

## **Impact of mechanization of cassava and yam chip processing on households' livelihoods in West Africa: A gender approach in Benin and Togo**

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### **Abstract**

With regards to the importance of roots and tubers for the food of the African populations. The promotion of processing end post-harvest can contribute substantially to the improvement of safety and food. This paper analyzes the impact of mechanization of cassava and yam chips processing in Benin and Togo with a reference to gender. A sample of 216 processors is selected across cassava and yam chips processing zones. Gini coefficients and Lorenz curves were used to assess inequalities in chips revenue distribution among adopters and non-adopters, women and men. Results show that cassava and yam chips processing activities contribute up to 31 % to total agricultural income of processors, particularly 33 % for women processors. Only thirty one percent (31 %) of cassava and yam chips produced are sold, the remain is consumed at household level. The adoption of improved processing technologies reduces inequality in income distribution among processors. There is a significant difference between income for women adopters and non-adopters. Access to information, membership of processors' group and agroecological zone affect significantly the adoption of cassava and yam chips improved processing technologies.

**Keywords:** Adoption, cassava and yam chips, inequality, processing technology, revenue.

## **Impact de la mécanisation de la transformation des tubercules d'igname et de racines de manioc en cossettes sur les moyens d'existence durables des ménages en Afrique de l'ouest : cas du Bénin et du Togo**

### **Résumé**

L'importance des racines et tubercules dans la nourriture des populations africaines n'est plus à démontrer. La promotion de la mécanisation de la transformation des tubercules d'igname et racines de manioc en cossettes contribue sensiblement à l'amélioration de la sécurité alimentaire et de la réduction de la pauvreté. Cet article, analyse l'impact de la mécanisation de la fabrication des cossettes de manioc et d'igname au Bénin et au Togo avec une référence au genre. Un échantillon de 216 transformateurs des tubercules d'igname et de racine de manioc en cossettes est choisi à travers des zones de transformation. Les coefficients de Gini et les courbes de Lorenz ont été utilisés pour évaluer les inégalités dans la distribution des revenus de cossettes parmi les adoptants et les non-adoptants, les femmes et les hommes. Les résultats montrent que les cossettes de manioc et d'igname contribuent jusqu'à 31 % au revenu agricole total des transformateurs, en particulier 33 % pour les formatrices. Seulement trente un pour cent (31 %) de cossettes de manioc et d'igname produits sont vendus, le reste est autoconsommé au niveau du ménage. L'adoption des technologies améliorées de transformation réduit l'inégalité de répartition du revenu des transformateurs. Il y a une différence significative entre le revenu des femmes adoptants et non-adoptants. L'accès à l'information, l'appartenance à un groupement et la zone agro écologique affectent de manière significative l'adoption des technologies améliorées de transformation de manioc et d'igname en cossettes.

**Mots clés :** Adoption, cossettes de manioc et d'igname, inégalité, technologies de transformation, revenu

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## Introduction

Poverty can be reduced through the increase in production and value added through processing of roots and tubers and mainly cassava and yam. The promotion of cassava and yam processing and post harvest technologies enhance food safety and generate substantial incomes for effective demand of food, goods and services aimed to reduce poverty. Cassava for example, produces more calories per unit of area cropped than the majority of food crops, and at a lower per unit cost than cereals (A. Bell *et al.*, 2000). The farmers who produce roots and tubers can generate significant incomes with access urban markets. The African production of yam and cassava was on average, approximately 37,5 million tons/year for the yam and 103 million tons/year for the cassava over the period 2000-2005, (FAO, 2006). The average production of yam in Benin and Togo is estimated to be 2 million and 0,6 million tons/year respectively and that of cassava up to 3 million and 0,7 million tons/year respectively (FAO, 2006). The development of the production of roots and tubers is highly dependent upon processing and diversification of products available for an increasingly urban demand and income. Many current processed products available in West African urban and rural markets are cassava-based. The promotion of the processing is needed for increased productivity and value added. Processed and diversified roots and tubers products contribute directly to poverty reduction of rural and urban populations through easy access, choices and lower prices. In Africa, most of the processing of food products is carried out by women on top of

**Table 1. Sampling framework and units**

Country	Geographical Areas	District	Village
Benin	North	Tchaourou	Tekparou, Mallété
	Central	Glazoué	Ouédèmè, Sowé
	South	Kétou	Adakplamé, Efehoutè
Togo	"Plateau and central regions "	Elavagnon Soutouboua	Issati, Morétan Nima/Bouronda

### Data collection

Phase 1: Secondary data have been collected from Universities, International Institute of Tropical Agriculture (IITA), Ministries of Agriculture livestock and fisheries (MAEP), National Institute of agricultural Research of Benin and Togo and Development projects.

Phase 2: The data are collected from farm and processors perceptions surveys on cassava and yam processing and income generation.

time consuming crop production. Processing and value adding also decrease women vulnerability to risks of malnutrition and increase their incomes. More than 90 % of food processing and manufacturing, 80 % of the storage practices and transport at short distance and 60 % of work related to harvest and marketing are ensured by the women (Bell *et al.*, 2000).

The purpose of the study is to analyze the contribution of cassava and yam chip production and marketing on food security and women incomes to reduce poverty specifically. It assesses the main factors affecting the adoption and women willingness to adopt cassava and yam chip processing technologies and evaluates ex ante cost and benefits of different cassava and yam chip processing systems developed. It analyzes also the effects of women's access to cassava and yam chip improved processing technologies and related incomes.

## Methodology

### Study area

The study was conducted in cassava and yam chip processing zones of Benin and Togo. Two zones are mainly considered: Cassava-based zone and the yam based zone (see the zones' delimitation in annexes). The mean rainfall is generally about 800 mm and a temperature varying from 20 °C to 32 °C.

### Criteria of sites selection

Sampling of cassava and yam chip production level, introduction and diffusion of new technologies for processing into chips in Benin and Togo.

Data have been collected on various technologies including the traditional systems of processing, though structured and semi-structured questionnaires and check lists.

Phase 3: A participatory observation is carried-out with processors to understand issues and factors affecting decision making.

The following types of data are collected: socio-demographic characteristics of stakeholders involved in the processing of cassava and yam chips; current technologies

(local and introduced technologies), processes/systems of cassava and yam, constraints and opportunities related to the processing of cassava and yam, perceptions of processors on various introduced technologies, allocation of incomes to household expenditures.

**Analyses**

**Adoption Modeling**

Descriptive statistics are used to analyze initial trends of the data collected. The Econometric (Logit) model is used to determine the factors that affect the adoption and the willingness to adopt improved cassava and yam chips processing technologies. Logit is a qualitative choice model suitable for assessing factors affecting adoption and diffusion of technologies. It evaluates the patterns of technology adoption. Many studies have used Logit modeling (Adesina & Sirajo, 1995; Adesina *et al.*, 2000) to analyze effects of factors like agro-ecological and socio-

**Table 2. Variable description**

Variables	Description	Predicted sign
ZONAGRO	Agroecological zone: 1= yam-based zone , 0= cassava-based zone	+/-
EDUCATION	Level of instruction : at least 6 years of formal school, 0= any education in formal school	+
GENDER	0= man, 1= woman	-
APGROUP	Membership to peasant group: 1=yes, 0=no	+
ACREDIT	Access to credit: 1=yes, 0=no	+
Other Income	Implication in other activities: 1= yes, 0=no	+
CONTACT	Access to information: 1=yes, 0=no	+
COSSEXP	Experience in chips processing activities (number of years)	+/-
SALE	Sale of cassava and yam chips: by volume=1: by kilograms=0	-
Aver. Income	Income from chips processing: 1 if > \$100; 0 if < \$100.	+/-

**Distributive analysis tools**

**Gini coefficient**

The Gini coefficient is a common indicator used in income distribution analysis.

This coefficient varies from 0 to 1. It takes a value of 0 when the distribution is completely unequal and 1 when the distribution is totally equal.

According to Atkinson (1970) cited by Adégbidi (1999) and Nouhoeflin (2001), the generalized Gini coefficient noted  $I_p$  can be written as follows:

$$I_p = \frac{\mu - \xi_p}{\mu} \quad (1) \text{ such as:}$$

$$\xi = \sum_{h=1}^H \left[ \frac{(V_h)^\rho - (V_{h+1})^\rho}{[V_1]^\rho} \right] Y_h \quad (2) \text{ and}$$

economic characteristics, demand characteristics of new technologies on the likelihood of adoption of these technologies. The decision of adopting cassava and yam chips processing technologies depends upon the farmers' socio-economic attributes, agro-ecological factors, and is defined as:

The conceptual model is given as:

$$P(Y_i = 1) = e^{(\alpha + X_i \beta)} / (1 + e^{(\alpha + X_i \beta)})$$

Where  $Y_i$  is the dependent variable that takes the value of 1 for the  $i^{th}$  farmer adopting the processing technology,  $P$  the probability of adoption by a farmer,  $\beta_i$  is a vector of parameters to be estimated  $X_i$  are explanatory variables related to the adoption of cassava and yam chips processing technologies and  $e$  the exponential function for logistic functional form.

The following table describes the dependent and independent variables used in the Logit model with their predicted signs.

$$V_h = \sum_{i=1}^H w_h \quad (3), \text{ where:}$$

$\mu$  indicates the mean of revenue-consumption,  $w_h$  the size of the household and  $Y_h$  the level of revenue or of consumption of the household. Here,  $\mu$  is considered as the mean of chip revenue;  $Y_h$  the level of revenue of each cassava and yam chip processing unit.

$\rho$  indicates the level of aversion to inequality in the society. The value of this parameter setting can be fixed between zero and infinite, reflecting the importance of preference for inequality.  $\rho$  expresses the elasticity of the marginal social value of the level of development and indicates the rapidity of which the marginal value diminishes when the level increases.

$w_h$  is the weight of the processing unit expressed in equivalent adult (Eq. Adt.).

Because the results found at the sample level for this study will be generalized to whole population of the study zone, it is necessary to consider the statistic weight or the sampling weight. To remedy to this problem, we consider the sampling weight of the household expressed in equivalent adult. This conversion of invidious to equivalent adult is made possible using the grid of evaluation used by FAO/OMS. This grid considers a man like 1 Eq.adt; a women 0, 8 Eq.adt; a children of at least of 15 years and old persons (> 65 years) 0.5 Eq.adt. The use of this grid allows to restore the processing units on a comparable basis.

### Lorenz curve

Another tool mostly used in inequality comparison between different distributions is the Lorenz curve. One of the reasons is that the Lorenz curve to compare inequality between two distributions is more valid in the normative point of view from the utilization of Gini or Atkinson inequality coefficients (Nouhoheflin, 2001).

As extended, Lorenz dominance provides a foundation for analysis of income distribution and establishes the Lorenz curve as the common measure of inequality. Such a curve relates the cumulative proportion of income received (ordered from lowest to highest incomes) to the cumulative proportion of total income of the population. The curve lies between the extremes of the perfect equality diagonal and that of the bottom right axes. For the income distribution analysis, both the Lorenz curve and Gini coefficient of inequality can be used.

The analytic expression of the Lorenz curve is given by the following formula:

$$L_{(\rho)} = \frac{\sum_{h=1}^H w_h y_h I(y_h \leq Q_{(\rho)})}{\sum_{h=1}^H w_h y_h} \text{ such as:}$$

$I(y_h \leq Q_{(\rho)}) = 1$  si  $y_h \leq Q_{(\rho)}$  and 0 otherwise, Where:

$Q_{(\rho)}$  indicates the quantile of the  $\rho$  proportion.

The value of the Lorenz curve at  $\rho$  percentile indicates the proportion of total revenue received by the household of which the revenue is equal to  $Q_{(\rho)}$  at least.

Graphically the Gini coefficient can be represented by the different areas of the

Lorenz curve. This curve is represented in a unitary mark where the vertical axis presents the cumulated percentage of revenue, and the horizontal one presents the cumulated proportion of the population or the considered sample. If each individual has the same revenue stemming from chips processing (total equality) the curve of revenue distribution will be the 45 degrees line. In the opposite case, the Lorenz curve is under the 45 degrees line (inequality).

For the measure of improved yam and cassava chips processing technologies impact on food security and poverty reduction, Gini coefficient and Lorenz curves are used to assess equity in yam and cassava chips incomes distribution.

## Results and discussion

### *Processors and processing units' characteristics*

#### *Roots and tubers cultivation*

Cassava and yam are among the staple food in Benin and Togo. Areas under crops are respectively 28 % and 13 % for cassava and yam of the total area cultivated. The mean area is about 1.05 ha for cassava and 0.48 ha for yam with a mean yield estimated at 8.5 tons for cassava and 10 tons for yam. The current yields are low compared to the potential yields. A study conducted by an IFAD funded Roots and Tubers Project PDRT (2004) in Benin reports that, cassava yield could reach up 36 tons per ha (with fertilizer supply). For yam, potential yield is assumed to attain 60-75 tons of fresh tubers per hectare (RFPP, 2006).

Many varieties of cassava and yam are used by processors to do chips. These varieties can be categorized in two types: local varieties and improved varieties introduced either by PDRT or extension agents.

#### *Processing of raw tubers to chips*

Half of the sample processors are women (58 %). Cassava processing is common and carried out by 88 % of cassava and yam. Women are active in root and tubers purchasing to chip. Thirty nine percent (39 %) of the sample buy cassava or yam chips (table 5). Women represent 80 % of this sub-sample confirming that chip processing is a woman activity. Prices for roots (cassava) and tubers (yam) used to produce chips, are \$90 and \$200 per ton respectively.

Table 3. Purchase of raw material (cassava or yam) according to gender

Purchase of roots and tubers	Percentage (%)		Total
	Women	Men	
Buy	31	8	39
Don't buy	26	35	61
<b>Total</b>	<b>57</b>	<b>43</b>	<b>100</b>

Source: Survey, 2006

### **Level of formal education of food processors**

Most of cassava and yam chips processors (55 %) have not received formal education. Only 20 percent of women have attended primary

Table 4. Distribution by Level of instruction

Level of instruction	Percentage		Total
	Women	Men	
No formal education	63	44	55
Primary school	16	32	23
Secondary school	4	19	11
High school/ University	0	0	0
Adult Education	16	4	11
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Survey, 2006

### **Access to credit**

Only 15 % of processors (table5) have access to credit with only 11 % for women. These institutions of microfinance hardly ensure access to credit for processors. They are risk averse and more oriented toward

Table 5. Access to credit for food processing

Access to credit	Frequency (N=212)	Percentage (%)
Men	09	4
Women	24	11
<b>Total</b>	<b>33</b>	<b>15</b>

Source: Survey, 2006

### **Chips drying and storage**

Cassava and yam chips are dried in different types according to the quantity produced and to be processed and the availability of a drying platform if it exists. Some producers often dry their chips on roofs. Another category of producers dry their chips on the side of roads or on rocks if available.

### **Adoption of processing techniques**

#### **Willingness to adopt chip processing technologies**

Most of cassava and yam chip processors (74 %) are willing to adopt new processing

and secondary school compared to 51 % for men. Some women (11 %) have received adult education in local languages.

manufacturing than agricultural production or processing. The microfinance institutions are formal (CLCAM, PADME, NGOs with micro-credit supply) and informal moneylenders with business based on trust and parental affinity.

technologies while 26 % are not ready or prepared to adopt them. The cost of new processing technologies and related operating knowledge are constraints on reported. Processors who heard about cassava and yam chip new processing technologies (42 %) are fewer to the majority (58 %) who were not informed about. Cassava and yam processing technologies are usually manual and motorized slicers and chip drying area. However after full information on the available processing technologies to processors, the willingness to adopt increases. This willingness to adopt the improved processing technologies is a proxy demand for these technologies.

**Table 6. Decision for adopting cassava and yam processing technologies**

Willingness to adopt	Number (N=175)	Percentage (%)
Quick and easy to operate	59	34
Improvement of chip quality	43	24
Decrease in labor drudgery	45	26
Increased processing yield	28	16
<b>Total</b>	<b>175</b>	<b>100</b>

Source: Survey, 2006

### **Rate of adoption of improved processing technologies**

The adoption rate of the improved processing technologies varies according to the types of

**Table 7. Improved technologies adoption according to the country**

Technology	Slicing		Drying	
	Traditional	Improved	Traditional	Improved
Country				
Benin	90	10	89	11
Togo	100	00	98	02

Source: Survey, 2006

The main reasons for the adoption of cassava and yam new processing technologies are improvement in quality of the chips, decrease in labor drudgery, the easy and speedy operations, the lower time of processing, and the significant increase in income.

### **Reasons for non adoption of processing technologies**

Lack of access to information makes is important for an awareness of new

**Table 8. Reasons for not using cassava and yam processing technologies**

Reasons for non adoption	Number(N=190)	Percentage (%)
Technologies not available	70	37
Chips sold by volume	65	34
Lack of access to market	30	16
Post-harvest losses	25	13
<b>Total</b>	<b>190</b>	<b>100</b>

Source: Survey, 2006

### **Econometric analysis results**

The membership of a processors' association is determinant to the adoption of cassava and yam processing technologies. The processor member of a group or professional association has a greater chance for access to information. Information and its exchange among group members is important. The age of the processor affects the adoption of cassava and yam processing technologies. Older processors are less interested in adoption of the improved cassava and yam processing technologies than youth. Gender of processor is important to the adoption of cassava and yam improved technologies. Women tend to adopt improved processing technologies more

the technology. The adoption rate is low in general for improved technologies in Togo compared to Benin (table 7).

technologies. Access to market is also reported as an incentive for processing. Selling chip by volume is supposed to penalize processors. Chips are sold by volume in nylon bags, and slices of different sizes to fill the bag. On the other hand, the improved processing technologies refine more the slices in regular size so an important quantity of chip may be needed to fill the same bag.

than men. The formal educational level although not having a statistically significant effect on the adoption of improved processing technologies can increase the probability of adoption. Actually a good education enhances the processor capacity to better include/understand the alternatives to improve quality of its cassava and yam chips and to increase incomes. Nkamleu et al (2000) found also that the level of education is important in the decisions of adoption.

The sale of cassava and yam chips by volume constraints the adoption of chips processing technologies. The sale of cassava and yam chips per standard measurement like kilo could stimulate the adoption of these improved

processing technologies. The ecological agro zone influences to a significant degree (with the threshold of 5 %) the adoption of the improved cassava and yam chips processing technologies. The processors of the cassava and yam-based zone adopt more improved processing technologies of cassava and yam chips. The slicers and the improved technologies of chip drying are the most adopted technologies. A constraint in full adoption is due to the fact that the majority of yam-based processing technologies consisted

more of demonstration tests or are in the introductory phase in the zone of production of yam. Access to credit although not significant may affect the adoption of improved processing technologies of cassava and yam chips. The lack of access to credit to processors is a barrier limiting processing and manufacturing of chips by women. A policy for support to processors group through the micro credit will enable more processing and higher value added income.

**Table 9. Estimation of adoption model of yam and cassava chips new processing technologies**

Variables	$\beta$ Coefficient	Standard Error	Probability
Gender	0.291	0.769	0.705*
Sale	-0.144	0.673	0.831
Education	-1.246	0.827	0.132
Processing experience	-0.049	0.028	0.079*
Non-tuber incomes	-1.945	1.108	0.079*
Contact	1.814	0.748	0.015**
Group Membership	4.274	0.886	0.000***
Agro-Ecological zone	-1.355	0.648	0.037**
Average Income	-1.221	0.798	0.126
Constant	0.439	1.742	0.801

Pourcentage de prédictions correctes: 89.6 %; Constante = 0.46217; N=212  
 Ratio de maximum de vraisemblance = 69.218; Chi carré = 72.100\*\*\*.  
 (\*\*\*) : significatif à 1 %; (\*\*) : significatif à 5 %.

Source: Survey, 2006

### **Chips incomes**

From this table, incomes from chip processing are higher for women (36 %) from total farm income compared to men (27 %) processors total agricultural revenue. Chips' processing activities bring back to processors 31 % of their

annual agricultural income. Average household yearly income stemming from chips processing activities is estimated at \$129 for women and \$201 for men. The annual agricultural raw revenue estimated in the study area is about \$536.

**Table 10. Proportion of chips revenue in total agricultural income**

Gender	Average income from chips	Total Farm income	Share of chips in total income
Women	\$129	\$352	36 %
Men	\$201	\$720	27 %

Source: Survey, 2006

The in-depth comparison of revenue between adopters and non-adopters show (table10) that the income from cassava and yam chips processing significant share of the total agricultural income for the processors (29 %

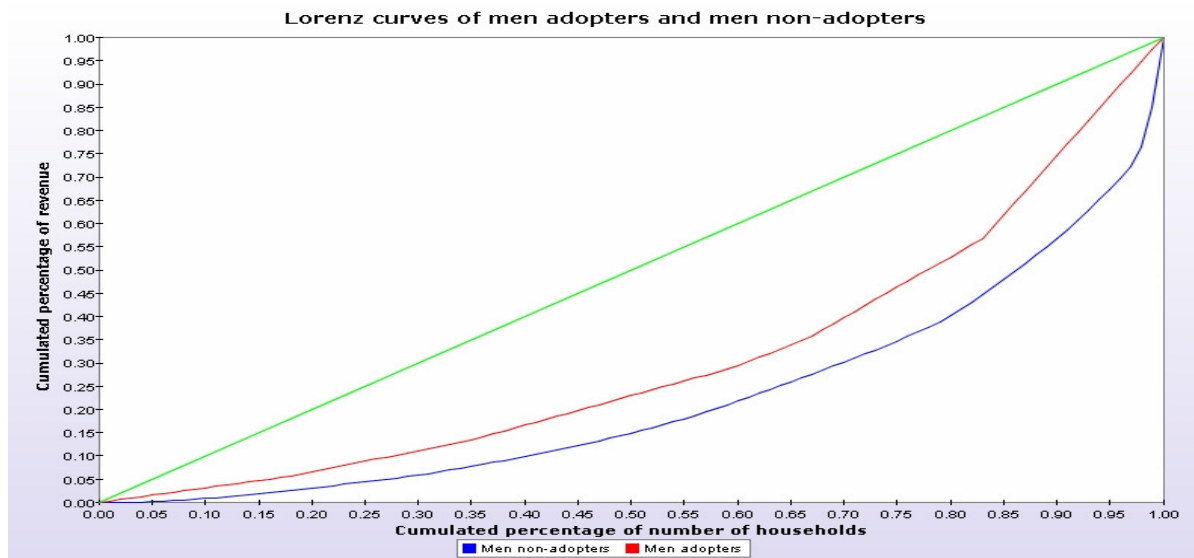
and 28 % for women non-adopters and men non-adopters respectively). This proportion has been increased by the adoption of improved processing technologies, mostly for women adopters (36 %).

**Table 11. Adopters and non-adopters' incomes**

Gender	Income from chips (\$)	Total farm income (\$)	Share of chips income in total income
Women Adopters	139	377	36 %
Women Non-Adopters	105	356	29 %
Men Adopters	264	1120	23 %
Men Non- Adopters	197	686	28 %

Source: Survey, 2006

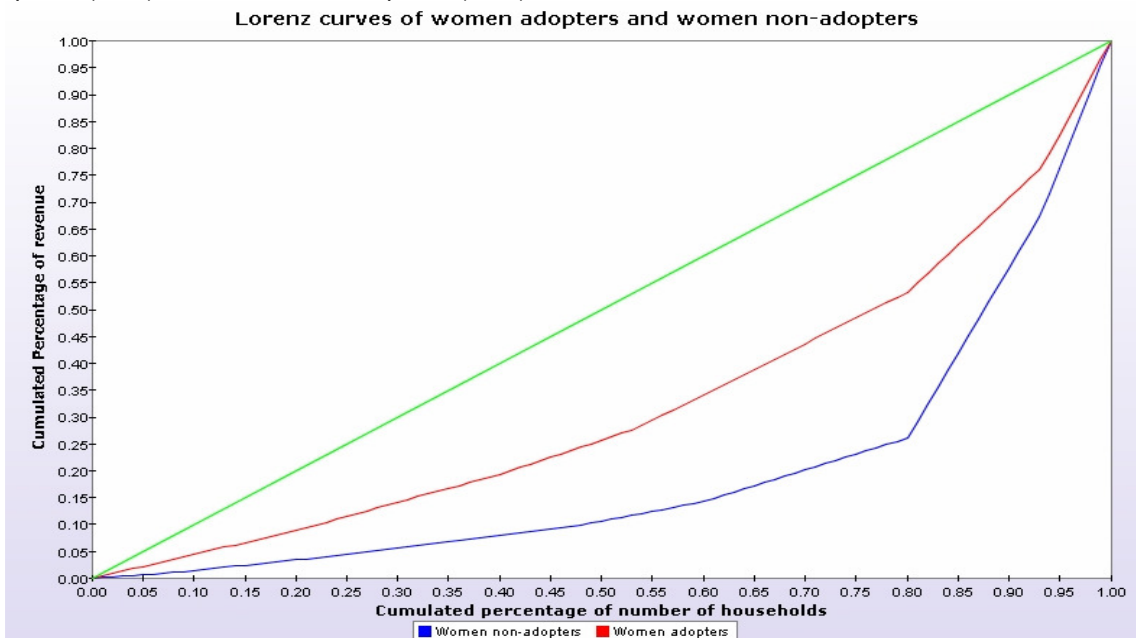
**Income distribution**



**Figure 1. Lorenz curves of men adopters and men non-adopters for income distribution**

Globally the men adopters curve is above the curve of men non-adopters and near the 45° line demonstrating that the adoption of cassava and yam chips processing technologies reduces the inequality in chips income distribution among adopters. This inequality reduction is confirmed by the difference between the Gini coefficient of men adopters (0.39) and men non-adopters (0.55)

Lower Gini coefficients mean higher reduction in inequality. The in-depth comparison of the two curves shows that, 80 % of the sample share about 50 % of the chips income from chips for men non-adopters while, 80 % of the sample adopters share 70 % of the total chip income, confirming more equity in the distribution of the income among adopters.



**Figure 2. Lorenz curves of women adopters and women non-adopters for income distribution**

Women adopters curve is above the curve of women non-adopters and near the 45° line meaning that the adoption of cassava and yam chips processing technologies reduces the inequality in chips income distribution among

adopters. This inequality reduction is again confirmed by the difference between the Gini coefficient of women adopters (0.57) and women non-adopters (0.78) where higher coefficient reflects more inequality in income



distribution. Once again the in-depth comparison of the two curves shows that while for women non-adopters 80 % of the population share only 20 % of the total chips income, for the women adopters 80 % earn about 65 % of the total chip income,

confirming more equity in income distribution among adopters.

The following table presents the the different Gini coefficients for men, women and adopters.

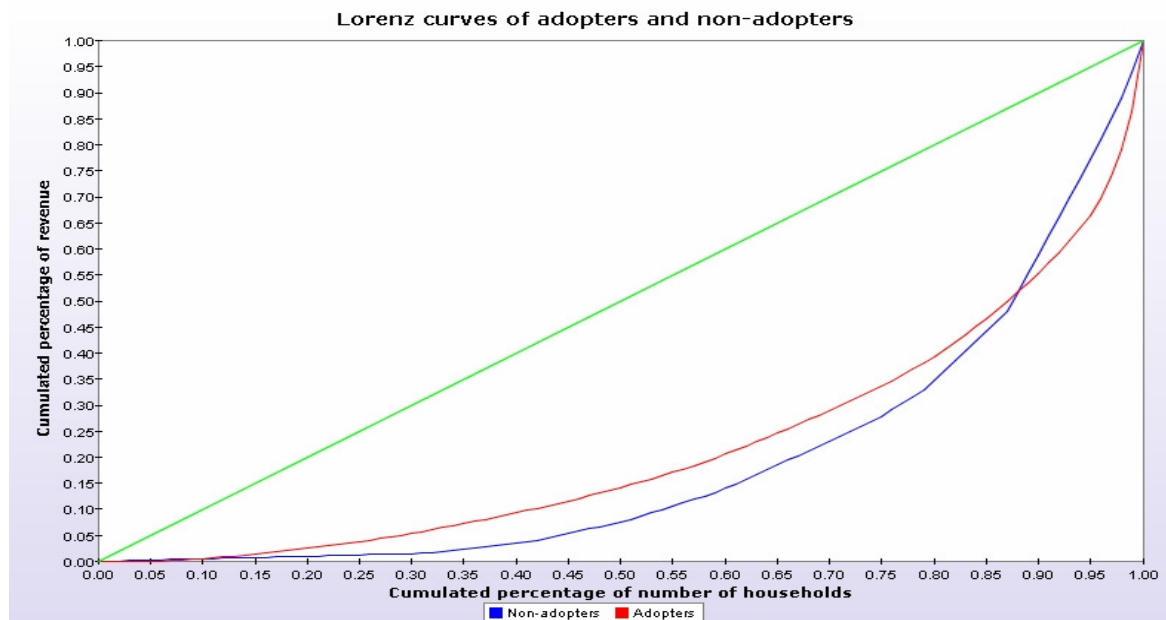


Figure 3. Lorenz curves of adopters and non-adopters for income distribution

Adopters curve is above the curve of non-adopters at least for 90 % of the population. We can notice that for the two curves, 90 % of the households share only 50 % of the total chips revenue while 10 % share 50 % of the total income, showing the inequality in income distribution. However the trend in inequality adoption is always pronounced. This inequality reduction is confirmed by the difference

between the Gini coefficients of adopters (0.56) and non-adopters (0.61).

The table 12 shows that the women adopters and women non-adopters present the highest values of Gini coefficient meaning more inequality in women income distribution than men income. The distribution of income is highly unequal and differ significantly between men and women, particularly among women non-adopters and women adopters.

Table 12. Gini coefficients for Income Distribution

Groups		Coefficient	Standard deviation
Women	Adopters	0.57	0.03
	Non-adopters	0.78	0.03
Men	Adopters	0.39	0.04
	Non-adopters	0.55	0.08
Whole sample	Adopters	0.56	0.03
	Non-adopters	0.61	0.07

Source: Survey, 2006

**Income allocation to household expenditures**

Chips processors generally distribute their incomes among five main expenditures' domain: food, health, children school fees, agricultural equipment and labor, and others including funerals, leisure etc.

The table 13 shows that processors spend a third (29 %) of their income for food expenditures despite household food production. The second important share (27 %) of their income is spent in children school fees. This important number of children or of household seize can also explain both the important parts of revenue allocated to food, children school fees and health (20 %).

Agricultural equipment and workforce occupy 19 % while funerals, leisure etc. take the 5 %

**Table 13. Chips revenue allocation to goods and services**

Main goods and services	Share of income per household expenditures ( %)
Food	29
Health	20
Children school fees	27
Agricultural equipment and workforce	19
Others (funerals, leisure)	5
<b>Total</b>	<b>100</b>

Source: Survey, 2006

## Conclusion and recommendations

The impact of mechanization of cassava and yam chip processing is in rural processors. Cassava and yam chip processing will have more impact, mostly in women processors if the level of adoption rate is more important. The study shows that 42 % of cassava produced and 17 % of yam are processed into chips. Only thirty one percent (31 %) of cassava and yam chips are sold, the remaining ensures family food security. Cassava and yam chips processing contribute up to 31 % to total agricultural income of processors, and 33 % to total agricultural income of rural women processors.

Access to information, membership of processors' group and agroecological zone are key factors affecting significantly the adoption

of cassava and yam chips improved technologies. The adoption of improved processing technologies reduces inequality in income distribution among processors.

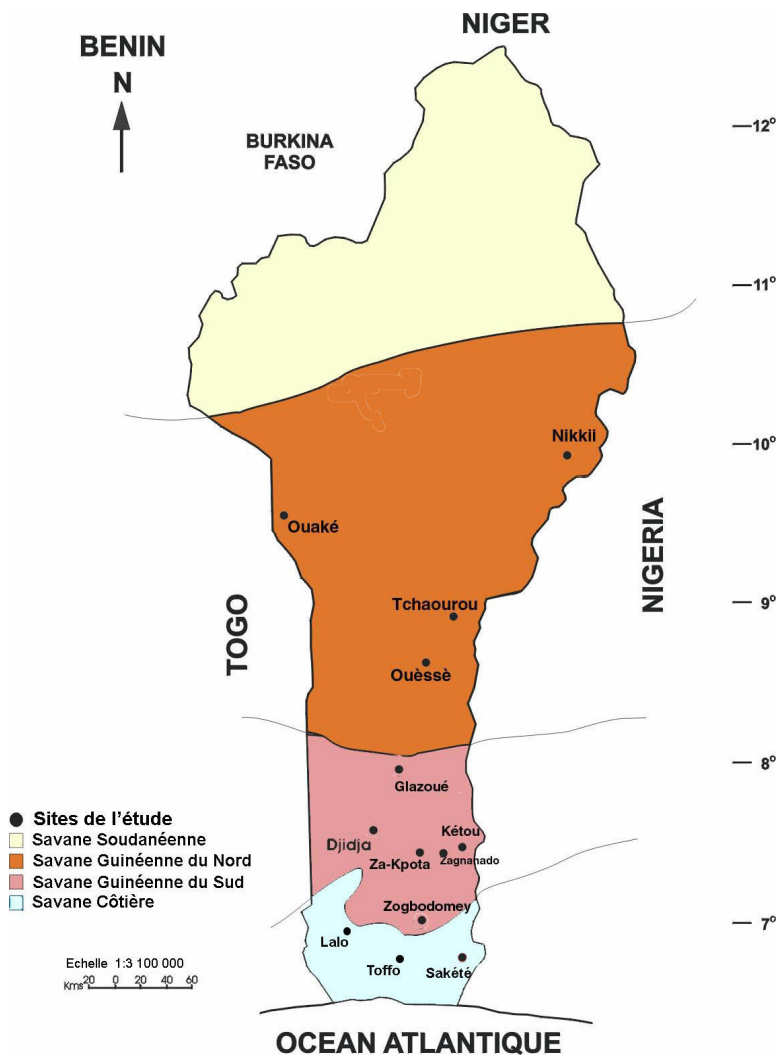
The study recommends: - A cost and benefits analysis of cassava and yam chip processing different systems; The promotion of these improved processing technologies through processors groups with access to credit for rural women which reduce women poverty through new market opportunities. A proposal taking into account processors' capacity building on chips quality, norms and standards, and the harmonization of measure unities and chips conditioning will take care of the missing nodes of the cassava and yam value chains nodes.

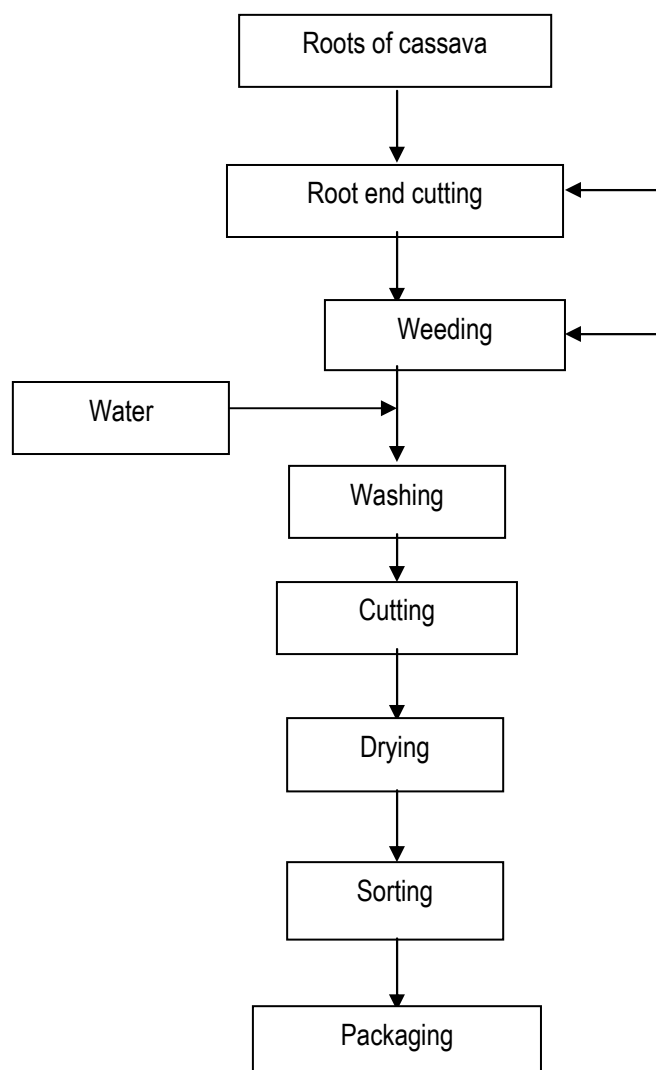
## References

- Adégbidi, Anselme. Adjovi Epiphane., et al (1999): Profil d'inégalité au Bénin. Cahier de recherche de l'équipe MIMAP-BENIN. Université Nationale du Bénin Décembre 1999 ; 45p
- Adesina A. A. & Sirajo S. 1995. Farmers' perceptions and adoption of new agricultural technology: analysis of modern mangrove rice varieties in Guinea-Bissau. Q. J. Int. Agric 34 (4), 358-371.
- Bell, A.; Mück O.; Schuler B. 2000. Les richesses du sol. Les plantes à racines et tubercules en Afrique: une contribution au développement des technologies de récolte et d'après-récolte. Thesis University of Pretoria etd. Pp 146.
- Ezeh N.O., 1992. Economics of yam production: implications for research and development, and promotion of yam based industries in Nigeria, in Proceedings of 4<sup>th</sup> AB-ISTR Symposium, 5-8 Décembre 1989, Kinshasa: 303-305.
- FAO, 2006. FAO data base <http://faostat.fao.org>
- Initiative pour la Fertilité des Sols (IFS), 2002. Plan d'action opérationnel pour la gestion durable de la fertilité des sols.
- Nouhoheflin T. 2001. Impact de l'adoption des nouvelles technologies de niébé sur l'amélioration et la distribution des revenus dans les sous-préfectures de Savè et de Klouékamè (République du Bénin). Thèse d'Ingénieur agronome. University of Abomey-Calavi, Cotonou Benin
- PDRT, 2004. Atelier d'évaluation des protocoles de Recherche-Développement sur les Racines et tubercules conduits par l'INRAB et des protocoles d'appui aux activités de Recherche-Développement du PDRT. Cotonou, 16 au 18 février 2004, Benin. 211pages.
- Research Fellow Partnership Program (RFPP), 2006. Modeling the growth of yam (*Dioscorea* spp.), IITA-IBADAN & ESA Cote d'Ivoire. <http://www.rfpp.ethz.ch>
- Vernier Ph.; Bricas N.; Etogbo E.; Hounhouigan J.; N'Kpenu K. E.; Orkwor G. 2001. Le développement des transformations post-récolte pour l'approvisionnement des marchés urbains : enquête sur la filière cosssette d'igname en Afrique de l'Ouest. International Institute of Tropical Agriculture, Cotonou, Benin.

**Annexes**

**Annex 1. Agro-Ecological zone**

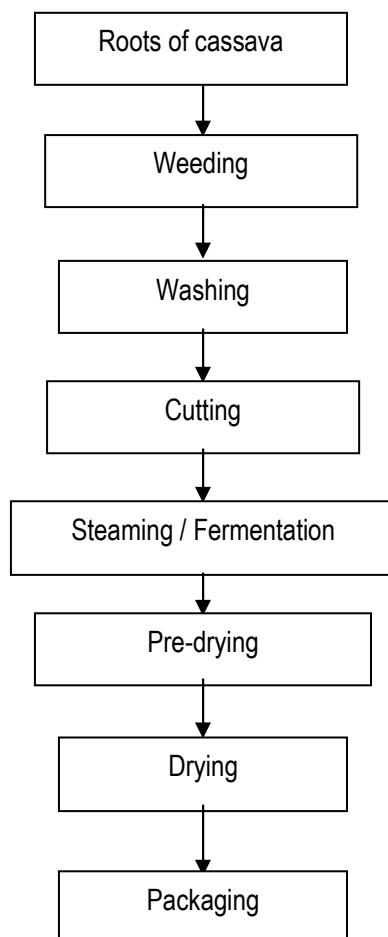


**Annexes: Processes of transformation****Chips exits of peeled roots / Chips exits of the not peeled roots****Diagram of production of the cassava chips**



**Improved traditional cutting**

**Processing of the cassava into chips for Livestock feed**



**Diagram of Cassava processing into “Lafoun”**



**Manual slicer "LOGOZO"**



**Motorized slicer "BECRREMA"**



**Motorized slicer "FMB"**

**Various kinds of improved slicers**

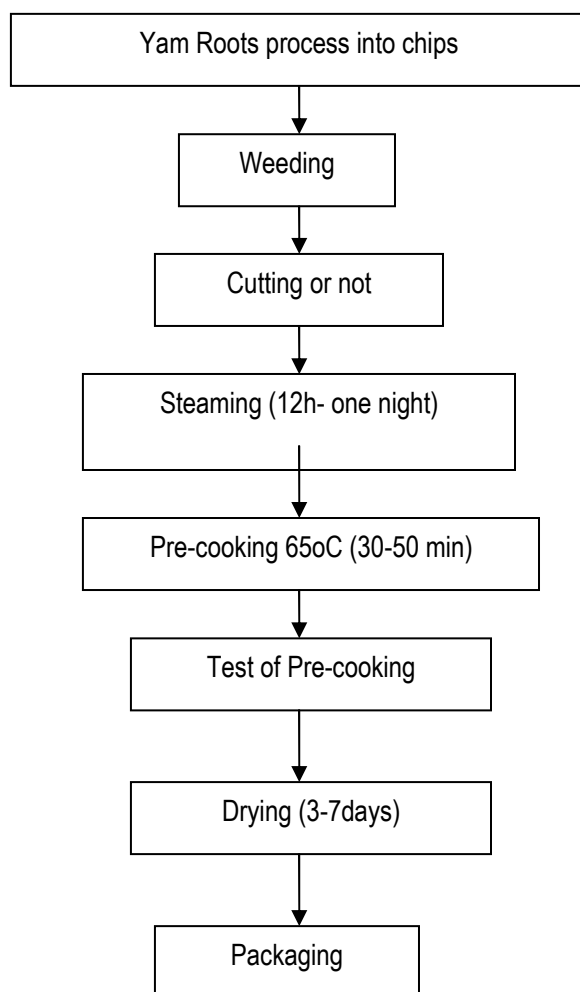


Diagram of Yam processed product 'yam chips'