.o.f	Sig. (2-tailed)
Distributors	20,250,000	11,000,000	64.8%	-3.776	4???	0.019

**Source:**

#### 4.1.3. Wholesalers

Table 7 indicates that, the average quantity sold annually per wholesalers was 3,600 kg. Averagely, each wholesaler makes an average of 27,000,000 FCFA annually from the sale of white pepper. For the wholesalers of white pepper, the cost associated with the business is enormous and comes in the form of expenditures on yearly cost to purchase white pepper, transportation, and hired labour. The total average cost stands at 24,711,459 FCFA. On average each wholesaler of white pepper makes a profit of 2,288,541 FCFA annually and a profit of 625 FCFA per kg from the sale of white pepper.

**Table 7: The Annual Net Profit of White Pepper and the Total Quantity Sold by Wholesalers from January to December 2022 in FCFA**

Indicators	Value FCFA
Mean unit selling prize per kg	7,500
Mean unit buying prize per kg	6,600
Mean annual quantity in kg	3,600
Mean revenue (net sales)	27,000,000
Mean annual cost for buying white pepper	23,760,000
Mean annual cost on transport, labor and others	951,459
Mean annual total cost and expenses	24,711,459
Mean annual net profit or income	2,288,541
Mean annual net profit or income per kg	625

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**Source:**

As indicated on the Table8, wholesalers make income from other sources at different rates on average, wholesalers make 1,534,313 FCFA from other income sources. Adding to the profit made from the sale of white pepper, average total income of wholesalers of white pepper is 3,822,854 FCFA. The results in Table 8 revealed that white pepper business contributed 60% to the overall income of wholesalers from January to December 2022. To evaluate the importance of white pepper contribution on wholesalers' households, the sample T test was used to test the significance of the contribution of white pepper with respect to the income from other sources. For wholesalers, the contribution of white pepper to their total household income was found to be statistically significant ( $p < 0,05$ ).

**Table 8: Contribution of White Pepper to the Income of Wholesalers and One-Sample Test for Wholesalers**

Item	Mean annual profit from white pepper FCFA	Annual income from other activities FCFA	Contribution of white pepper to HH income	T-value	d.o.f	Sig. (2-tailed)
wholesalers	2,288,541	1,534,313	60%	-89.065	50	0.000

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**Source:**

#### 4.1.4. Retailers

Table 9 indicates that, the average quantity sold annually per retailers was 184 kg. Averagely, each retailer makes an average of 1,659,259.3 FCFA annually from the sale of white pepper. For the retailers of white pepper, the cost associated with the business is enormous and comes in the form of expenditures on yearly cost to purchase white pepper, transportation, expensive packaging and hired labour. The total average cost stands at 1,353,930 FCFA. On average each retailer of white pepper makes a profit of 305,329 FCFA annually and a profit of 1659 FCFA per kg from the sale of white pepper.

**Table 9: The Annual Net Profit of White Pepper and the Total Quantity Sold by Retailers from January to December 2022 in FCFA**

Indicators	Value FCFA
Mean unit selling prize per kg	9,020
Mean unit buying prize per kg	725
Mean annual quantity in kg	184
Mean revenue (net sales)	1,659,259.3
Mean annual cost for buying white pepper	1,237,069
Mean annual cost on transport, labor and others	116,861

<b>Mean annual total cost and expenses</b>	1,353,930
<b>Mean annual net profit or income</b>	305,329
<b>Mean annual net profit or income per kg</b>	1,659

**Source:**

As indicated on the Table 10, retailers make income from other at different rates on average, retailers make 520,000 FCFA from other income sources. Adding to the profit made from the sale of white pepper, average total income of retailer of white pepper is 825,329 FCFA. The results in Table 10 revealed that white pepper business contributes 37.5% to the overall income of retailers from January to December 2022. To evaluate importance of white pepper contribution on retailers' households, the sample T test was used to test the significance of the contribution of white pepper with respect to the income from other sources. For retailers, the contribution of white pepper to their total household income was found to be statistically significant ( $p < 0,05$ ).

**Table 10: Contribution of White Pepper to the Income of Retailers and One-Sample Test for Retailers**

<b>Item</b>	<b>Mean annual profit from white pepper FCFA</b>	<b>Annual income from other activities FCFA</b>	<b>Contribution of white pepper to HH income</b>	<b>T-value</b>	<b>d.o.f</b>	<b>Sig. (2-tailed)</b>
Retailers	305,329	520,000	37.5%	12.498	129	0.000

**Source:**

## **5.0. CONCLUSION AND DISCUSSION**

### **5.1. Profit Margin and Contribution of White Pepper to the Incomes of Main Actors**

#### **5.1.1. Producers**

The profit margins are important in any trade because when they are favorable, they serve as a strong incentive for participants to stay in the business. The study revealed that, 293kg of white pepper was sold constituting an annual profit margin of 1,248,692 FCFA for the producers. The annual profit margin of white pepper for producers in Njombe-Penja sub-division was observed to be less than the profit margin of *Ricinodendronheudoloti* harvested in the entire south west region from 2013-2015 and estimated at 21,949,705 FCFA (Ndumbeet *al.*, 2018). It should however be noted that the profit margin of *Ricinodendronheudoloti* for producers was calculated for the entire south west region from 2013 to 2015 while our study focused only on Njombe-Penja sub-division and for one year. In the present study, the producers had a high profit margin of 4262 FCFA per kg. High profit margins were obtained for traded NTFP in similar studies in Uganda (Barirega *et al.*, 2012; Tegumeet *al.*, 2016)

which indicated minimal exploitation of primary producers by middlemen. The current finding contradicts the general belief that final sellers exploit producers (Tegume *et al.*, 2019). In the current study, several producers sold their products directly to consumers thus they receive maximum benefits. A large proportion of rural population earn their livelihoods from the collection or extraction and sales of NTFPs thereby improving the quality of life and standard of rural population living around forestlands (Aiyeloja *et al.*, 2012). The results revealed that the contribution of white pepper to the overall income of white pepper producers was significant. White pepper business contributed 40.7% to the overall income of producers in Njombe-Penja from January to December 2022. Similar results were obtained by Demie, (2019) and suggests that NTFPs contribute significantly to household income and thus can act as a safety net during the period of hardship and other emergencies. This finding also implies that NTFPs constitutes an important component of the rural households' economy. A study made by Melaku *et al.* (2014) in Bonga forest area, Southwestern Ethiopia estimated that NTFPs income is the second most important source of household income, contributing about 47% of the total household income. This finding also agrees with studies conducted in Kano, Nigeria by Suleiman *et al.* (2017) where NTFPs contributing about 30% of the total annual household income as compared to crop production.

### **5.1.2. Traders**

Traders profit margins vary depending on the type of trader. In the present study, retailers had the smallest annual profit margin (305,329 FCFA), followed by wholesalers (2,288,541 FCFA). Distributors had the highest annual profit margin of 20,250,000 FCFA. These results corroborate those of Dembele *et al.* (2019) and can be explained by the fact that distributors and wholesalers buy very large quantities of white pepper and stock them in order to make them available even during periods of shortage. Unlike retailers who buy small quantities thus justifying their low annual profit margin. The results revealed that, the marketing of white pepper has contributed significantly to the overall household income for all traders (distributors, wholesalers, retailers), contributing more than 50% (for distributors and wholesalers) of the total annual household income. White pepper income was the most viable first source of income of all the respondents because alternative options were few or even absent. Similar result was obtained by Peerzada *et al.* (2022) who found that NTFP contribute for 53,33% of the total annual household income of traders. The marketing of NTFPs generates substantial income and occupy an important place in the household economy (Peerzada *et al.*, 2022).

### **5.3. Conclusion**

The study revealed that white pepper from Njombe-Penja Cameroon is a valuable non-timber forest product that contributes significantly to the livelihoods of the main actors involved in the value chain. The study showed that the distribution of profit margins among the actors is uneven, with distributors earning the highest annual profit margin, followed by wholesalers, producers and retailers. The study also found that the contribution of white pepper to the total household income was statistically significant for all of the actors, meaning

that white pepper is an important source of income for them. In order to improve the profitability and sustainability of the white pepper value chain in Njombe-Penja, there is a need to enhance the capacity and bargaining power of the producers, who are the most vulnerable and marginalized actors in the chain. This could be done by providing them with access to quality inputs, extension services, credit facilities, market information and collective action platforms. To increase the competitiveness and quality of the white pepper from Njombe-Penja Cameroon, there is a need to adopt and enforce standards and certifications that comply with the requirements of the domestic and international markets. This could be done by strengthening the regulatory and institutional framework, promoting good agricultural practices, enhancing traceability and quality control systems and facilitating the participation of the actors in the certification schemes. To diversify and expand the market opportunities for the white pepper from Njombe-Penja Cameroon, there is a need to explore and develop new market segments and niches that can offer higher prices and value addition for the product. This could be done by conducting market research, developing branding and marketing strategies, establishing linkages and partnerships with potential buyers and supporting product innovation and differentiation.

(Note : The conclusion must be aligned with research objectives and the research findings)

## 6.0. RECOMMENDATIONS

### 6.1. Recommendation to the study

### 6.2. Recommendation to the future researchers

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