SCIENTIFIC JOURNAL OF ACCOUNTANCY, MANAGEMENT, AND FINANCE
ECONOMIT JOURNAL

Socio-Economic and Ecological Impact of Charcoal Production in the Fianarantsoa Region, Madagascar

Razafindrazanakolona A. D.[1], Rakotonirina M.D.L.[2], Ramanampisoa V.E.[3], Rabesiaka R.[4], Damy T. S.[5], Razafimahefa V.M.[6], Koto-te-Nyiwa Ngbolua[7], Robijaona Rahelivololoniaina B.[8], Muhammad Ridwan[9]

[1,3]Institute of Sciences and Techniques of the Environment, University of Fianarantsoa, Madagascar
[1,4,5]Doctoral School Geochimed University of Fianarantsoa, Madagascar
[2]Higher Institute of Technology of Ambositra, Fianarantsoa, Madagascar
[6,8]Doctoral School of Industrial, Agricultural and Food Process and Systems Engineering, University of Antananarivo, Madagascar
[6,8]Laboratory for the Valorization of Natural Resources, Antananarivo, Madagascar
[7,8]Department of Environmental Sciences, Faculty of Science, University of Gbado -Lite, Gbado-Lite, Democratic Republic of the Congo
[7]Department of Biology, Faculty of Science, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[9]Universitas Islam Negeri Sumatera Utara, Indonesia
Email: robijob111@gmail.com

Abstract:

Charcoal, the main domestic fuel used in the city of Fianarantsoa, comes mainly from the forests of Fianarantsoa II. The increase in demand for charcoal in Fianarantsoa puts considerable pressure on the natural woody formations of Fianarantsoa II. The implication of charcoal burning in deforestation depends on the intensity of charcoal production and the respect of the forest regeneration phase. This activity is, however, essential for charcoal makers who live from it as producers or as resellers. It generates a significant income for the rural population, and even for the resellers in urban areas, despite its relatively low cost compared to other fuels such as gas, oil, ethanol, and electricity. Most charcoal burners are also farmers, but the charcoal produced is intended to meet the urban energy demand of Fianarantsoa. This study focuses on the socio-economic and environmental impacts of this logging in order to highlight the solutions available to ensure sustainable development through the cases of Amnbondrona, Antanifotsy, and Ankaranosy. Environmental education and sustainable development as well as the proposal of income-generating alternatives and more ecological fuels would allow the restoration of environmental harmony while ensuring socio-economic balance.

Keywords:

Charcoal; fuel; forest; income; deforestation; fianarantsoa

I. Introduction

Energy is essential to all sectors of humanity's daily life. Wood - energy constituted by firewood, and charcoal, represents more than 90% of the energy supply in Madagascar (CIRAD, 2012; La Gazette de la Grande île, 2019). In fact, it is common to see bags of charcoal for sale lining the main national roads in Madagascar. Charcoal is mostly used, in urban areas, by nearly 47% of urban households in rural areas, and firewood is more prized (IRG, JariAla, 2013). This is observed in Madagascar as well as throughout sub-Saharan Africa (Girard, 2002).

In urban areas, charcoal is the primary source of household energy for cooking. This fuel represents about 10% of a household's monthly expenses (Montagne and al., 2010). The

increase in the urban population, observed during the last fifty years, has increased, as a corollary, the pressure on the forest, by an exponential increase in the demand for charcoal. Today, it is one of the basic necessities of life (CIRAD, 2012). Charcoal production tripled between 1993 and 2013, from 461,000 tons to 1,560,000 tons (Ministère des Eaux et forêts, 2000). In 2012, the Ministry of Energy and WWF estimated that Madagascar's timber resources would no longer be able to meet the national demand for charcoal by 2025 (Randrianarison et al., 2021).

In the charcoal production area, the villagers have all made charcoal for sale at some point in their lives. These villagers depend on the natural resources provided by the forests, charcoal, and agriculture. This charcoal-making is a threat to the forests. The reforested area in Fianarantsoa is 100 to 200 ha per year between 1990 and 2000 (Raharimanaka and al., 2010). The deforestation rate was 23% or an area of 17,537 ha (Girard, 2002). There is, undoubtedly, more exploitation of wood products than effective reforestation. The Ministry of Environment and Sustainable Development announces an annual loss of 100,000 ha of forest at the national level, in 2020 (Ministry of National Education of Madagascar, 2015). According to a prospective study of the Malagasy forestry sector, in 2020, the reforestation rate in relation to the total area destroyed in Fianarantsoa will be 0.86 for 891 ha reforested, 7457 ha exploited, 93474 ha burned and 2099 ha cleared (Montagne et al., 2010). Consequently, forest degradation generates, directly and indirectly, negative impacts on the environment and on socio-economic development.

In the context of this study, a series of questions arise in order to understand the importance of education in the sustainability of forests and to know if this forest degradation represents a major factor conditioning the precariousness of the socio-economic conditions of the studied region. The following questions would therefore allow us to know:

- What are the local causes and consequences of forest destruction?
- What is the impact of environmental education and sustainable development on the sustainable and rational management of forest resources in this region?

To answer this question, we will first explain the methodology adopted. Secondly, the results of the surveys will be discussed. The third part will be dedicated to the discussion and the perspectives of implementation of the awareness and education on the environment and sustainable development.

This observation led us to study the socio-economic and ecological impacts of coal production. Our main objective here is to highlight a solution that is more adapted to local realities. This is essential to mitigate or even eliminate the harmful practices related to the production of charcoal.

II. Review of Literature

Study Area

The villages of Ambondrona, Antanifotsy, and Ankaranosy were chosen for this study. These are the three main areas of charcoal production in Fianarantsoa. Ambondrona is located 40 km north of Fianarantsoa; Antanifotsy is located 30 km northwest of the city and Ankaranosy is located 7 km northwest. The choice of the study area was dictated by several criteria, including:

- accessibility of the village ;
- access to information ;
- The practice of charcoal production as a main activity (Girard, 2002;).

III. Research Method

The main task here is to determine whether charcoal burning is indeed a local cause of the deforestation and socio-economic insecurity observed. The answer is obtained from the study of a database collected in the field and through documentation.

The bibliographic investigation consists of collecting information related, in general, to our study theme. It was then completed with information from the webography. Other equally important data were also obtained through interviews with resource persons. Field surveys were then used to collect data from the main people involved in charcoal production: farmers and consumers. We interviewed ten (10) charcoal makers per village, i.e. 30 charcoal makers, five (5) resellers, and ten (10) charcoal users. The choice of these 45 individuals was purely random, as not all the people we spoke to were willing to answer us.

Questions asked of coal miners include when they started making coal, why they started making coal, their understanding of the impacts it generates, and alternatives that might make them decide to stop coal mining (Ministry of Water and Forests, 2000). Resellers were asked about when they started reselling coal and the income they earn from it. For users, the questions were about how much coal they use, and why they are not switching to other, more environmentally friendly fuels. The processing of all the information obtained made it possible to highlight the importance of the factors harmful to the forests, the prospects of this manufacture, and the use of charcoal (Ministry of National Education of Madagascar, 2015).

IV. Results and Discussion

4.1 Distribution of Cultivated Areas by Type of Crop

Relevant facts have been highlighted in the practice of charcoal burning and its impacts in the villages of Ambondrona, Antanifotsy, and Ankaranosy. The data obtained for each questionnaire tends to confirm the unreasonable exploitation of wood resources by charcoal burners who engage in this activity out of necessity.

- The unreasonable exploitation of wood resources, preponderant in the study site

The vegetation cover of Fianarantsoa is predominantly grassy savanna (Haute Matsiatra Region, 2017). The reforested plants, which are introduced species in the region, are mainly Eucalyptus camalduelensis and robusta, Pinus patula, Pinus keshia, Grevillea robusta, and banskii, Cupressus lusitanica (Ramamonjisoa, 1999). They are only intended to be exploited after ten years of their plantation. This is often not respected. 93% of the charcoal burners surveyed admitted to cutting the trees well before their tenth year because large trees are rare.

The fire that inadvertently escapes from stoves can be a source of bushfires. All the charcoal burners interviewed confirmed that they had had at least one experience with a fire escape. The area where the kiln was placed is eroded and the water table is polluted. Moreover, according to the law, the charcoal maker must clear a radius of 50 m around his charcoal-burning site. The destroyed vegetation will only regenerate after several years if it is left as it is. The heat from the kiln will disturb the surrounding wildlife. Coal mining also

produces greenhouse gases, including methane, carbon dioxide, and nitrogen oxides, which contribute significantly to climate change (FAO, 2017).

Large trees are very rare in our study area. Most of the trees are juvenile. Stumps about half a meter above the ground remain in most of these villages. Large eucalyptus and pinus trees, more suitable for charcoal making, are increasingly rare. This affects the coal mining activity, which is no longer able to produce the same income as before, hence the increase in the school dropout rate. Coal miners have stated that the income they earn from their activity is decreasing. They are no longer able to cover their expenses related to the schooling of their children. Although the majority of students attend public schools where fees are lower, the dropout rate is increasing year after year. It stood at 36.1% in 2015 (Ministry of National Education of Madagascar, 2015). Their parents' financial worries prevent them from enjoying their right to schooling.

o Causes for a villager to make coal

Some charcoal makers have been in the business from generation to generation, while others have become charcoal makers out of necessity. Those coal makers who only do this activity out of necessity announced that it is the change in climate and financial difficulties that push them to start making coal. This activity allows them to quickly earn money to support themselves and their families. Rain has become scarce and the crop can no longer produce enough to meet their minimum daily needs. Some of the charcoal burners interviewed said that they did not have enough land for cultivation to meet their minimum needs. This confirms the prediction of the Ministry of Economy and Industry and INSTAT that the number of farms will increase if the average size of farms continues to decrease (INSTAT, 2011). Le revenu qu'ils en tirent est indispensable notamment durant les périodes de soudure. Most of these charcoal makers do not produce charcoal for their own use, but rather to sell to the urban population. 36% of the charcoal makers surveyed admitted to using charcoal for burning a few times. It should not be forgotten that villagers also use wood for other purposes, such as the construction of "varamba" carts, furniture…

4.2 Discussion

The results obtained confirm some points stated in the literature (CIRAD, 2012).

o Charcoal making and socio-economic insecurity, a vicious circle

The manufacture of charcoal is an activity, which is not ready to stop in Fianarantsoa. The charcoal makers need the quick income it generates to support themselves. The increase in their production is caused by the increase in demand in the urban environment (Ranaivoson and al., 2023). Other fuels such as petroleum, which costs 4,000 Ariary per liter, and gas, which costs 6,000 Ariary per kilo, are more expensive than coal, which can be purchased for as little as 200 Ariary per heap for daily cooking needs.

Pressed by this high demand, charcoal makers cut trees without waiting for them to regenerate. The large trees become scarce. The forest is shrinking. The climate is drying up. This further increases the pressure on the forests. This forms a vicious circle that needs to be broken through environmental education and sustainable development. It is also essential to offer them sustainable alternatives for income-generating activity and for the production of household fuel (INSTAT and Ministry of the Economy, 2011).

o Dichotomy between education and forest protection

Education is the very basis of all environmental education aimed at improving the lives of the present and future generations. The Belgrade Charter even stipulates that it represents a tool of transformation allowing the creation of new relationships between man and his

environment (FAO, 2017). Environmental education is, therefore, essential to sustainable development. It initiates a change in civic and citizen behavior. It is based on the observation of an environmental concern resulting from an imbalance between the actions of men on the resources found in the natural environment. This education relative to the environment or (E.r.E) is set up by the decree 2002-751 of the national Policy of Education Relative to the Environment (PERE) in the framework of the implementation of the Charter of the Environment. This law has been adapted over the years to become the Policy of Environmental Education for Sustainable Development P.E.E.S.D., in 2013. Article 4 of the Law on the Malagasy Environment Charter stipulates that "The protection and respect of the Environment are of general interest. It is everyone's duty to safeguard the environment in which they live (Conti and al., 2016). The implementation of the Charter of the Environment would help to alleviate the pressure on the forest and on the natural resources it produces. Awareness of the importance of environmental balance for the well-being of the present and future generations requires a case-by-case approach.

It should be recognized, however, that the results obtained may suffer from some bias. Respondents were afraid of the authorities and were reluctant to give exact figures. They gave only evasive answers and approximations. We also noted a tendency to standardize the answers given.

V. Conclusion

The forest is an ecosystem where fauna and flora are interdependent. The absence or the rarefaction of only one of these entities is enough to alter the whole balance. This would have repercussions on the environment, and just as much in the socio-economic field. To ensure its sustainability, it is essential to preserve the forest by reducing or even eliminating the pressure exerted on it by coal mining. The promotion of environmental education and sustainable development is essential. It must be done in and out of school in order to train responsible citizens who are committed to acting individually and collectively to establish a harmonious environment that guarantees sustainable development. It is recommended to:

- reduce charcoal consumption by promoting an alternative environmentally friendly fuel;
- sustainable wood production and the promotion of reforestation campaigns must be continued to restore degraded forest resources;
- and propose more ecological alternatives for income-generating activities for charcoal makers. These alternatives should facilitate access to a more environmentally friendly fuel for all charcoal users.

References

Benard A.G., Rasamindisa A., Aubert S., Danflous J.P.l. 2015. Synthèse bibliographique sur la filière charbon de bois dans la région Analamanga polarisée par Antananarivo.

CIRAD. 2012. La question de l'énergie domestique à Madagascar.

Conti J., Holtberg P., Diefenderfer J., LaRose A., Turnure J.T., and Westfall L. International Energy Outlook (EIA) 2016 With Projections to 2040. United States: N. p., 2016. Web. doi:10.2172/1296780.

FAO.2017. La transition du secteur du charbon de bois.

Girard P, 2002. Quel futur pour la production et l'utilisation du charbon de bois en Afrique ? Unasylva211, Vol. 53, 2002. INSTAT and Ministry of the Economy, 2011. Periodic Household Survey 2010.

IRG, JariAla, MINENVEF. 2013. Étude sur la consommation et la production en produits forestiers ligneux à Madagascar.

La Gazette de la Grande Île. Offres énergétiques : Les matières ligneuses prédominent. 2019.
Montagne P., Razafimahatratra S., Rasamindisa A., Crehay R.n (éds.), 2010. Arina Le charbon de bois à Madagascar, entre demande urbaine et gestion durable, Antananarivo, CITE.
Randrianarison M.P., Randrianandrasana N. , Raheliarilalao B. . 2021. Flux Des Émissions Aériennes Et De Gaz A Effet De Serre Du Charbon De Bois Par La Méthode d'Analyse De Cycle De Vie.
Ministère des Eaux et forêts. 2000. Étude prospective du secteur forestier en 2020 à Madagascar.
Ministry of National Education of Madagascar. 2015. Education for All: EFA Assessment 2015, Madagascar.
Raharimanaka, L., Razafindratovo, N., Andriatsimisetra, D. 2010. La question de l'énergie domestique à Madagascar et la politique forestière : quelles solutions et perspectives. CITE ; CIRAD, Antananarivo, Madagascar, 21–22.
Montagne, P., Razafimahatratra, S., Rasamindisa, A., Crehay, R. (Eds.), Arina. Le charbon de bois à Madagascar : entre demande urbaine et gestion durable. CITE ; CIRAD, Antananarivo, Madagascar, 21–22.
Ramamonjisoa B. 1999. Rapport de compilation et d'analyse des données existantes sur le secteur des plantations forestières de Madagascar : État des plantations villageoises et familiales malgaches d'aujourd'hui.
Ranaivoson S. L. O., Rakotomamonjy P., Razafindramanga A. W., Razafimahefa M.V., Razafindrakoto N.R.F., Letsara R., Andriatsilavo M.H., Koto-te-Nyiwa Ngbolua, Robijaona Rahelivololoniaina B. (2023) "Valorization of Agricultural Waste into Ecological Coal in the Region of Vakinankaratra" in "Britain International of Exact Sciences Journal (BIoEx-Journal) Volume 5, No. 2.