Typology of agroforestry models in the *Anacardium occidentale* L. (Anacardiaceae) parks of the FARE project: case of the southern and western peripheral zones of the Benoué National Park, Northern Region, Cameroon

Abstract

Biodiversity, a natural biological capital of the earth that presents important opportunities for all societies, provides goods and services essential for human livelihoods and aspirations. Thus, this study aims to investigate agroforestry models of western *Anacardium* parks in the southern and western zones of the Bénoué National Park (North Cameroon), in order to determine the most appropriate system for the study area. More specifically, the aim is to: characterize the diversity of crops associated with *Anacardium occidentale*; estimate crop yields obtained in *Anacardium occidentale* parks; assess the socio-economic and environmental impact of the *Anacardium occidentale* parks established. The Ishikawa tool enabled us to analyze and visualize the socio-economic and environmental impact of the agroforestry parks established, and using the KoboCollect tool, the survey form was drawn up and administered to the producers. Per cashew tree, 25 or more are considered to be exploited for a sample of 100 surveyed out of 300 producers of *Anacardium occidentale*. Crops associated with *Anacardium occidentale* include maize, soya, cowpeas, groundnuts, cotton, yams, cassava, millet and sesame. The most common are cashew-peanut (27 %), cashew-maize (24 %), cashew-cassava (21 %) and cashew-millet (17 %). The results showed that the cashew-rachis system produced 42,800 kg, the cashew-maize system 36,700 kg and the cashew-manioc system recorded the highest production of 46,100 kg. The study also highlighted the potential socio-economic benefits of collaboration between trees and crops associated with the preservation of soil biological activity by cashew trees. Western *Anacardium* plantations offer growers numerous partnership opportunities, with cashew by-products widely consumed, sold and recycled. This integration can have mutual benefits for both partners (trees and crops). This research topic provides added value in the environmental field, in that it provides a solution to the problem of soil degradation from which many

farmers suffer, and increases production while maintaining the soil in a healthy state. It also contributes to achieving the goals of sustainable development, which are to protect biological diversity (ODD15), ensure food security (ODD2) and the living conditions of human populations (ODD3).

Key words: Models, Agroforestry, Park, *Anacardium occidentale*, Systems.

INTRODUCTION

Land degradation is one of the major environmental concerns facing Africa today (Harris *et al.*, 2006). The loss of vegetation cover makes soils more susceptible to water and wind erosion (Alexandrotos and Bruinsma, 2012). The degradation process is also accentuated by population growth and climate variability, with serious consequences for living conditions (Favretto *et al.*, 2018), In Cameroon, as a result of demographic and socio-economic pressure, the introduction of unsustainable production techniques, overgrazing and the overexploitation of energy resources (deforestation around towns and villages), crop yields are falling despite organo-mineral fertilization, soil properties are deteriorating in relation to fertility, and degraded land (> 20 % of arable land) is being denuded (Roose *et al.*, 2011). The North Cameroon region is subject to significant direct pressure (demographics, migration linked to cross-border conflicts and mining activities) and indirect pressure (climate change) on protected areas. Protected areas also act as migration corridors for wildlife, habitats, biodiversity and, more generally, the natural resources of these areas and therefore the livelihoods of the communities living there. Hence the implementation of the FARE project (Support for the cashew nut industry, the restoration of degraded areas and the resilience of ecosystems and communities around protected areas in North Cameroon) (CERAF-Nord, 2022). Today, land as a production factor has become increasingly scarce, raising the issue of land management and soil fertility. One of the objectives of rural development policy is to increase agricultural production by 5-10 % per year through the sustainable management of natural resources (Wend-Kuni, 2014). Agroforestry systems then present themselves as an alternative by creating a close synergy between forestry and agriculture. They contribute to the livelihoods of 70 % of the population and represent a key to rural development (Adjahossou, 2013). Thus, the main objective is to determine the most profitable western *Anacardium* park model in the cropping system to the south and west of the Benoué National Park. More specifically, the aim is to: characterize the diversity of crops associated with *Anacardium occidentale*; estimate crop yields obtained in *Anacardium occidentale* parks;

assess the socio-economic and environmental impact of the *Anacardium occidentale* parks established.

MATERIALS AND METHODS

Study zone

The present study was carried out on the outskirts of the National Park, to the south (Sassa Mbersi, Sassa Garda, Sassa Sockwa and Vourgne Mamboum) and to the west (Guidjiba, Banda and Bawan). The departments of Vina and Mayo-Rey are among the country's favourable regions for the production of *Anacardium occidentale* (Eric, 2003). The study area lies between latitudes 7°30'0" and 8°30'0" North and longitudes 13°12'0" and 14°24'0" East. This area was chosen because it contains plantations of *Anacardium occidentale*, used in their agroforestry park system. It was also chosen on the basis of its level of production, which is among the highest, and the age of its plots. The study site is a traditional farming and livestock-raising area, and the population carries out other related activities such as trading, gold panning, hunting and beekeeping.

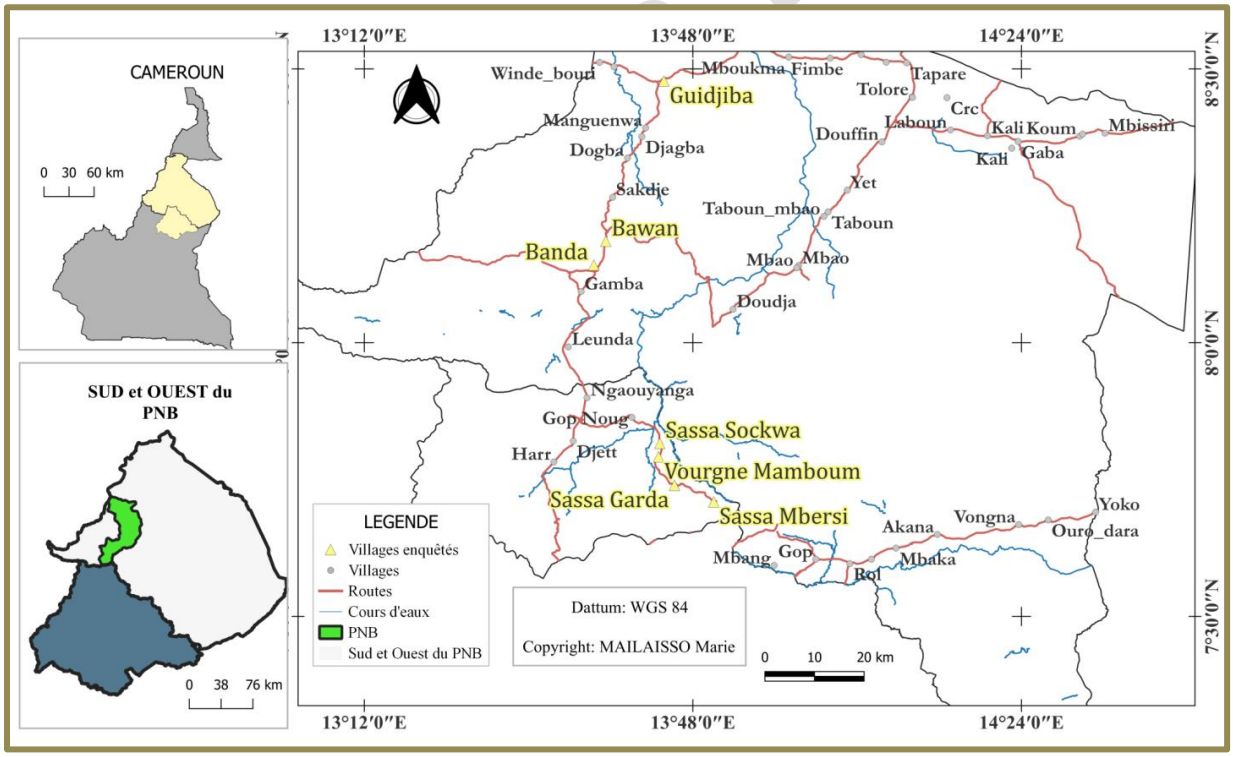

Figure 1 : Location map of the South and West of the BNP

METHODS

Socio-economic and socio-cultural surveys

Using the KoboCollect tool, the survey form was drawn up and administered to farmers using a tablet. To do this, a stratified random sampling of farmers from the 07 villages mentioned above was carried out. At the level of each locality identified, farmers were selected according to the size of their plots ranging from 1⁄4 ha to 1 ha. Per cashew foot, we consider from 25 exploited feet for a sample of 100 surveyed out of 300 producers of *Anacardium occidentale* in cultivation association listed in the survey frame on a sample of one hundred 100 producers spread over several villages in the commune of Tcholiré and Mbé, as shown in Table 3.

Table 1: Villages surveyed

N°	Villages	People surveyed
1	Banda	6
2	Bawan	26
3	Guidjiba	13
4	Sassa Garda	4
5	Sassa Mbersi	42
6	Sassa Sockwa	5
7	Vourgne Mamboum	4
Total		**100**

Estimation of yields of crops associated with *Anacardium occidentale*

The comparative method was used to evaluate the yields of crops associated with cashew. In other words, to find points of convergence or divergence favouring the yields of the southern and western zones of the Benoué National Park on the Cashew-Maize, Cashew-Peanut, Cashew-Cassava association.

It made it possible to measure yields from different angles, which necessarily provokes reflection. In short, the aim is to understand the real factors behind performance and to determine what stimulates yield efficiency. In order to carry out this comparative analysis of the two approaches, we looked at aspects such as climate, soil in relation to the type of fertilizer used, temperature and rainfall.

In order to structure this section, we developed different plans, in particular presenting a portrait of each of the two approaches, one after the other (based on the points to be compared), and then ending with a summary outlining the similarities or differences between the two. Another way of doing this is to first present the similarities between the two approaches. Then discuss their differences, and finish with a summary of what has been learned from the extent of these similarities.

Cashew nut seedling production process

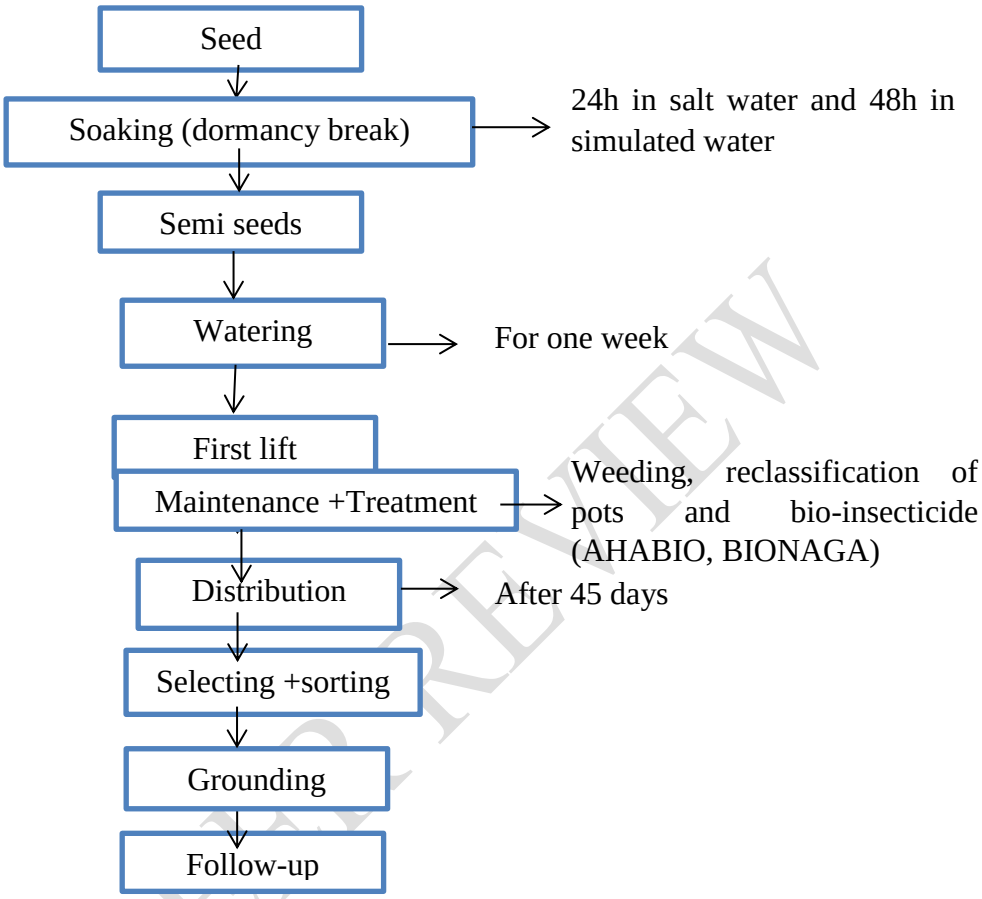

Figure 2: Setting up the nursery

Ishikawa method

Analyzing and visualizing the socio-economic and environmental impact of the agroforestry parks set up was facilitated by the Ishikawa tool, which was developed by KAORU Ishikawa in 1962. The Ishikawa diagram was used to understand how the western *Anacardium* parks had an effect on the area's inhabitants on a social, economic and environmental level. It also made it easier to analyze the relationship between an effect and all the possible causes.

The Ishikawa diagram or cause-effect diagram, also known as the 5 M method, takes the form of a fishbone graph categorized according to the 5 M law. It was constructed in the following five stages :

Stage 1. The arrows were pointed horizontally towards the problem ;

Stage 2. Using the "brainstorming" method, potential causes were grouped into families, commonly known as the 5 M, which are:

M1-Materials: raw materials, parts, assemblies, supplies, identification, storage, quality, handling, quality and all components used in the production process;

M2-Materials: machines, tools, equipment, capacity, age, number and means of production;

M3-Workforce: employees, training, experience, skill issues, organization and management;

M4-Environment: physical environment, layout, relationships, temperature, climate and market ;

M5-Methods: technique, procedure and operating methods.

Stage 3. Draw the secondary arrows corresponding to the number of families of potential causes identified and connect them to the main arrow. Each secondary arrow identifies one of the families of potential causes.

Stage 4. Write the causes associated with each family on mini arrows. Make sure that all the potential causes appear.

Stage 5. Among the potential causes shown, look for the actual causes to be identified.

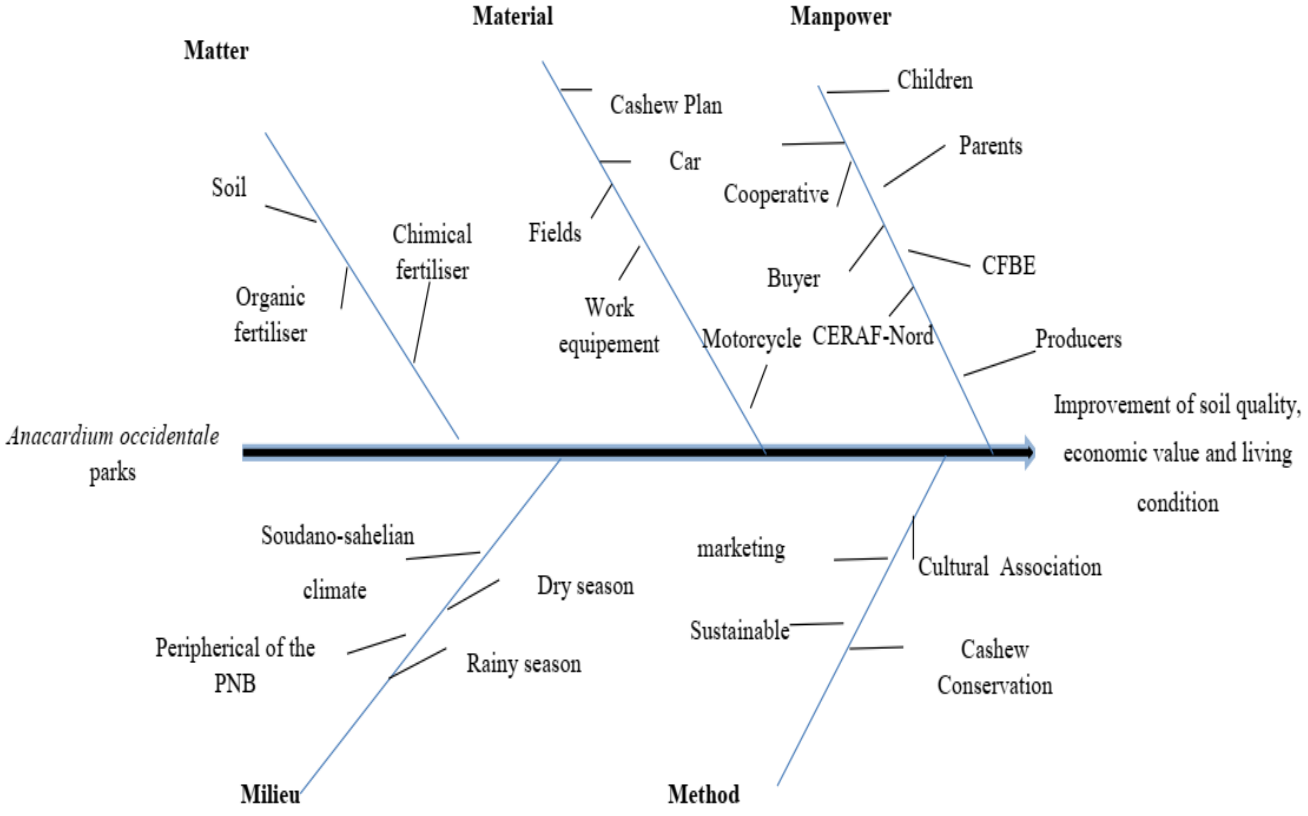

Figure 3: Ishikawa diagram

RESULTS AND DISCUSSION

Characterization of crops associated with *Anacardium occidentale*

Characteristics of people surveyed

Table 3 describes the people surveyed in the study area. The table shows that the majority of growers surveyed were men (86 %), with few women, which means that they are even less involved in this agroforestry practice. However, the commune of Mbé has a larger number of producers (55 %) than the commune of Tcholiré (45 %), which can be explained by the fact that in the villages of Sassa Mbersi, Sassa Sockwa, Sassa Garda and Vourgne, some producers already had cashew trees in their fields even before the project arrived. However, in the villages of Bawan, Banda and Guidjiba, the project arrived 2 years later. The age structure of the farmers shows that the older ones (40-50 years old) practise this technique more than the younger ones (20-30 years old), who are even less numerous to do so.

Table 2: Descriptive statistics of respondents in the study area

Factor	Factor level	Number	Percentage
Sex	F	14	14%
	M	86	86%
Town	Mbé	55	55%
	Tcholiré	45	45%
Level of education	Illitterate	16	16%
	Primary	40	40%
	Secondary	40	40%
	University	4	4%
Age	20-30	13	13%
	30-40	27	27%
	40-50	40	40%
	More than 50	20	20%

Characterization of cashew trees in the south and west of the BNP

The age of cashew trees surveyed varied greatly, ranging from 1 to >10 years. Figure 5 presents the ages of the cashew trees, showing that the majority of cashew trees are 5 years old, i.e. 30.92 % of those surveyed, and few cashew trees are 8, 9, 10 and >10 years old, i.e. 1.03 % and 2.06 % respectively. The area of land used varies considerably, which justifies the choice made by each grower according to his or her means. Some growers grow these crops on large areas (over 1 ha), while others grow them on small areas.

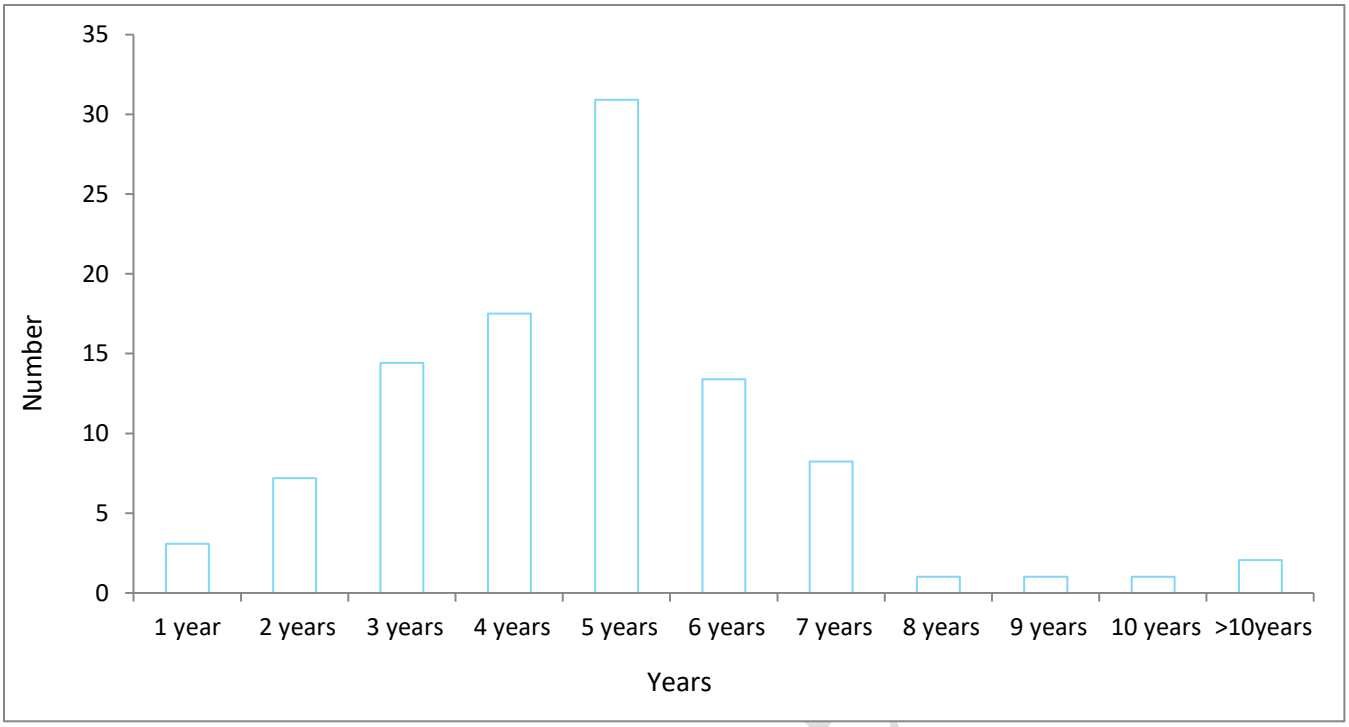

Figure 4 : Presentation of cashew tree ages

Areas of cropping associations in the south and west of the BNP

Areas devoted to cropping associations with western *Anacardium* are shown in Figure 5. This pie chart of area representation according to grower shows 38 % of growers devoting 1⁄4 of their plot to the agroforestry system and 16 % who do so in 5 ha.

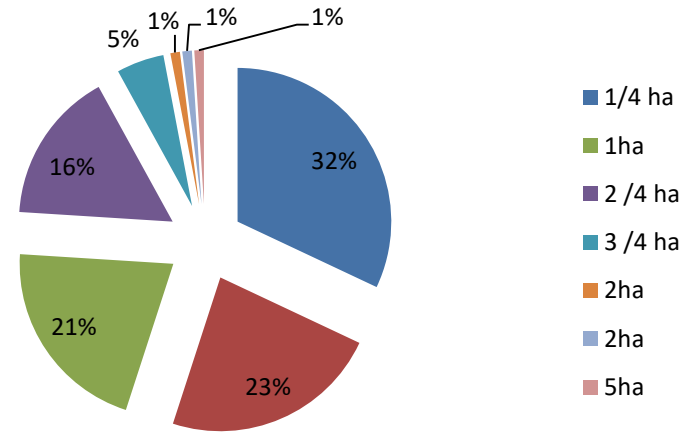

Figure 5: Area under crops associated with *Anacardium occidentale*

Typology of agrosystems based on *Anacardium occidentale* in the south and west of the BNP

A diversity of crops has been identified in the south and west of the BNP. These include simple crops that are not associated with any tree or other crop, and crop associations in which two or more types of crop are found in the same plot.

A wide variety of cashew-based agroforestry systems were encountered in the two (02) communes surveyed. These were the Cashew-Maize, Cashew-Soybean, Cashew-Niebe, Cashew-Peanut, Cashew-Cotton, Cashew-yam, Cashew-Cassava, Cashew-Millet and Cashew-Sesame systems. Of the 100 farmers surveyed, all practise seasonal crop rotation, with no crop grown on the same plot every year. Figure 7 shows the distribution of the nine (09) agroforestry systems used in the south and west of the BNP.

Of the nine (09) systems identified as the main ones practised in the study area, the most frequent are: Cashew-Peanut, Cashew-Maize, Cashew-Millet and Cashew-Cassava. These are followed by four (04) relatively less frequent varieties: Soya, Yam, Cotton, Cowpea and Sesame. The figure shows that the cashew-raspberry combination is the most popular with farmers, with 27 %, followed by cashew-maize, cashew-manioc and cashew-millet with 24 %, 21 % and 17 % respectively. Not all crops associated with *Anacardium occidentale* are favourable, as is the case with the Cashew-Niebe (4 %), Cashew -Cotton (4%), Cashew-Soybean (1 %), Cashew -Yam (1 %) and Cashew -Sesame (1 %) systems.

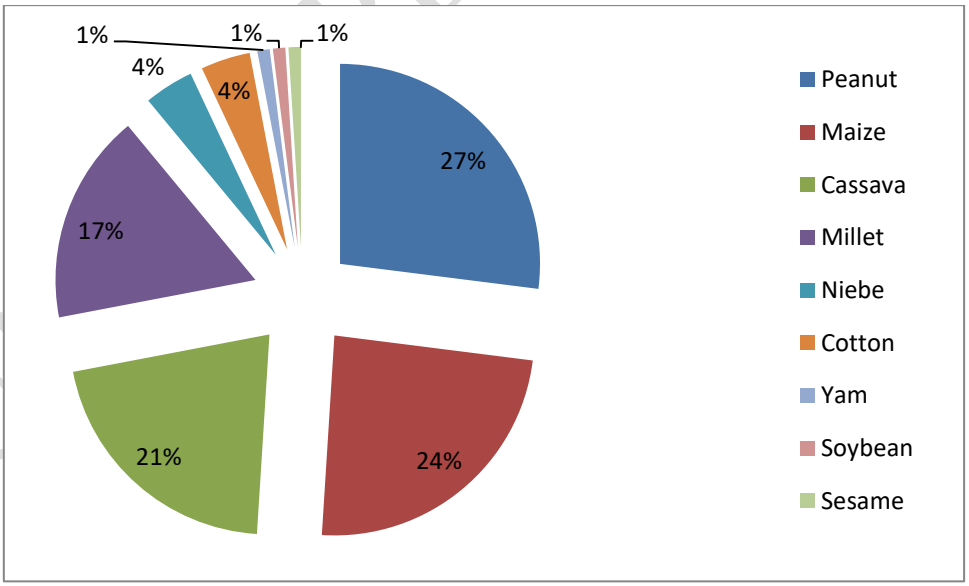

Figure 6: Crop with favourable development with *Anacardium occidentale*

The images below show some of the types of association identified to the south and west of the BNP. Image A shows a cashew-may association and image B shows a cashew-cassava association.

Photo 1: Cashew -Maize

Photo 2: Cashew -Cassava

Photo 3 : Cashew -Peanut

Photo 4 : Cashew -Millet

Effect of crop association with *Anacardium occidentale*

Across the study area, a total of (03) reasons encouraged growers to do more of this agrosystem (cashew + crops): annual crops with cashew were cited (Figure). The main advantage cited is opportunity (39 %), which can be explained by the fact that *Anacardium occidentale* has led some projects to take an interest in, or even set up in, the study area. The figure below shows all the different reasons why growers use this system.

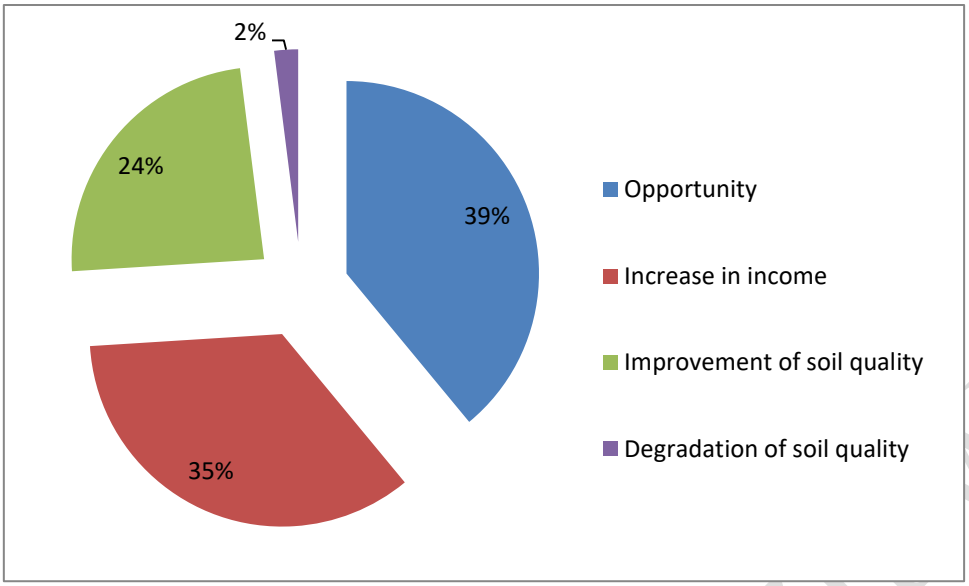

Figure 7: Impacts of associating crops with *Anacardium occidentale*

Yields of cashew associations with crops

Cashew-Peanut system

Peanut is one of the most popular crops in the association system found in the south and west of the BNP. It is widely traded, as it is found everywhere in the markets and nowadays at a high price. Diagram 9 shows the yields obtained in the cashew-raspberry system by area. Yields range from 1200 kg to 18400 kg/ha/year. Producers with more than 1 ha are more numerous. The total yield is 42,800 kg, or 42.8 t higher than the yield obtained in the cashew-peanut system.

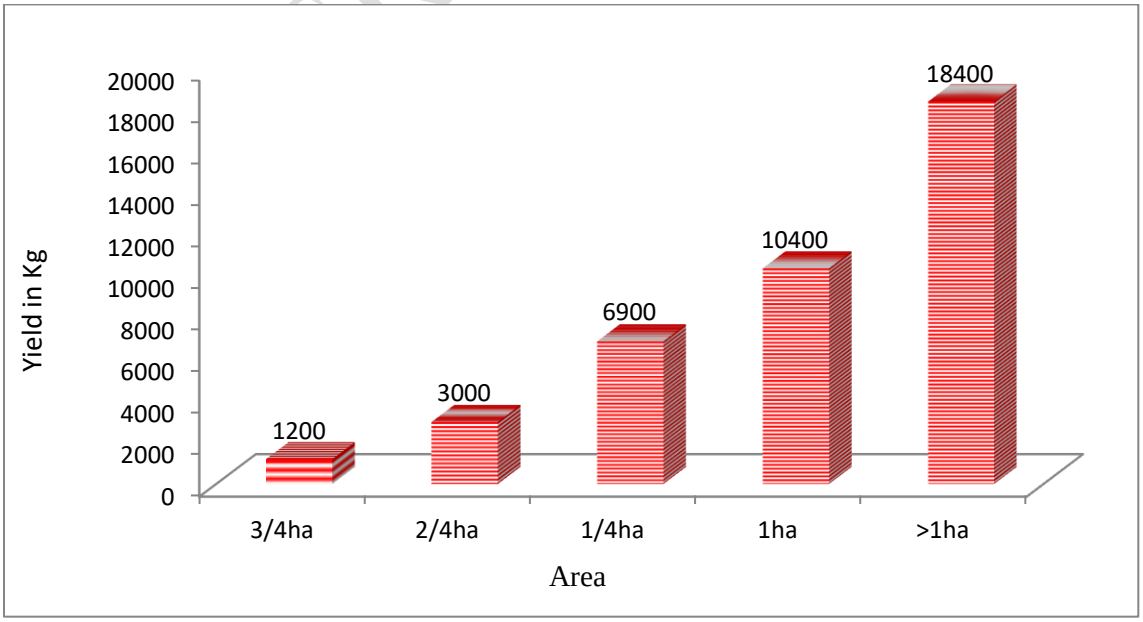

Figure 8: Cashew-Peanut system yield per area

Cashew-Maize system

Maize is also a crop much used by people in the south and west of the BNP. It is considered an essential crop, as it appears again and again in the list of respondents. This is because the crop is used in several ways, for consumption, for marketing and also for processing (traditional drink). During the surveys, people grew this crop at least once a year in their fields. Figure 10 shows maize yields by area in 2023. It should be noted that yields range from 1,400 to 10,800 kg per/year over an area ranging from 3⁄4 to over more than 1ha. This diagram represents the yield quantities obtained in each area. Representing 27 % of those who made the cashew-maize association, 36,700 kg of maize was harvested, i.e. 36.7 t.

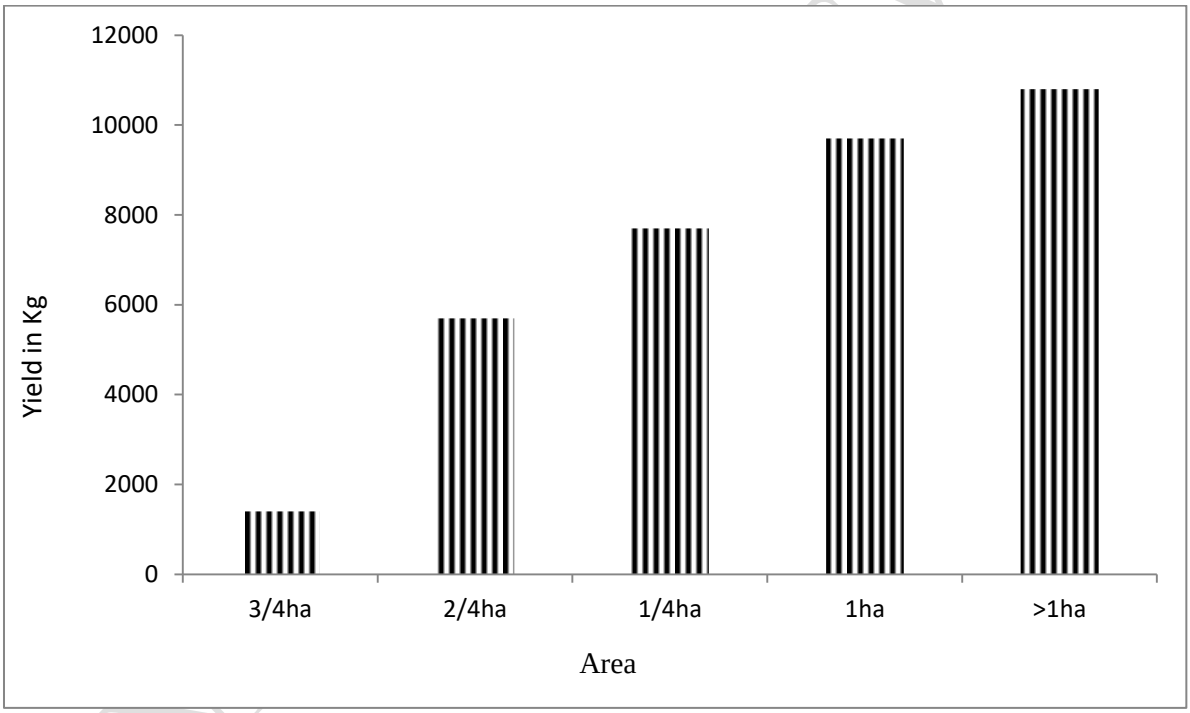

Figure 9: Yields of the cashew-maize system per area

Cashew-Cassava system

Cassava is not only consumed, but for most producers it is also sold. The villages in the south of the BNP (Sassa Mbersi, Sassa Sockwa, Sassa Garda and Vourgné) produce the most cassava. The yield of this system is shown in Figure 11. This diagram shows that cassava is grown on larger areas than other crops. Yields range from 600 kg to 28,600 kg for a total of

46,100 kg, or 46.1 t. This gives a higher yield than other types of system. Few grow it, but the yield remains higher than the others.

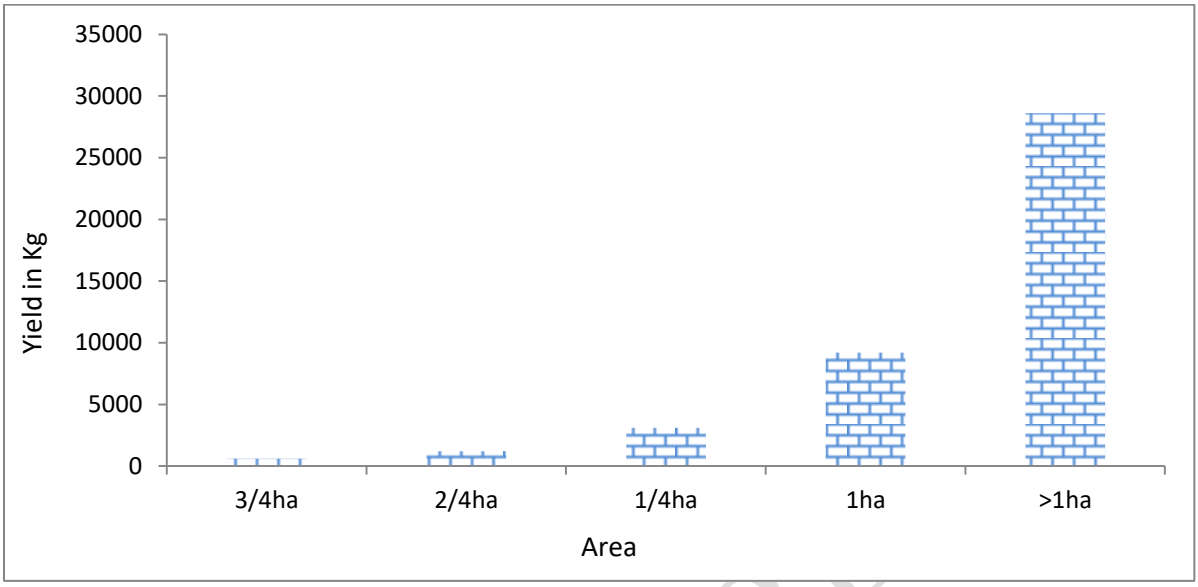

Figure 10: Cashew -Cassava system yield per area

Social, economic and environmental impact of *Anacardium occidentale* parks on the population of the south and west of the BNP

Economic level

Anacardium occidentale is one of the most economically valuable plants. All activities revolving around it are profitable, and those who produce it make a lot of money. The different routes taken by cashew nuts in the southern and western peripheries of the BNP appear relatively simple, but involve several players. A schematic representation of these routes is shown in Figure 12. In each case, the behaviour of the economic players is based on maximizing profit and minimizing costs. The first link is used by producers seeking liquidity. The second link is taken by producers taking part in group sales initiated in the two departments. Producers who use this channel aim to reduce the marketing chain and sell their nuts at a better price.

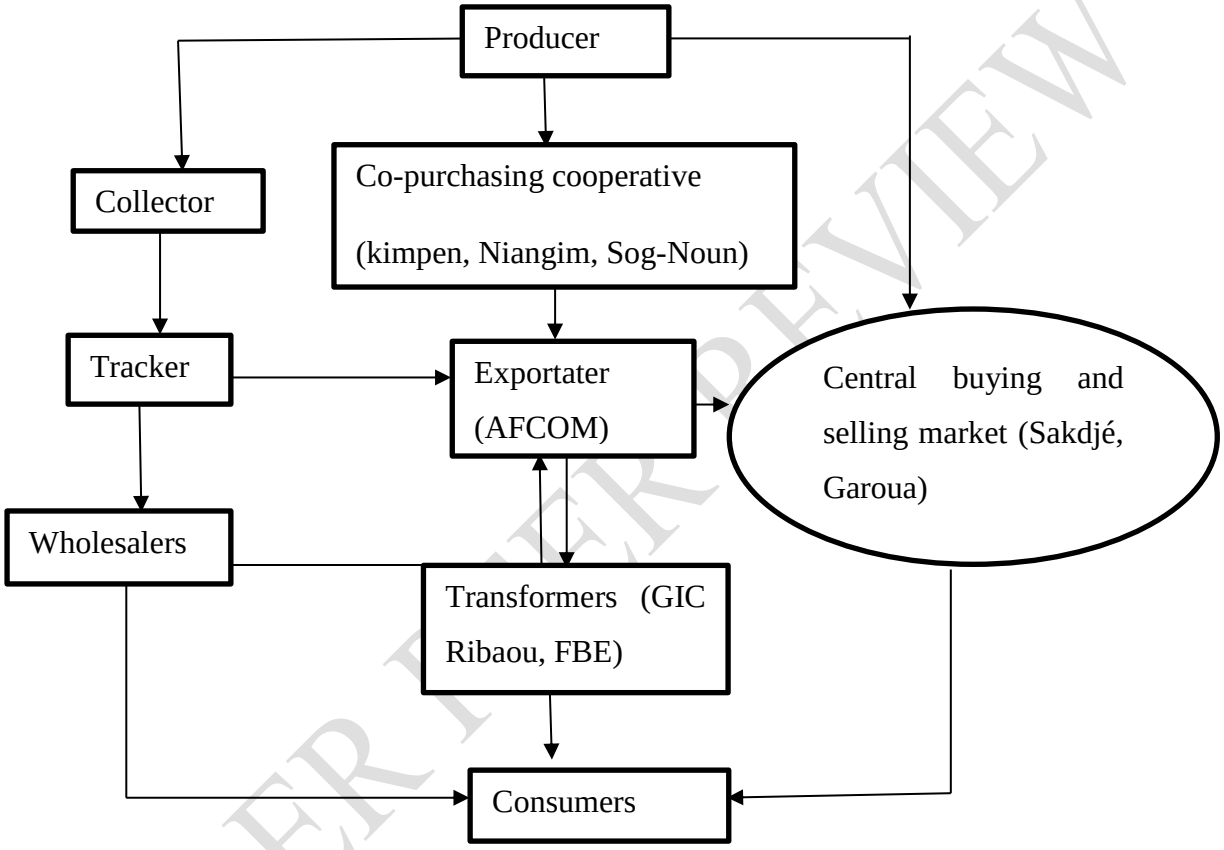

Figure 11: Marketing circuit for cashew nuts on the southern and western periphery of the BNP

Economic impact

Figure 13 uses the Ishikawa tool to show the effect of western *Anacardium* parks on economic value. The environment is a great advantage for marketing, as it is accessible. This is demonstrated by the presence of the N^0 1 national road, which covers the entire western part of the Park, and the southern road, which is in full expansion, facilitating the movement of cashews. In addition, the production zone is favourable to the growth of *Anacardium occidentale*, boosting its productivity, and demand for nuts and apples is increasing. This is

due to the popularization of knowledge about these species, the setting up of organizations that attract buyers and the involvement of farmers in the production chain.

The workforce is essentially family-based, which can be explained by the fact that the population does not have sufficient means to buy working machinery. Here, the CERAF-Nord facilitators, through their experience and working closely with the growers, help them to improve their production using new techniques and knowledge.

On *Anacardium occidentale*, the most widely marketed products are apples and walnuts. The apple is bought either for consumption or for processing into cashew juice and syrup by the FBE company. The local population is well organized in its marketing system, with cooperatives in Kimpem, Ymgim and Soc-Nou. The price of nuts is fixed at 250g per kg, but apples have no fixed price; they are sold according to demand and the availability of apples, which are only available from January to February.

The organizations form sales partnerships with the producers, and when the apples are available, they come and collect the product. These organizations are African Commodity, CERAF-Nord and individual exporters. Some growers use chemical products, while others opt for organic fertilizers, which has an impact on the quality of the product, which nevertheless remains in high demand. From production to marketing, the equipment used is basic: tarpaulins, shovels, machetes, wheelbarrows and so on.

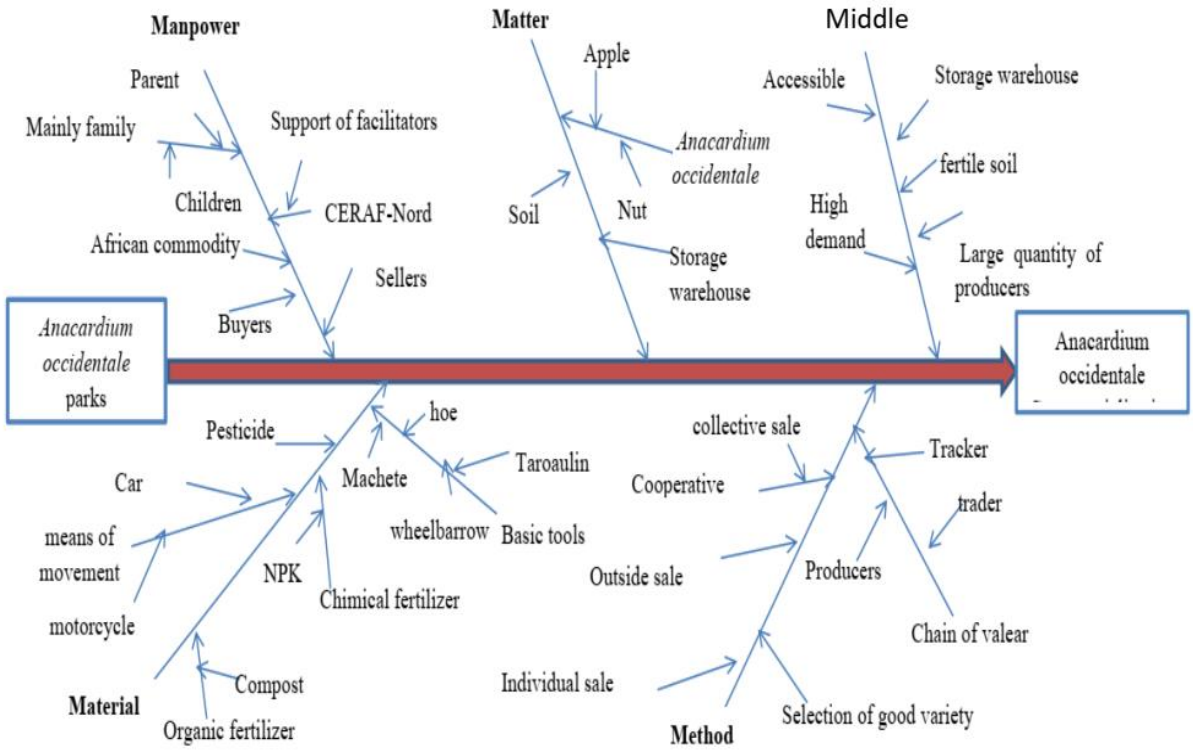

Figure 12: Economic impact of *Anacardium occidentale*

Social impact

Anacardium occidentale parks have helped to improve social conditions in the locality studied. The involvement of children and parents already shows that *Anacardium occidentale* plays an important role in their diet, in that products derived from the cashew tree are widely consumed (apples). Diagram 16 shows their effect on the social conditions of people in the south and west of the BNP. It shows that, thanks to the agroforestry parks, people have organized themselves into cooperatives, which makes leadership easier. Women have the opportunity to give their opinion and to work with the men. Some women have their own cashew trees, the income from which is gradually giving them financial independence, and they are able to send their children to school.

They are better organized to manage conflicts between producers and herders through local monitoring and awareness-raising. They have several partnership opportunities with the organizations present in their villages, which organize training sessions to improve their skills. In May, CERAF-Nord set up a training course on juice and syrup production.

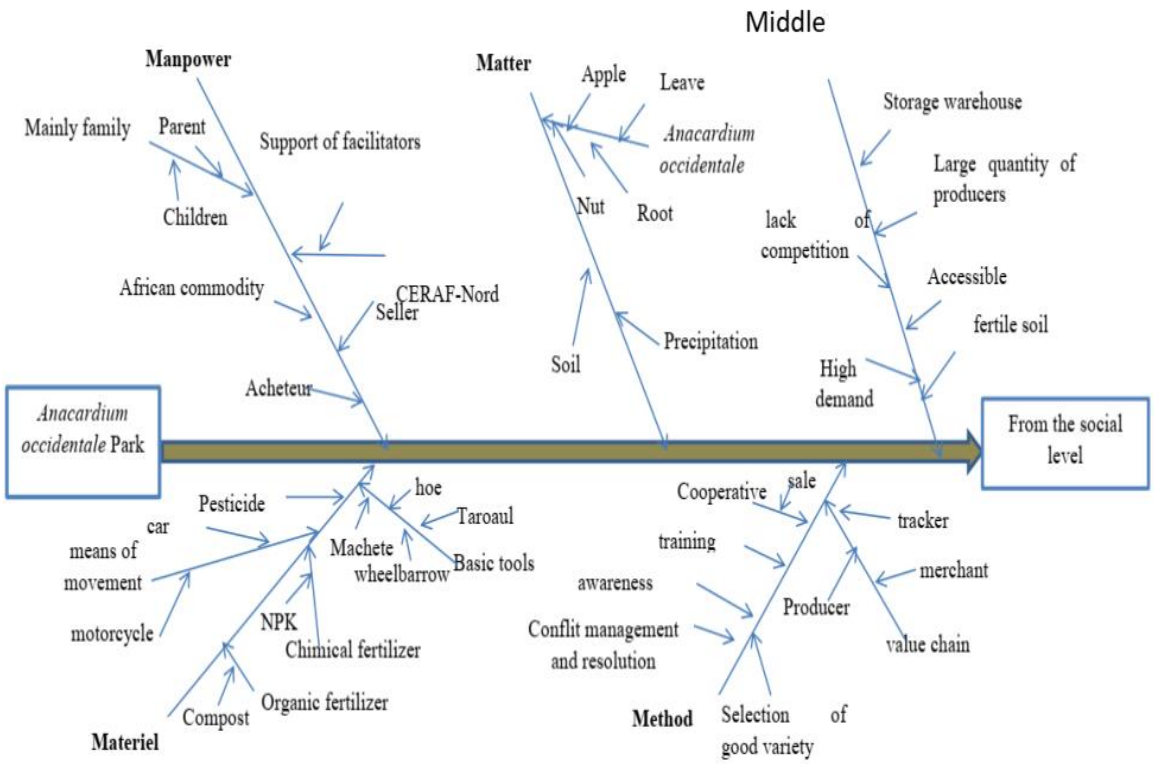

Figure 13: Effect of *Anacardium occidentale* plantations on social conditions

Environmental level

Diagram 17 has been used to determine the effect of *Anacardium occidentale* plantations on the environment, setting out all the elements involved.

The equipment used by growers is traditional and has no impact on soil quality. Except for those using chemical fertilizers, which are more common in the western part of the park, not all of which guarantee a healthy soil and also do not all contribute to respect for the environment.

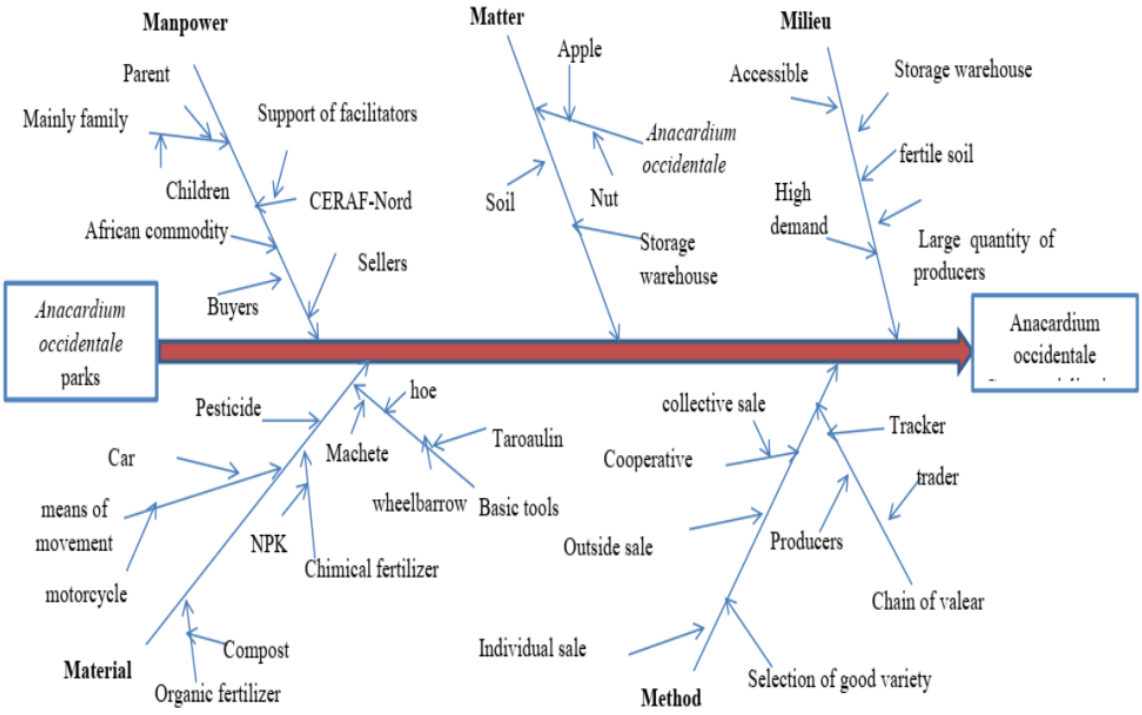

Figure 14: Environmental impact of *Anacardium occidentale* parks

Discussion

The integration of trees into agricultural production systems has long been practised by farmers (Dupraz and Liagre, 2008). This integration can have reciprocal benefits for both partners (trees and associated crops), with each gaining from the other. Trees play a number of roles when combined with crops. Among other things, they maintain the biological activity of the soil through tree-soil-microorganism interactions (Altieri and Rosset, 2002). In this way, they help to recycle the mineral elements in the soil that are essential to the life of trees and crops. The mechanical effect of their roots helps to fix the soil and decompose the litter, which is often the main source of nutrients for plant growth (Bayala *et al.*, 2002). This shows that materials such as leaves, apples and *Anacardium occidentale* nuts, when they fall and decompose, enable the litter to be incorporated into the soil, forming stable aggregates, with the mixture of organic matter and clay particles forming compost in a natural way that promotes soil fertilization (Maithya et al., 2006; Neupane and Thapa, 2001). Indeed, when litter is removed from the soil, it leads to the creation of humus, the degradation of which subsequently releases mineral elements that are easily assimilated by plants (Kajembe *et al.*, 2005). Soil organic matter is also a carbon sink and a source of energy and nutrients for crops (Swart *et al.*, 2001). However, the North Cameroon Region is under considerable direct pressure (demography, migration linked to cross-border conflicts, human activities and human

habitats) and indirect pressure (climate change) on protected areas (Montambault and Alavalapati, 2005). They also have an impact on wildlife migration corridors, habitats, biodiversity and, more generally, the natural resources of these areas and therefore the livelihoods of the communities living there (Rasul and Thapa, 2004). Today, land as a production factor has become increasingly scarce, raising the issue of land management and soil fertility. One of the objectives of rural development policy is to increase agricultural production by 5-10 % per year through the sustainable management of natural resources (Wend-Kuni, 2014). Thus, this practice in the study area is dominated mainly by men. These results corroborate those of Adama *et al.* 2023, which were carried out in northern Cameroon and which also showed that cashew nut production is an activity largely dominated by men, the majority of whom are elderly. Agroforestry systems offer an alternative by creating a close synergy between forestry and agriculture (Girardin and Liagre, 2008). They contribute to the livelihoods of 70 % of the population and are a key to rural development (Adjahossou, 2013). In North Cameroon, more specifically around the Benoué National Park, agroforestry is practised and used with crops such as maize, soya, cowpeas, groundnuts, cotton, yams, cassava, millet and sesame. Local and exotic species such as *Anacardium occidentale* are also widely used. However, given the relatively low level of knowledge about this species, it can be favourably combined in a profitable agroforestry system in association with *Anacardium occidentale*. Studies by Houndagnon (2019) on the typology of cashew-based agroforestry systems in central Benin, specifically in the communes of Dassazoumé, Glazoué and Bantè, reveal systems that are almost identical to those identified in the south and west of the PNB. In Senegal, and more particularly in Casamance, annual crops are often combined with cashew plantations in order to intensify yields, although the ecological impact of cashew on soil fertility is not well known. However, a study of the physico-chemical properties of soils under and outside the cashew tree canopy revealed that many of the mineral elements that characterize the fertility level of the soil substrate were higher under the cashew tree canopy than in the area outside the canopy. The highest levels of total carbon, total nitrogen, available phosphorus, organic matter and exchangeable potassium were obtained on soils under cover (Seydou *et al.,* 2020). In West Africa, some logging groups have organized themselves to better manage cashew agroforestry parks and the constraints associated with this practice (Yoni, 2023). The reforestation of multi-purpose trees, such as cashew plantations, has been identified locally as one of the priority options that can help restore the environment in this sensitive agro-ecological zone of the Sudano-Sahelian savannah and support the emergence of

green value chains that promote the local development of local communities and strengthen their ability to adapt to the effects of climate change (Tilman *et al.*, 2001).

CONCLUSION

In summary, the aim was to analyze the agroforestry models of the western *Anacardium* parks of the FARE project: the case of the southern and western peripheral zones of the Benoué National Park (North Cameroon), with the aim of determining the most profitable western *Anacardium* park model in terms of the cultural system in the south and west of the Benoué National Park. In particular, the aim was to characterize the agrosystems in the southern and western peripheral zones of the Benue Park, analyze the performance of the crops obtained and assess their impact on society, the economy and the environment. The characterization of the diversity of crops associated with *Anacardium occidentale* enabled us to determine that there are 09 nine systems, including Cashew-Maize, Cashew-Soybean, Cashew-Niebe, Cashew-Peanut, Cashew-Cotton, Cashew-Yam, Cashew-Cassava, Cashew-Millet and Cashew-Sesame aged from 01 to >10 years spread over 1/4 to more than 1ha, of which the most popular are: Cashew-Peanut (27 %), Cashew-Maize (24 %), Cashew-Cassava (21 %) and Cashew-Millet (17 %). The yield obtained in the cashew-corn combination was 36,700 kg, equivalent to 36.7 t. The cashew-peanut system produced a total of 42,800 kg, equivalent to 42.8 t, while the Cashew-Cassava system produced a yield of 46,100 kg, equivalent to 46.1 t. As far as the socio-economic effects are concerned, the Western *Anacardium* plantations offer producers numerous partnership opportunities: they can easily provide for themselves and their families, and cashew by-products are widely consumed, sold and recycled. As far as the environment is concerned, this integration can have mutual benefits for both partners (trees and associated crops) where each benefits from the other. Indeed, the biological activity of the soil is maintained by the cashew trees thanks to the interactions between the tree and the soil and the micro-organisms. The leaves and apples of *Anacardium occidentale*, when they fall and decompose, constitute a fertilizer that promotes the growth and development of the crops.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

REFERENCES

1. Adama R., Teweche A., Balna J. and Sali B., 2023. Characterization of Anacardium occidentale l in northern Cameroon: the case of the Garoua III terroir. Les cahiers de l'Acaref. 3-7 pp.

2. Adjahossou N.V., Adjahossou S.B., Dovonou F., Adjahossou F.D. and Boko M., 2013. Evaluation of the territorial intensity of two moderately fertilized associated cropping systems in southern Benin. Int. J. Biol. Chem. Sci: 7(6): 2233-2247pp.

3. Alexandratos N. and Bruinsma J., 2012. World agriculture towards 2030/2050: The 2012 Revision, ESA Working Paper No.12–03, Rome: FAO 72-159pp.

4. Altieri M. and Rosset P., 2002. Ten Reasons Why Biotechnology Will Not Ensure Food

Security, Protect the Environment or Reduce Poverty in the Developing World.

In Ethical Issues in Biotechnology, R. Sherlock and J.D. Morrey, eds. (New York:

Rowman & Littlefield), 175-182 pp..

5. Aoudou D.S., 2010. Dynamics of woody vegetation cover in the Upper Benue Valley in Northern Cameroon. 307pp.

6. Bayala J., Teklehaimanot Z. and Ouedraogo S.J., 2002. Millet production under pruned

tree crowns in a parkland system in Burkina Faso. Agrof. Syst. 54: 203-214pp.

7. CERAF-Nord. 2022. Strategic Plan. 10-30 pp. ww.ceraf-nord.org.

8. Dupraz C. and Liagre F., 2008. Agroforestry – Trees and crops. Editions France Agricole, 410 p.

9. Eric L., 2003. Cashew trees, cashew nuts and the cashew sector in Bassila and Benin. Bassila Forest Resources Restoration Project, GFA Terra Systèmes and GIZ. pp22-39.

10. Favretto N., Dougill A., Stringer L., Afionis S. and Quinn C. 2018. Links between climate change mitigation, adaptation and development in land policy and ecosystem restoration projects: Lessons from South Africa. Sustainability 10 (3): 779-788pp.

11. Fomekong T.S., 2014. Evaluation of ecosystem services in the Benue Biosphere Reserve (northern Cameroon). Master's thesis in Forestry Sciences. University of Yaounde I. 3-5 pp.

12. Girardin N. and Liagre F., 2008. Agroforestry, producing differently, 65-minute DVD, Agroof Production. Liagre F., 2007, Rural hedgerows. Editions France Agricole, 320 p.

13. Godwe G.J.M., 2015. Impact of anthropogenic activities on the fragmentation of wildlife habitats: the case of the Benue National Park. pp116.

14. Harris J.A., Hobbs R.J., Higgs E. and Aronson J., 2006. Ecological restoration and global climate change. Restoration Ecology 14 (2):170 –76pp.

15. Houndagnon T.P., Adjahossou V.N. and Gbemavo C., 2019. Typology of cashew-based agroforestry systems in Central Benin (Dassazoumé, Glazoué and Bantè). Proceedings of the 3rd international scientific conference, kara: https://www.researchgate.net/publication/357684020 .pp30.

16. Kajembe G.C., Julius F., Nduwamungu J., Mtakwa P.W. and Nyange D.A., 2005.

Impact of indigenous-based interventions on land conservation: a case study of a

soil conservation and agroforestry project, Arumeru District, Tanzania. Land Deg.

& Dev. 16:311-325pp.

17. Maithya J.M., Kimenye L.N., Mugivane F.I. and Ramisch J.J., 2006. Profitability of

agro-forestry based soil fertility management technologies: the case of small holder

food production in Western Kenya. Nut. Cyc. in Agroecosyst. 76:355-367.

18. Mbamba J.P., Ntumwel B., Kamgang S. and Bobo K.S., 2014. Status of the mammalian fauna of the Benue National Park complex and hunting interest zones 1 and 4: inventory report. Cameroon. 70p.

19. Montambault J.R. and Alavalapati J.R.R., 2005. Socioeconomic research in agroforestry: a

decade in review. Agrof. Syst. 65: 151-161.

20. Neupane R.P. and Thapa G.B., 2001. Impact of agroforestry intervention on soil fertility

and farm income under the subsistence farming system of the middle hills, Nepal.

Ag., Ecosyst. & Env. 84: 157-167.

21. Rasul G. and Thapa G.B., 2004. Sustainability of ecological and conventional agricultural

systems in Bangladesh: an assessment based on environmental, economic and

social perspectives. Ag. Syst. 79: 327-351.

22. Roose E., Zougmore R., Stroosnijder L., Dugue P. and Bouzou M., 2011. Traditional techniques for restoring the productivity of degraded soils in semi-arid regions of West Africa. 2-5 pp.

23. Seydou N., Mohamed M.C. and Malaïny D., 2017. Characterization of cashew (Anacardium occidentale L.) plantations in Balantacounda: the case of the communes of Kaour, Goudomp and Djibanar (Casamance/Senegal). European Scientific Journal. 13 (12): 5-7 pp.

24. Siroma J., 2007. Impact of human activities on protected areas in the Northern Province: Case of corridors in the Benue National Park complex. DESS (Specialized Higher Education Diploma) thesis. Regional Center for Specialized Education in Agriculture (CRESA) forest-wood. Yaoundé, Cameroon. 65 p.

25. Swart J.A.A., van der Windt J.H. and Keulartz J., 2001. Valuation of Nature in

Conservation and Restoration. Rest. Ecol. 9: 230-238.

26. Tilman D., Reich P.B., Knops J., Wedin D., Mielke T. and Lehman C., 2001. Diversity

and Productivity in a Long-Term Grassland Experiment. Science. 294: 843-845.

27. Wend-kun B.J., 2014. Typology of mango and cashew agroforestry systems in the Kotoudeni Terrom (Kenedougou): impact on agricultural production. Master's thesis in Management and Development of Forest Ecosystems. Polytechnic University of Bobo-Dioulasso (UPB). 1-8 pp.

28. Yoni M., Issaka S. and Yempabou Y.E., 2023. Characterization of Agroforestry Parks with Anarcadium occidentale L. and Ecosystem Services in the Dindéresso Classified Forest in Western Burkina Faso. European Scientific Journal. Vol.19, No.27.pp 4-3.