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PERCEPTION AND SOCIO-ECONOMIC IMPORTANCE OF RICINODENDRON HEUDELOTII (BAILL.) PIERRE EX HECKEL IN THE LOH-DJIBOUA REGION IN SOUTHERN CÔTE D'IVOIRE

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ABSTRACT

This study focuses on Ricinodendron heudelotii, widely known in tropical Africa for its almonds. However, this species is very little taken into account during the establishment of agrosystems by peasant populations. This article aims to assess the socio-economic importance of this Euphorbiaceae in the Loh-djiboua region of southern Côte d'Ivoire. To achieve this, we looked for the distribution of this species in cocoa fields, fallows, new plantations and in young secondary forests. We also searched through a survey the state of knowledge of the populations living in the Loh-djiboua region on this species. At the end of the inventories, we encountered only 15 rods with a diameter of more than one meter in the different agrosystems. No juvenile individuals were observed. The name most used by the majority of the population is the term "akpi". The study of the sector gave gross marketing margins of 74.43% in times of scarcity and 18.18% in times of abundance. At the end of this study, we suggest the implementation of sustainable management methods for this species with a view to making this resource available to future populations.

Keywords: Ricinodendron heudeloti, Loh-Djiboua, akpi; Côte d'Ivoire, use value, almond, agrosystem.

1. INTRODUCTION

In Africa, it is widely accepted that natural resources are of particular socio-economic interest to local populations and enable them to meet basic needs. According to Loubelo (2012), these natural resources contribute to the reduction of poverty and provide some food security for several sociolinguistic groups on the African continent. The vast majority of people living in forests depend directly on the natural resources found there, including non-wood products. Some of these products such as game, fruits, seeds, roots, insects or fungi are used as food sources and contribute to the nutritional balance of populations (FAO, 2016). These products have long been called "secondary" or non-timber forest products (NTFPs), to mark their lesser importance (Loubelo, 2012). But over the years, several scholars have noted the central role of NWFP in improving the livelihoods of local populations (Ndoye and Ruiz-Pérez, 1999; Belcher and Schreckenberg, 2007). According to some authors such as Peters *et al*. (1989) and Hall and Bawa (1993), the long-term value of NWFPs may exceed the short-term benefits of forest transformation as a result of logging and agriculture.

In sub-Saharan Africa, apart from wood, forests contain many resources whose exploitation is essential in the daily life of village communities (Gbesso *et al*, 2015). In this environment, local

Vol. 07, No. 04; 2022

ISSN: 2456-8643

populations generally and directly harvest many products (Kokou, 2006; Sop, 2011). Despite this abundance of natural forest resources, the exploitation of which is done without major destruction of the forest, we are witnessing according to the FAO (2012) a significant reduction in forest areas on the African continent. In Côte d'Ivoire, forest cover increased from 16 million hectares in 1960 to 2.5 million hectares in 1990 (Koné *et al*., 2014). The main source of deforestation and forest skimming is demography. People participate in deforestation through several facts. These include logging, agriculture, hunting, urbanization (Peters; 2000). Some species highly prized by populations are therefore threatened with extinction in the short, medium and long term. This is the case of *Ricinodendron heudelotii* Baill a Euphorbiaceae found in Central and West Africa. This species is known in most countries where it is found for its widely marketed seeds (Gbesso *et al*, 2015). Almonds are among the products that occupy a prominent place in the diet (Grivetti, 1987). Several studies have been conducted in Côte d'Ivoire on useful plants and in particular on *Ricinodendron heudelotii*. They generally focus on techniques for picking and processing harvest products (Akpavi, 2013; Atato *et al*, 2013; Atakpama *et al*, 2014). Rarely, data on resource availability and sustainable management and conservation techniques have been observed. It is in this context that this has been conducted. The general objective of this work is to assess the socio-economic importance of *Ricinodendron heudelotii* in the Loh Djiboua region and in some markets in the agglomeration of the city of Abidjan. Specifically, these are:

-to establish the structure of the population in the Loh Djiboua region ;
-to analyse people's attitudes towards *Ricinodendron heudelotii*.
-to evaluate the different uses of *Ricinodendron heudelotii*.
-to study the marketing of *Ricinodendron heudelotii*.

2.MATERIALS AND METHODS

2.1 Study site

This study took place in the village of Gogo in the department of Hiré located in the Loh-djiboua region and in some large urban markets in the agglomeration of Abidjan, the economic capital of Côte d'Ivoire. The city of Abidjan belongs to the lagoon region. It covers an area of 422^{km2} with a population of about 5 million inhabitants. The Loh-djiboua region covers an area of 10650 km2 with an estimated population in 2014 at 729169 inhabitants. The Loh Djiboua region used for inventories has a transitional equatorial climate with two rainy seasons that are located for the first between the months of February and July and for the second between the months of August and November. The average rainfall is between 1200 and 1600 mm/year with an average annual temperature of about 26 °C. The relief, relatively uneven is composed in places of some rare hills. The maximum average altitudes are of the order of 300 m. The soil of the Loh djiboua region is of the ferralitic type. It is characterized by the presence of calco-alkaline granites with biotite, or biotite and muscovite (Anonymous, 2020).

Vol. 07, No. 04; 2022

ISSN: 2456-8643

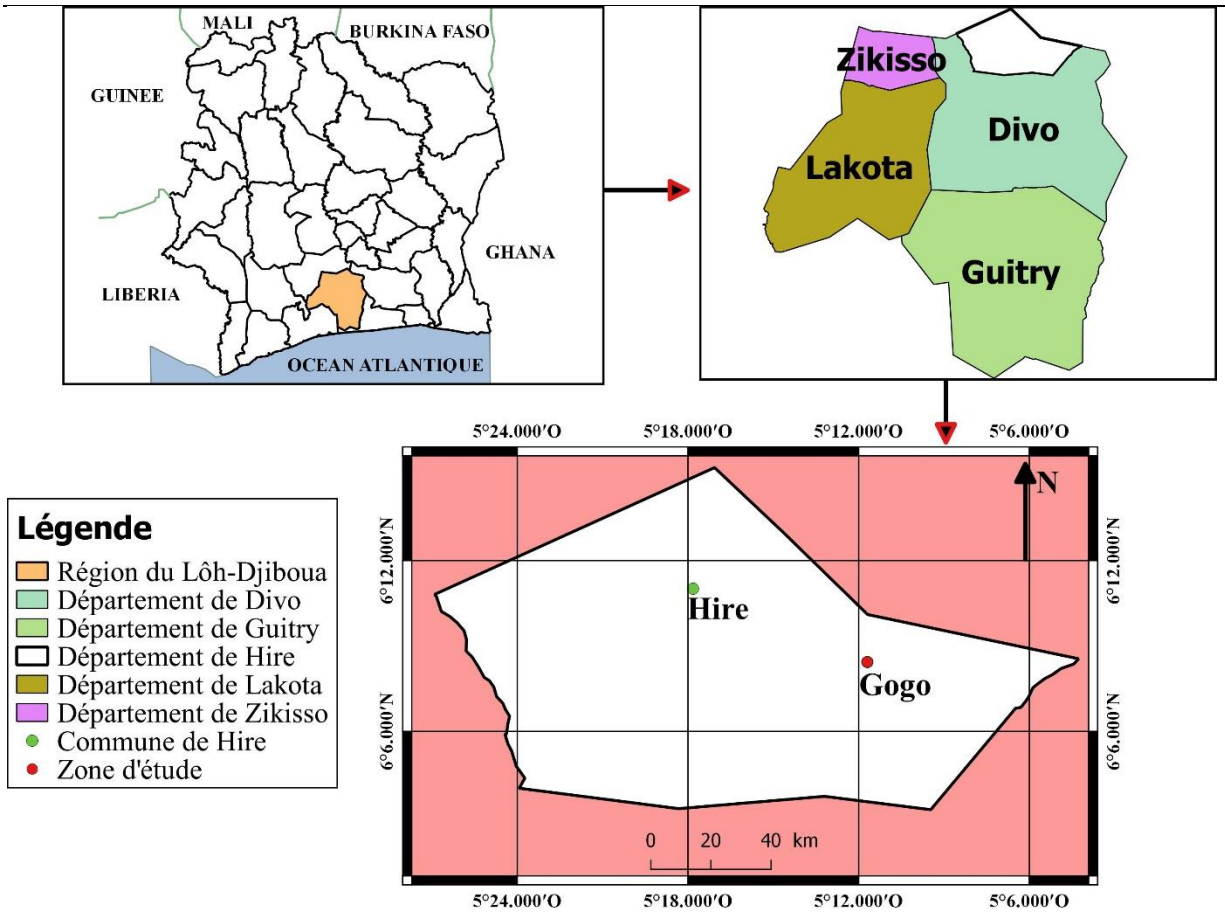

Figure 1 : Map of the area of the inventories of *Ricinodendron heudelotii* in the region of Loh djiboua

2.2 Inventory

A systematic inventory of *Ricinodendron heudelotii* stems was carried out in agroforestry areas in the village of Gogo à Hiré in the Loh djiboua region. The dendrometric parameters recorded for each tree are the diameter at chest height (DBH), the height and the sanitary status. The phenological situation of all the individuals recorded was also observed. The information collected is the percentage of fruits and flowers present on each foot during the inventory.

2.3 Ethnobotanical survey

In order to determine population perceptions of *Ricinodendron heudelotii*, ethnobotanical surveys were conducted in Gogo. We used "door-to-door" as a method. According to Thompson and Zhang, (2006) and Assogba *et al*. (2017), this method frequently used during ethnobotany work provides immediate results. This survey was conducted to look for data such as fruit harvest periods, plant use and the socio-cultural importance of this species in the Loh djiboua region. With regard to the markets of the Abidjan agglomeration, the survey focused on the technique known as semi-structured or semi-direct listening. This is based on concerns identified on the screen. Therefore, it allows new questions to be expressed from the answers provided by

Vol. 07, No. 04; 2022

ISSN: 2456-8643

previous questions (Thompson and Zhang, 2006). As a result of this method, as much information as possible was provided on trafficking in *Ricinodendron heudelotii seeds.*

Various indices were used to process the data collected during the surveys. These are:

- The ethnobotanical use value that makes it possible to determine the most used organ at the level of *Ricinodendron heudelotii*. It is obtained according to the following formula:
  - $UVS = \frac{U}{N}$
  - U= number of uses where the organ is mentioned
  - N= number of informants who mentioned the organ
  - UVS = Ethnobotanical Use Value
- The response rate that shows the proportion of sampled individual who uses a given organ. It is between 0 and 100. A zero value indicates that the organ is not used and a maximum value of 100% indicates that the organ is mentioned by the entire population (Thompson and Zhang, 2006). The response rate is calculated by the following formula:
  - $F = \frac{S}{N} * 100$
  - F: calculated response rate;
  - S: number of persons who gave a positive response for the use of the organ concerned;
  - N: Total number of interviewees
- **Gross**marketing margin (CBM) is the percentage of the difference between the selling price and the purchase price to producers divided by the selling price in urban markets (Gregory and Dany, 1997). Gross Marketing Margin (CBM) was obtained from the following formula:

$$\text{MBC (\%)} = \frac{\text{Prix de vente} - \text{Prix d'achat}}{\text{Prix de vente}} * 100$$

3.RESULTS

3.1 Population structure and phenology

The population of *Ricinodendron heudelotii* inventoried in the village gogo was observed in 4 agroecological zones (Table 1). These are cocoa farms, new plantations, fallow land and young secondary forests. Fifteen feet were identified throughout the area. The maximum number of individuals was observed in cocoa farms with a proportion of 40% against only 13% in young secondary forests. Fallow land and new plantations recorded respectively 3 and 4 individuals or 20% and 26.67% of all individuals. All feet of *Ricinodendron heudelotii* have an average diameter of 1.7m. The largest individuals are located in cocoa farms. They have an average diameter at chest height (DBH) of 1.8m. The smallest feet with an average DBH of 1.6m were observed in young secondary forests. All the trees encountered are very large with an average height of 34.4m. The survey revealed that flowering begins in March and fruit maturity is reached in August. During the inventories we observed 10 fruiting trees.

Vol. 07, No. 04; 2022

ISSN: 2456-8643

Table 1. Dendrometric characteristics of *Ricinodendron heudelotii* in some agroecological zones of the Loh-djiboua region

Agroecological zones	Number of individuals	DBH: Average diameter at chest height (m)	Average tree height (m)	Proportion (%)
Cacaoyères	6	1,8	35	40
Fallows	3	1,6	33,5	20
New plantations	4	1,7	34	26,67
Young secondary forests	2	1,6	35	13,33
Total	15	1,7	34,4	100

3.2 Local names

Several names are used to designate *Ricinodendron heudelotii* depending on the socio-linguistic groups encountered in the Loh-djiboua region. However, according to Table 2, the most common designation is the term "akpi". Indeed this name is used by 7 different socio-linguistic groups namely the Agnis, the Attiés, the Baoulés, the Didas, the Koyakas, the Malinkés and the Morea. The indigenous populations of the Agnéby-Tiassa region that are the Abey use the term "eho" in reference to this species. Groups such as the Bétés, the Ebriés and the Yacoubas use the terms "kô", "proposi" and "goodi" respectively.

Table 2. Designation of Ricinodendron heudelotii by various socio-linguistic groups in the Loh-djiboua region

Linguistic social groups	Title
Agni	Akpi
Attié	Akpi
Abey	Eho
Baoulé	Akpi
Bété	Kô
Dida	Akpi
Ebrié	Propose
Gouro	Kô
Kroumen	Katô
Koyaka	Akpi
Malinké	Akpi
Morih	Akpi
Ya	Goodi

3.3 Use of *Ricinodendron heudeulotii* in the Loh-djiboua region

Vol. 07, No. 04; 2022

ISSN: 2456-8643

At the end of the survey, the different uses were grouped into two categories. Firstly, it concerns the use of almonds and secondly the therapeutic use of bark and leaves. The use value of almonds is 1 (F=100%). On the other hand, that of the bark and leaves is 0.55. The use of almonds was indeed cited by all respondents from all socio-linguistic groups. The use of bark and leaves is recognized only by the Attiés, the Baoulés, the Didas, the Gouros and the Moreas.

3.4 Profitability of the *trade in Ricinodendron heudelotii* almonds

The supply of *Ricinodendron heudelotii* almonds to urban areas is done through intermediaries. The unit of measurement is a box with an almond content weighing about two kilograms (Figure 2). The contents of the box once filled are sold to intermediaries by the farmers for the sum of 4500 FCFA or $ 7.34. This sum is constant regardless of the period. The contents of this box are sold on the markets at 8000 FCFA ($13.04) in scarcity periods and at 5500 FCFA ($9) in times of abundance. The gross marketing margin is therefore 43.74% in times of scarcity and 18.18% in times of abundance.

Figure 2. Units of measurement of *Ricinodendron heudelotii* almonds used by farmers

4.DISCUSSION

Inventories have shown that the density of *Ricinodendron heudelotii* in the Loh-djiboua region of Côte d'Ivoire is very low. Indeed, in the four major agro-ecological zones that are cocoa trees, fallows, new plantations and secondary forests, only 15 stems of large diameters have been encountered. One could therefore think that these are individuals spared during the establishment of plantations. According to Doucet (2003) and Kouadio *et al*. (2021) forest species dominating the upper stratum generally show low natural regeneration. Indeed, once the canopy is closed,

Vol. 07, No. 04; 2022

ISSN: 2456-8643

the young shoots that emerge after fruiting do not evolve and die due to lack of light. In the case of this study no small diameter rods were observed. This could be due to agrosystems. The establishment of mainly perennial crops such as the cocoa tree requires a clearing of the plot with a total clearing followed by slash-and-burn (Penot and Feintrenie; 2014). This method of plot preparation eliminates almost all climactic species and especially natural regeneration (Kouadio *et al*., 2021). Thus, young stems of *Ricinodendron heudelotii* representing future regeneration are eliminated, leaving only elderly individuals. According to Tchatat and N'doye (2006), the removal of young stems from non-timber forest products during the implementation of agrosystems is a real concern for the sustainable management of these species.

The most common name is the term "akpi". The massive use of this name by several socio-linguistic groups shows that there is no ancestral relationship between this essence and both indigenous and non-native populations. This is confirmed by the very small number of uses of this species which is only three. That is, the use of almonds, bark and leaves. Indeed, of all the 13 socio-linguistic groups surveyed in the Loh Djiboua region of Côte d'Ivoire, the use of bark and leaves is known by only five socio-linguistic groups. According to Assogba et *al*. (2017), the number of uses of a species is generally high when there is a distant relationship between that species and populations. However, several uses of this species have been mentioned by Akpovo *et al*. (2022). According to them, this plant is a melliferous species and a host plant for caterpillars and fungi consumed in some Central African countries. For Tchoundjeu and Atangana (2006), the stem could replace kitchen salt when it is transformed into ash after burning.

As far as the sector is concerned, our results show that this is still an informal activity. The use of old tin cans as a unit of measurement also shows the secondary nature of this activity. Indeed, the sale of almonds comes in addition to a main activity when they are available. This translates into the very low gross marketing margin in times of abundance. But this activity could bring in large sums of money for both producers and traders if it is practiced with great seriousness. This is the case in Cameroon where the marketing of almonds would bring each year a gain per family of up to $ 860 according to Akpovo *et al*. (2022).

5.CONCLUSION

Our study on *Ricinodendron heudelotii* complements several works carried out on this species of high socio-economic interest in several countries of both West and Central Africa. The results of the inventories showed that in the Loh-Djiboua region of Côte d'Ivoire, *Ricinodendron heudelotii* is represented only by a very small number of large stems. The species is therefore threatened in the short and long term if sustainable management measures are not quickly proposed. With a use value of 1 the almond seeds remains the most used organ in this region. However, some groups recognize the role of the bark and leaves. The socio-economic interest of the species is therefore focused on the almond which is very popular with mainly urban populations. However, the marketing sector remains secondary and complements main activities.

At the end of this study several lines of reflection seem to emerge. The natural regeneration of *Ricinodendron heudelotii* needs to be boosted to mitigate threats to its sustainable management. We are thinking of enriching agrosystems with seedlings of this species. These individuals, once large, will be able to play the role of shade trees especially for cocoa trees that are moderate heliophilic. Since the dormant nature of almonds is proven, pragmatic methods of dormancy should be developed for large-scale production of seedlings. An awareness-raising campaign will

Vol. 07, No. 04; 2022

ISSN: 2456-8643

have to be carried out among farmers with a view to keeping young people on the plantations. This will increase natural regeneration. In addition, an organization of the sector will have to be carried out in order to increase the incomes of farmers and intermediaries in the sector because the economic interest of this species is widely known in many countries of tropical Africa.

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Vol. 07, No. 04; 2022

ISSN: 2456-8643

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