

CONTRIBUTION OF ASSISTED NATURAL REGENERATION (ANR) TO IMPROVING THE LIVING CONDITIONS OF THE POPULATIONS OF THE URBAN MUNICIPALITY OF TIBIRI

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Abstract

This study on the contribution of Assisted Natural Regeneration (ANR) to improving the living conditions of populations was conducted in the urban municipality of Tibiri. Its general objective is to identify the products and services of woody species derived from the ANR. The choice of the study area was guided by the existence of the ANR, which has grown there. The field surveys concerned both men and women. The information gathered during the surveys made it possible to assess the contribution of ANR wood products and by-products in improving the living conditions of the populations. In each village, a meeting was held and discussions were initiated with focus groups constituted for that purpose. This study shows that both men and women practice ANR with respectively a proportion of 83% and 17% and that the factors such as the level of education and mode of land acquisition are parameters favorable to the adoption of this practice. The species that benefit the most from the practice of ANR are *Guierasenegalensis* (24%) followed by *Piliostigmareticulatum* (23%), *Albiziaachivalrie* (14%) and *Hyphaenethebaica* (13%). The choice of these species is guided more by the products and services that they provide to the populations, which are in fact the service and energy woods, the leaves, fruits and flowers for human consumption and fodder, the 'improvement of crop yields. In addition to these advantages, the sale of these products generates income for the populations, which allows them to cope sovereign expenses. The practice of ANR has significant advantages in that it improves the living conditions of populations.

Keywords: RNA, Products, Services, Improving, Living conditions and Tibiri.

INTRODUCTION

Niger is a Sahelian country, whose sustainable development is based on the enhancement of the primary sector. Its climate is marked by shortage and irregularity in rainwater supplies. At the same time, it faces continued degradation of natural resources due to inappropriate management and poses a threat to the livelihoods of poor rural people (John, 2009). However, Food Safety of populations as well as that of animals in rural areas depends almost entirely on rain-fed agriculture, a particularly fragile agriculture, due to climatic hazards and strong demographic pressure which has led to overexploitation of land and natural resources and subsequently to continued degradation of these resources. This degradation has resulted in a reduction or even disappearance of trees and shrub cover in many villages (Larwanou, 1998; Joet *et al.*, 1998; Carucci, 2000). Faced with this situation, the need to restore the plant cover, protect the land against erosion, improve soil fertility and contribute to satisfy the energy needs of the populations has become a priority with the implementation of various strategies and techniques (Fanna, 2012). Since then, various collective and individual strategies of environmental protection have been undertaken with the support of international and bilateral assistance (Jesse, 1995; Larwanou *et al.*, 2006; Abdourahmane, 2009). Among the strategies of resilience of the populations is the assisted natural regeneration (ANR) which is a technique within the reach of the local populations with many advantages including the availability of firewood, fodder, fruits and an improvement of agricultural yield in the areas. fields (Rinaudo, 2010). According to the authors Botoni and Reij (2009) and Rabo *et al.* (2021) RNA is a method

allowing to enrich agroforestry parks in terms of diversity but also to increase the number of plants of woody species. It is carried out either by sowing fields with selected species, or by maintaining natural regeneration by sparing and maintaining certain shrubs (useful and multiple-use trees), so as to reconstitute the woody cover on the fields (Rinaudo, 2010; Botoni and Reij, 2009, Joet *et al.*, 1998). In the Sahel and particularly in Niger, woody species play a key role in the socio-economic and cultural life of populations. In fact, ligneous plants enter the bio-geochemical cycle of production systems by providing biomass and / or necromass, creating a microclimate favorable to crops and protecting the soil against water and wind erosion (Bremen *et al.*, 1995; Young, 1995). In addition, woody plants constitute important inputs for human and animal food, especially during difficult times of the year. Beyond that, they are a main source of energy and provide service wood, timber and traditional pharmacopoeia products for rural populations (Bonkoungou, 1993; Larwanou *et al.*, 2006; Dan Guimbo *et al.*, 2006; Dan Guimbo *et al.*, 2010; Laouali *et al.*, 2014). However, the current vegetation which characterizes the woody formations of the urban municipality of Tibiri is mainly made up of species from the ANR. These species, through the provision of wood, food, fodder and the improvement of crop yields, play a socio-economic, agronomic and pharmaceutical role in the life of the populations of Tibiri. Therefore, this study intends to deepen knowledge relating to assisted natural regeneration with the objective of evaluating the contribution of ANR to improving the living conditions of populations in the urban municipality of Tibiri.

MATERIAL AND METHODS

Site presentation: The urban municipality of Tibiri-Gobir is located in the eastern part of the GuidanRoumdji department,

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Maradi region. The climate is Sahelo-Sudanese type with average annual precipitation fluctuating between 500 and 600 mm / year. The herbaceous vegetation is mainly composed of *Eragrostistremula*, *Cenchrusbiflorus*, *Aristidalongijflora* and the woody vegetation of *Prosopisafricana*, *Piliostigmareticulatum*, *Combretumglutinosum*, *Lanneamicrocarpa*, etc. Agriculture is practiced by more than 90% of the population on about 80% of the land.

Documentary research: In this phase, an in-depth inventory of documents relating to the area was made. The consultation concerned not only end-of-study dissertations, articles published in recognized scientific journals, administrative documents but also existing maps. This made it possible to take stock of the information and data that already existed. In addition, beyond written data, it was necessary to have interviews with officials of certain technical services including those of the environment, agriculture, livestock services, projects and various village heads.

Sampling: The choice of the study area was made because of the existence of the RNA which has grown in the Urban Municipality of Tibiri, as well as the existence of diverse ethnic groups (Fulani, Tuaregs, Hausa) with different attitudes in the exploitation of natural resources (agriculture and agropastoralism) in the area. As the area is very large, research was carried out on four villages which perfectly meet the defined criteria (waraou, Fagagaou, Garinyari Idi and Janjouna Dan Tanin) in the municipality of Tibiri. In these four areas, the practice of ANR has been the subject of training and this is what justifies their choice for the conduct of this study.

Data collection: The field surveys concerned both men and women. The information gathered during the surveys made it possible to assess the contribution of ANR wood products and by-products in improving the living conditions of the populations. At the level of each village, an assembly was held around the governing structure and discussions were initiated with focus groups formed for the occasion. After that, individual questionnaires were administered to farmers trained in ANR practice. To do this, a sample of ten (50) people was considered in each village, ie a coverage of 10 to 12%.

Data analysis and processing: The data collected were recorded with the software then Excel coded, and recorded using IBM SPSS Statistics version 20 software, which made it possible to determine the frequency of modalities for each variable studied. Then Excel was used for the preparation of tables and figures.

RESULTS

Characteristics of respondents and farms: Figure 1A gives the distribution of respondents by sex. Thus, men represent 83% of respondents. As for the respective occupations of the respondents, they are given in Figure 1B. The analysis of this figure shows that 75% of the respondents are agro-pastoralists. Furthermore, these survey results show that farmers in this study area acquire their cropland in several ways (Figure 1C). Also, the group of farmers who own their land is the major component and represent 78% of respondents, followed by those who acquire their land by donation (20%).

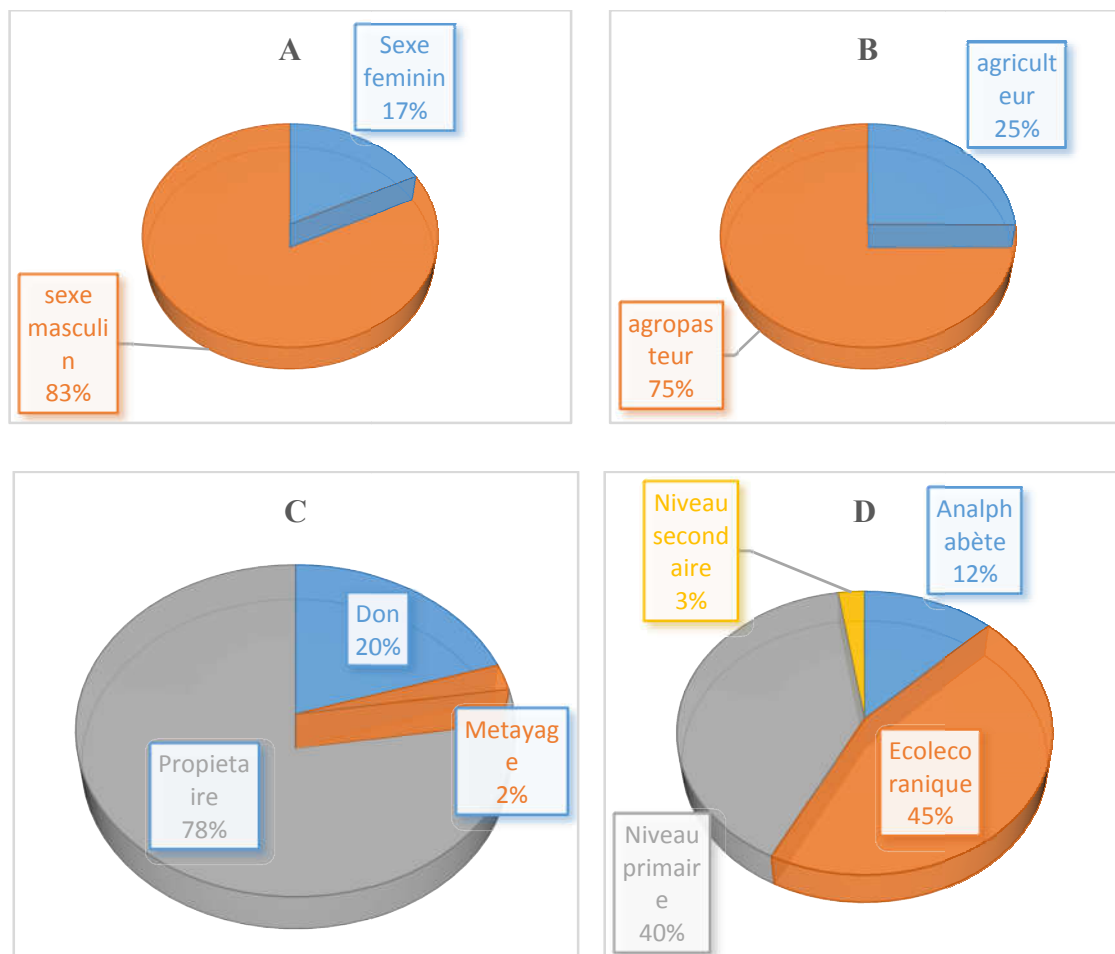


Figure 1. Characteristics of respondents and farms: in A) Gender representation; in B) Representativeness of professions; in C) Representativeness of the modes of land acquisition and in D) Representativeness of the educational levels of the respondents

In addition, 45% of respondents have learned the QUR'AN, 40% have attended western school up to secondary level, 3% have a primary school level and 12% are illiterate (Figure 1D).

The most common species in the fields: Several woody species are found in the fields. Thus, the most frequently found species in the area are given in Figure 2. The analysis of this figure shows that *Guierasenegalensis* (47%) is the most encountered species, followed by *Piliostigmareticulatum* (19%) and *Faidherbiaalbida* (18%). The least encountered species are *Hyphaenethebaica* (10%) and *Prosopisafricana* (6%).

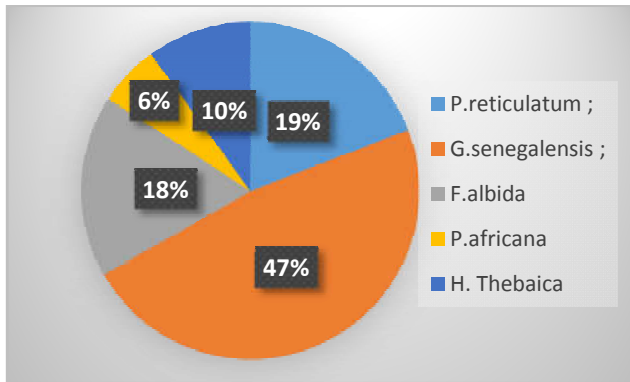


Figure 2. Representativeness of the most common species in the fields

Species that benefit from the practice of ANR: According to the people surveyed, several species benefit from the practice of RNA. The choice of a species is linked to its socio-economic importance or its contribution to fertility. The species that benefit the most from the practice of RNA are given in Figure 3. Thus, *Guierasenegalensis* (24%) is the most cited species by respondents as benefiting from the practice, followed by *Piliostigmareticulatum* (23%), *Albizia chivalry* (14%) and *Hyphaenethebaica* (13%). The species which benefit the least from this practice are *Faidherbiaalbida*, *Prosopisafricana* (6%), *Combretum glutinosum* (5%), *Ziziphus mauritiana* (4%) and *Sclerocaryabirrea* (3%).

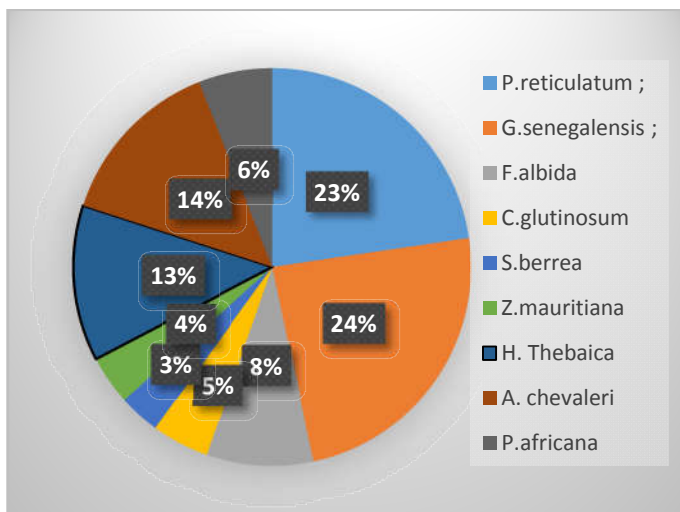


Figure 3. Representativeness of the species that benefit from the ANR

The techniques of the practice of ANR: The peasants surveyed affirmed that in the urban municipality of Tibiri the practice of ANR was based on several techniques as shown in

Figure 4. From the analysis of this figure it emerges that more than 100% of the respondents use the techniques of selection of the best strands and by rejection of the stumps and more than 80% use the techniques of selective thinning and formation of size. Sowing and planting techniques are the least practiced (less than 50%).

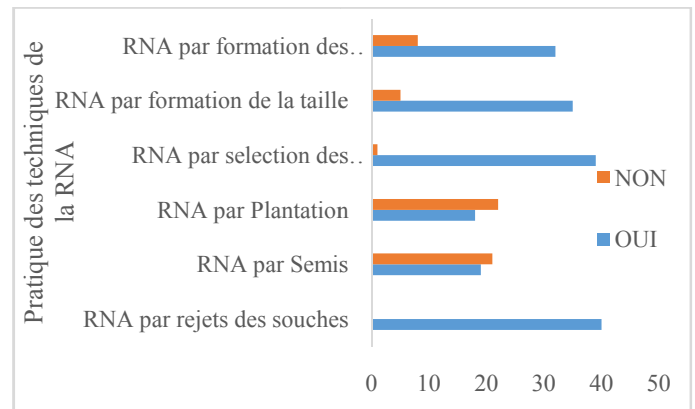


Figure 4. The different techniques of the practice of ANR

Techniques for improving the practice of ANR: Techniques for improving the practice of ANR are many and diverse. These are the techniques used by farmers to ensure the best maintenance of young shoots. Figure 5 gives the most used techniques. The analysis of this figure shows that 85% of the respondents practice the individual protection of young plants, 62.5% clean around the plants, 57.5% make stakes for the plants and 52.5% make basins around the plants seedlings.

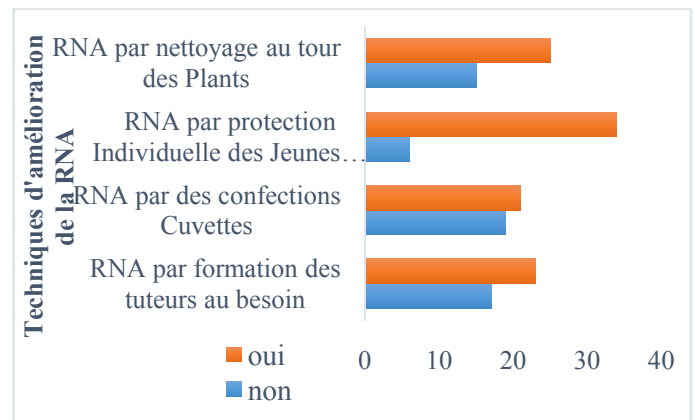


Figure 5. ANR improvement techniques

Identification of ANR products and services: In the terroir of the municipality of Tibiri, the woody species resulting from the ANR play a preponderant role in the life of the populations. Indeed, all the parts of the ligneous plants are used (Figure 6). These parts are used either in crafts (manufacture of mortars; pestles; dabas, etc.), food (consumption of fruits and leaves), fodder (leaves and fruits) and in constructions (concessions; sheds; granaries ... Etc.). Thus, fuelwood and timber are used by 100% of the people surveyed. As for fruits and leaves, they are used respectively by 95% and 87.5% of respondents. The flowers are the least used by the populations (12.5%). The following species: *Balanitesaegyptiaca*; *Faidherbiaalbida*; *Piliostigmareticulatum*; *Ziziphusmauritiana*; *Hyphaenethebaica*; *Prosopisafricana*; *Bauhinia rufescens* provide fruits, fuelwood and timber while others such as *Guierasenegalensis*; *Adansoniadigitata* mostly leaves and flowers.

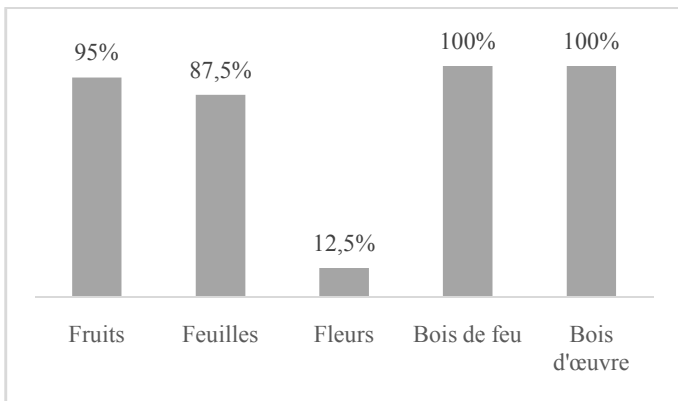


Figure 6. Representativeness of RNA products

RNA and traditional pharmacopoeia: Wood resources are used in the treatment of diseases such as diarrhea, hemorrhoid, malaria, diabetes, ulcers and wounds... etc. The most used products are bark mentioned by 43% of respondents, followed by leaves (23%) and roots (18%) (Figure 7). The least used parts are fruits (10%) and flowers (6%). The woody resources resulting from the RNA whose bark, roots and leaves are used for the pharmacopoeia are: *Guierasenegalensis*, *Sclerocaryabirrea*, *Piliostigmareticulatum* while for *Balanitesaegyptiaca* it is the fruits which are the most used.

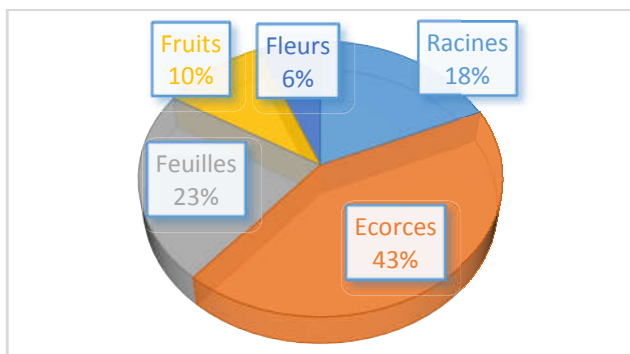


Figure 7. Representativeness of the parts of the species used in the traditional pharmacopoeia

RNA and forage: Woody resources from ANR are used in animal feed, especially during the lean season. Thus these species are tasted by the latter, which feed mainly on the leaves of trees (green fodder). According to the people surveyed, the most used forage species are *Guierasenegalensis* (34%), *Faidherbiaalbida* (30%) and *Bauhiniarufscences* (20%) (Figure 8).

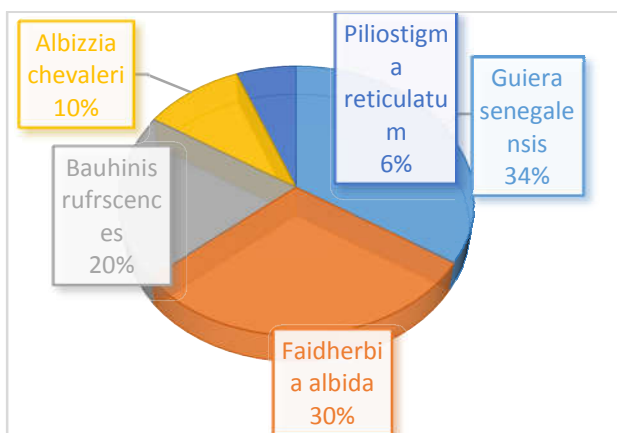


Figure 8. Representativeness of the species used in the fodder

Improved crop yields: Some woody species such as Legumes and bushy stumps of young plants, by trapping fine material, can improve the yields of underlying crops. Figure 9 illustrates the woody species that improve crop yields in the Tibiri terroir, according to the respondents. Thus, the most cited species are *Guierasenegalensis* (47%) followed by *Piliostigmareticulatum* (19%), *Faidherbiaalbida* (18%) and *Hyphaenethebaica* (10%).

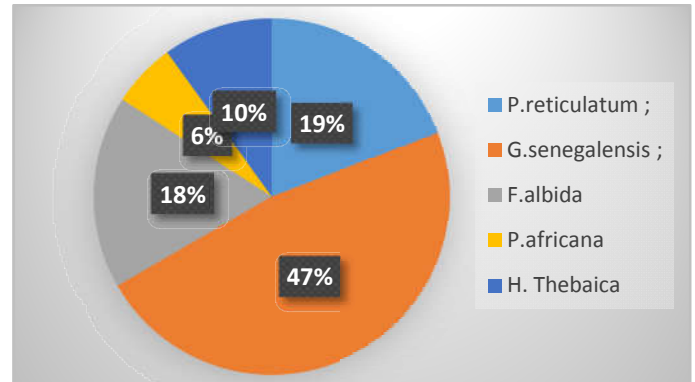


Figure 9. Representativeness of the species that most improve crop yields

Crops whose yields are improved by the practice of ANR: The practice of ANR constitutes a real means of support for improving the yields of agricultural production. Indeed, the crops whose yields are improved by the practice of ANR are given in Figure 10. This figure shows that 100% of the respondents confirm that the yield of millet is improved by the practice, more than 80% responded that the Sorghum and cowpea yields are also improved. On the other hand, crops such as corn and sesame are those whose yields are less improved. Also, 60% of respondents affirm that the yield of peanuts is improved by the practice of ANR.

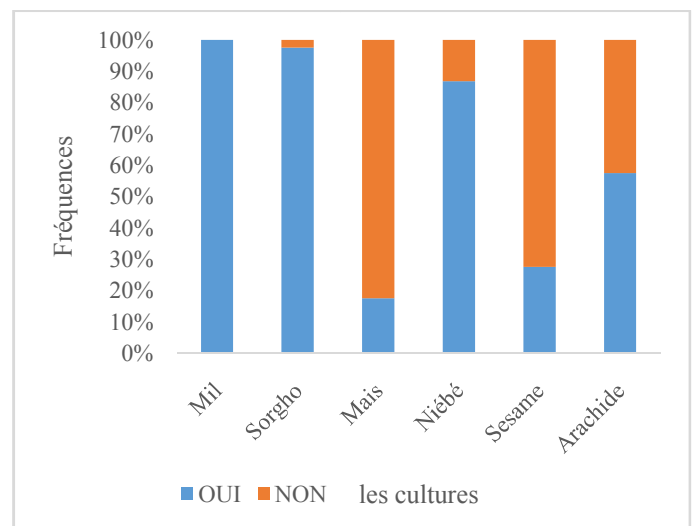


Figure 10. Representativeness of crops whose yields are improved by RNA

Figure 11 expresses the yields of these crops before and with the practice of RNA. The analysis of this figure shows that more than 75% of the respondents have a millet yield of 500 to 800kg / ha whereas before the practice it is only 35% who have this yield. Both sorghum and cowpea yield have also improved with this practice. In fact, more than 40% of the respondents have a sorghum yield greater than 300 kg / ha. As for the yield of cowpea, it is at least 300kg / ha for more than with the practice 70% of the surveyed.



Figure 11. Yield (kg/ha) of crops before and with RNA

Contribution of the ANR to the income of the populations:

RNA provides people with parts of plants that can be marketed and subsequently improve their income. The income from the sale of these products is given in Figure 12. For some respondents, this income can go up to 100,000 FCFA. Thus, 33% of the respondents have an income of between 25,000 and 50,000 FCFA. On the other hand, more than 50% of the respondents have an income of less than 25,000FCFA.

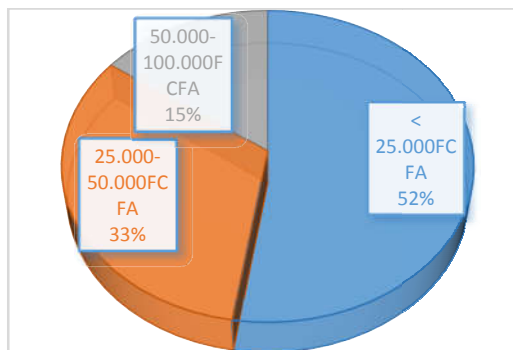


Figure 12. Representativeness of revenues from the sale of ANR products

The parts sold are wood, fruits and leaves (Figure 13). Indeed, 35% of respondents sell wood (energy and works), 34% sell fruits and 31% sell leaves. *Faidherbiaalbida*, *Guierasenegalensis*, *Piliostigmareticulatum*, *Prosopisaficana* and *Bauhinia rufescens* are the species whose woods are the most sold.

The fruits sold mostly come from *Ziziphusmauritiana*, *Hyphaenethebaica*, *Balanitesaegyptiaca* and *Guiera Senegalensis*.

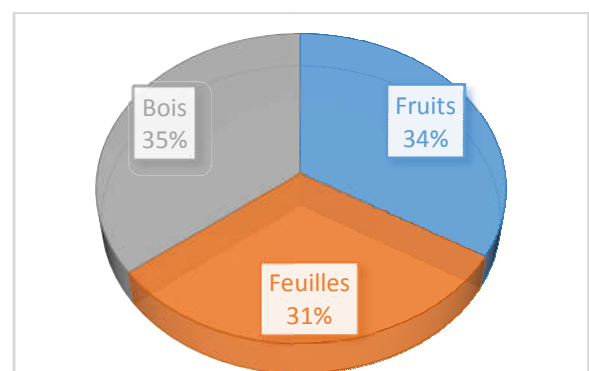


Figure 13. Representativeness of the sold parts of woody species from the ANR

Appreciation of the ANR by the populations: Most of the respondents positively appreciated the effects of RNA as contributing to improve their living conditions. These effects are multiple and diverse, the most cited are given in Figure 14. The analysis of this figure shows that more than 80% of the respondents assert that the ANR makes it possible to fight against desertification, more than 60% confirm that it improves soil fertility. The practice of ANR not only makes it possible to revegetate cropland but also to fight against wind and water erosion. One of the good things about this practice is that it

provides fodder and shade. The interviewees unequivocally affirm that assisted natural regeneration is the most effective means for the recovery and / or re-greening of soils in order to fight against all land degradation, in particular wind erosion and water erosion, thus making it possible to revegetate the land of the crops (fields) and fertilize them.

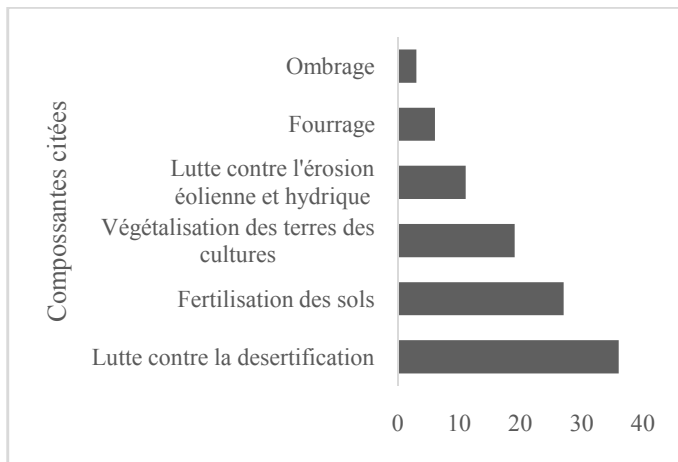


Figure 14. Representativeness of the components of the ANR appreciated by the population

DISCUSSION

Characteristics of respondents and farms: Surveys have been largely dominated by men. This is because the fields are cultivated by men and only a few rare women are able to use the land for agricultural purposes. Another factor to be taken into account according to KAGNE F. (2012), is that few women adopt ANR because they do not own enough land that can contain both crops and a significant number of trees. They believe that associating trees with crops helps to reduce the size of the area. Also very few women take care of the management of trees in the fields because they do not have the necessary material time to do so. The results of this study corroborate those of BUTARI *et al.* (2004) who underline that compared to the ANR, the impact of the activities of regeneration of the woody cover on the fields is better appreciated by the men than by the women. In addition, the practice of ANR is favored by the fact that more than 75% of the land exploited belongs to the heads of farms. Indeed, planting trees or even their maintenance can be synonymous to appropriation of the land. Farmers, who are mainly agropastoralists, can happily take care of the trees in their fields for several uses without the risk of losing them since they own them. The status of field is a determining parameter in the adoption of the practice of ANR. Another factor that has favored the adoption of this practice is the level of education of the operators. According to MAROU *et al.*, (2002) it is rather variables such as the operator's level of education and perceived advantages that have been identified as factors affecting the adoption of ANR. However, within the framework of this study only 12% of respondents are illiterate.

Species that benefit from the practice of ANR: Protected species come mainly from the stock of existing trees and seeds found in the soil. In the context of this study, it is about local species which have the double advantage of being ecologically adapted to the environment and having other uses. These species are mainly *Faidherbia albida*, *Piliostigma reticulatum*, *Guierasenegalensis*, *Hyphaenethebaica*, and *Prosopis africana*.

These species are in most cases spontaneous and their abundance in the fields is explained by the mode of dissemination (Morou, 2010), by their resistance in particular to lack and insufficient rainfall, but also to high temperatures (Savadogo *et al.*, 2015). However, the species protected in the fields testify to the farmers' preference for certain species according to the advantages they provide (human and animal food, wood production, soil fertilization, etc.). These observations agree with those of Yamba (1993) indicating that the valuation of ligneous plants takes place mainly in the social, economic and ecological functions that they fulfill in daily life. As a result, the species most represented in the fields are the most useful according to the farmers.

Identification of ANR products and services: The choice of the species that benefit from ANR is explained by the benefits that the populations derive from them: human and animal food (fruit, leaves, flowers), pharmacopoeia, wood supply (service, work, fires) or their use as fertilizer. Similar results have been reported by Fanna (2012). According to this author, assisted natural regeneration strongly contributes to improving the living conditions of populations and that RNA products are used either in human food (most often), in animal food or in traditional pharmacopoeia. Fleur (2000) asserts that in the Sahelian zone of West Africa in general and in Niger in particular, spontaneous plant species in the domain of agroforestry parks play an important role in the life of rural communities. They provide many products and services which are used by the populations. Products from ANR include fuel and service wood (Bagnian *et al.*, 2013; Larwanou *et al.*, 2012; Fanna, 2012). Wood forest products are mainly used for the supply of service wood and fuel wood (Fanna, 2012). According to Larwanou *et al.* (2006) the greater availability of wood in crop fields results from the massive adoption of ANR and Bougi (2004) to add that the peasants of each village area practice it not only for domestic needs, but also for the ecological services provided.

It is clear from this study that ANR plays a key role in the diet of populations that feed on the leaves, fruits and flowers of forest species. The results of several studies have supported this point (Dan Guimbo, 2011; KAGNE, 2012; Fanna, 2012). According to Saadou and Idrissa (1995), around a hundred species of spontaneous flora offer leaves, fruits, roots and tubers which are regularly sought out, harvested and consumed or even sold. The results of KAGNE (2012) show the important role of uses linked to self-consumption of products derived from ANR. Several species of RNA trees provide fruits and leaves that are commonly used in human and animal food. The authors BOTONI *et al.*, (2010), BELEM *et al.*, (2008), BUTARI *et al.*, (2004) have highlighted the diverse uses and the important role of products derived from ANR on farms. The consumed organs of plants are of particular importance for different social categories and are sources of vitamins, minerals and proteins in a diet dominated by cereals (Boudraa *et al.*, 2010). These products are particularly important in that their availability occurs at the end of the dry season and until the second half of the rainy season, which corresponds to the lean period (Longhurst, 1985; Hussain, 1985). We can say that the periods of availability of resources consumed by the populations constitute a considerable advantage because these periods are characterized by a food deficit in agricultural products (Aïchatou, 2009). In addition to providing food for people, woody plants also provide fodder for animals. According to Dan Guimbo (2007) several plant

species, especially woody ones, play a key role in feeding animals, always providing them with green fodder. Woody fodder are used by livestock either directly in the fields or through humans following pruning. The fodder value of leaves and fruits of trees and shrubs is often higher than that of herbaceous plants, particularly in the case of legumes (Baumer, 1997). The choice of certain species is only due to the fact that they provide quality fodder for animals. This thesis corroborates that of BOTONI *et al.* (2010) for whom most of the protected woody species produce quality fodder, in particular the leaves and pods which are used in animal feed. By carrying out an analysis of the advantages of the RNA KAGNE (2012) also revealed the contribution of woody fodder in the improvement of breeding conditions on farms. He continues that woody fodder constitutes a source of food diversification for animals and an important food supplement during the lean season. According to Nierenberg (2010), ANR has made it possible to meet the forage shortage challenge faced by pastoralists. The natural regeneration of several species has increased forage availability. At the start of the winter season, branches and twigs are the only way to feed animals in stalls. These are: *Bauhinia rufescens*, *Piliostigmareticulatum*, *Guierasenegalensis* and *Commiphora africana*. Also, in the dry season *Faidherbia albida*, a rare tree in the Sahel with green leaves, is used by breeders to cope with the lean season (Botoni and Reij, 2009). Indeed, *Faidherbia albida* provides fodder for livestock or above all provides income for farmers through the sale of pods (Bagnian *et al.*, 2014). Beyond feeding families and feeding animals through these products from the ANR, the farmers sell them to meet other needs that require the mobilization of capital such as baptism, marriage, celebrations and also ceremonies, school supplies for their children. Thus, the results of this study shows that a farmer can benefit from up to 100,000 FCFA per year by the sale of products from ANR which are mostly woods. So this monetary value goes up to DanGuimbo's findings (2011) that estimate the annual income derived from the exploitation of *Borassusaethiopum* varies from 25,500 to 43,000 FCFA per farmer. As for the sale of shea butter (*Vitellariaparadoxa*), annual income varies between 23,000 to 31,500 FCFA for small producers and from 84,000 to 93,000 FCFA for large producers.

The main woody species that generate income in agroforestry parks are *Neocaryamacrophylla*, *Adansoniadigitata*, *Neocaryamacrophylla*, *Hyphaenethebaica*, *Guierasenegalensis*, *Prosopisafricana*, *Vitellariaparadoxa*, *Balanitesaegyptiaca*, *Vitexdoniana*, *Ziziphusmauritiana* etc. Otherwise, improving soil fertility is a contribution made by trees in the fields and which guides farmers in choosing the species to be managed (Dan Guimbo, 2011; Rabo *et al.*, 2021). Trees ensure the renewal of soil fertility while producers cannot buy fertilizer. The synthesis of Piéri (1989) comes to the conclusion that in the semi-arid tropical zone, in the absence of long-term fallows, crop yields and land productivity can only be maintained by restoring soil organic products. Similar results have been reported by Larwanou *et al.*, (2006) who asserted that some species derived from RNA such as *Faidherbia albida* are nitrogen fixers. In addition, all the dominant species (*Combretum glutinosum*, *Piliostigmareticulatum*, *Prosopisafricana*, *Faidherbia albida*...) are all fertilizers. According to the same authors, natural regeneration participates in agricultural intensification in a dynamic of crop-woody-animal integration (agriculture, forestry and livestock) within farms. The practice of assisted natural regeneration

which is within the reach of local populations with many advantages including the availability of firewood, fodder, fruits and improved agricultural yield in the fields (Rinaudo, 2010).

Conclusion

This study conducted in the urban municipality of Tibiri focused on the contribution of the ANR to improving the living conditions of the populations. It appears that ANR is practiced by women as well as by men who represent the main component; the level of education and the mode of land acquisition were also factors that contributed to the adoption of the practice of ANR. This study made it possible to highlight the woody species benefiting from RNA. Indeed, species such as *Guierasenegalensis*, *Piliostigmareticulatum*, *Albizia chivalry*, *Hyphaenethebaica*, *Faidherbia albida*, *Prosopisafricana*, *Combretum glutinosum*, *Ziziphus mauritiana* and *Sclerocaryabirrea* are those which benefit from this practice. The choice of these species is based on the products and services they offer to farmers. Thus, these forest species, in addition to playing an essential role in the fertilization of fields, effectively contribute to human food through their fruits, leaves and flowers, provide fodder and wood. It also emerges from this study that the bark, roots and leaves of species such as *Guierasenegalensis* and *Sclerocaryabirrea* are used in the pharmacopoeia. On the other hand, the sale of non-timber forest products generates income for the populations, which allows them to face certain sovereign expenses.

Statement of competing interests: The authors have no competing interests.

List of abbreviations

ANR: Assisted Natural Regeneration

REFERENCES

- Abdou, S. M. N, Impacts de la Régénération Naturelle Assistée des Ligneux sur la Réduction de la Vulnérabilité des Ménages : cas du terroir de Kirou Haussa dans la commune urbaine de Matameye, Zinder, 2007, 91p.
- Abdourahmane, M. S, "Développement durable et impacts des politiques publiques de gestion de la vallée du fleuve Sénégal : du régional au local", *VertigO- la Revue Electronique en Sciences de l'Environnement*, 9(3). 21. 2009.
- Aichatou, D. L, Contribution de la régénération naturelle des ligneux dans la sécurité alimentaire des ménages: cas des terroirs villageois de Kangna Malan Gaja et Garin Daoudou, Mémoire de Master en Agroforesterie, Faculté d'Agronomie, Université Abdou Moumouni de Niamey, 2009, 85 p.
- Bagnian, I., Adamou, M. M., Adam, T. et Mahamane A., "Impact des modes de gestion de la Régénération Naturelle Assistée des ligneux (RNA) sur la résilience des écosystèmes dans le Centre-Sud du Niger", *J. Appl. Biosci.*, 71. 5742– 5752.2013
- Bagnian, I., Toudou, A., Mahaman M. A., Issa C. et Ali M, "Structure et dynamique de la végétation ligneuse juvénile issue de la régénération naturelle assistée (RNA) dans le Centre-Sud du Niger" *Int. J. Biol. Chem. Sci.*, 8(2). 649-665.2014
- Batouré, D. D. S. et Abdoul Karim, O. M. M, Influence de la régénération naturelle assistée (RNA) dans la conservation

- des ressources ligneuses dans le département de Madarounfa : cas de la commune de SarkinYamma. Mémoire pour l'obtention de la licence professionnelle en Environnement et Ecologie, Université de Diffa, Niger, 2019, 53p.
- Baumer M., L'agroforesterie pour les productions animales, CTA/ICRAF, Wageningen, Pays-Bas, 1997, 340 p.
- Boudraa, S., Hambaba, L., Zidani, S. et Boudraa H, "Composition minérale et vitaminique des fruits de cinq espèces sous exploitées en Algérie : *Celtis australis* L., *Crataegus azarolus* L., *Crataegus monogyna* Jacq., *Elaeagnus angustifolia* L. et *Zizyphus lotus* L." *Fruits*, 65 (2). 75-84. 2010
- Botoni, E. et Reij, C, La transformation silencieuse de l'environnement et des systèmes de production au Sahel: impact des investissements publics et privés dans la gestion des ressources naturelles, CILSS, Center for International Cooperation, Université lihrd d'Amsterdam, 2009, 61 p.
- Boug, i C. S, Analyse de quelques initiatives et innovations paysannes et leurs effets sur la sécurité alimentaire des ménages : cas des terroirs villageois de Damama et de El Gueza (Arrondissement d'Aguié/Maradi), Mémoire de fin d'étude/ Ingénieur des Techniques Agricoles /Faculté d'Agronomie, Université Abdou Moumouni de Niamey, Niger, 2004, 71 p.
- Butari, I., Zounhi, J. S. et Diallo, A, Leçons tirées des expériences de lutte contre la désertification au Sahel: actes des travaux de l'Ateliers sous-régional d'échange et de réflexion organisé par le Centre de recherche pour le développement international (CROI), SalyPortudal, Sénégal. CROI, Dakar, Sénégal, 2004, 187p.
- Carucci R., "Les arbres hors forêt: un moyen essentiel dans la lutte contre la désertification du Sahel", *Unasylva*, 51. 19. 2000.
- Dan Guimbo, I, Etude des facteurs socio-économiques influant la biodiversité des systèmes des parcs agroforestiers dans le Sud-Ouest nigérien : Cas des terroirs villageois de Boumba, Kotaki, Sorikoira, Gongueye et Djabbou, Mémoire de DEA de Géographie, Université Abdou Moumouni de Niamey, Niger, 2007, 111 p.
- Dan Guimbo, I., Mahamane, A., Ambouta, K. J-M, "Peuplement des parcs à *Neocaryamacrophylla* (Sabine) Prance et à *Vitellariaparadoxa* (Gaertn. C. F.) dans le sud-ouest nigérien : Diversité, structure et régénération", *Int. J. Biol. Chem. Sci.* 4 (5). 1706-1720. 2010
- Dan Guimbi, I, Fonction, dynamique et productivité des parcs à *Vitellariaparadoxa* C.F. Gaertn. et à *Neocaryamacrophylla* (Sabine) Prance dans le sud-ouest du Niger, Thèse de doctorat en Sciences de l'Environnement, Université Abdou Moumouni, Niamey, Niger, 2011, 158p
- Fanna, M. A. M, Contribution de la régénération naturelle assistée (RNA) dans l'amélioration des moyens de subsistance des populations de Daré et Zédrawa dans la commune urbaine de Matameye (région de Zinder). Mémoire pour l'obtention du diplôme de master 2 en Biodiversité et gestion de l'environnement Sahélo-Saharien et Soudanien. Université de Maradi, Niger, 2012, 46p.
- Fleur, E. S, Les habitants du Sahel face à la déforestation : Activités quotidiennes et lutte des femmes, INRA, France, 2000, 6 p.
- Hussain, M. A, "Seasonal Variations and Nutrition in Developing Countries", *Food and Nutrition*, 11(2). 23-27. 1985
- Ibrahim, H, Impacts de la régénération naturelle assistée des ligneux sur la réduction de la vulnérabilité des ménages dans le département d'Aguié : cas des villages de Dan Damou, GuidanBakoye et GuidanAdamou, Mémoire de DEA, Université Abdou Moumouni, Niamey, Niger, 2017, 88p.
- Jhon, C-W, Programme de renforcement des stratégies de subsistances à travers une utilisation et une gestion améliorée de parcs agroforestiers au Sahel, 2009, 52p.
- Joet, A, Jouve, P, et Banoin M, "Le défrichement amélioré au Sahel. Une pratique agroforestière adoptée par les paysans", *Bois et Forêts des Tropiques*, 255(5). 31-43. 1998
- Kagne, F, Impact socio-économique de la régénération naturelle assistée (RNA) dans les stratégies d'amélioration des moyens de subsistance des producteurs agricoles: cas de la Gnagna et du Gourma, Mémoire pour l'obtention du diplôme d'ingénieur du développement rural, option: sociologie et économies rurales, Université polytechnique de Bobo-Dioulasso, Burkina Faso, 2012, 80p.
- Larwanou, M, Rapport d'activités, Institut National de la Recherche Agronomique du Niger, Niger, 1998, 57 p
- Larwanou, M., Saâdou, M. et Hamadou S, "Les arbres dans les systèmes agraires en zone sahélienne du Niger : mode de gestion, atouts et contraintes" *Tropicultura*, 24(1). 14-18. 2006a
- Larwanou, M., Abdoulaye, M. et Reij C, Etude de la Régénération Naturelle Assistée dans la Région de Zinder (Niger), USAID/IRG-FRAME, Zinder, Niger, 2006b, 2 P.
- Longhurst R, "Cropping systems and household food security: Evidence from three west African countries", *Food and Nutrition*, 121 (2). 10-16. 1985
- Mari, M. M, Facteurs favorables à l'adoption de la Régénération Naturelle Assistée (RNA) dans quelques villages de la Commune de Matameye (Niger) *Option : « Protection de l'Environnement et Amélioration des Systèmes Agraires Sahéliens »*, Université Abdou Moumouni, Faculté d'Agronomie, Centre Régional Enseignement Spécialisé en Agriculture (CRESA), Niger, 2008, 68p.
- Marou, Z. A., Abasse, A.T., Bokar, M., Niang, A., Cheick, O.T, Analyse de l'adoption de la régénération naturelle assistée dans la région de Maradi au Niger. Bamako, Mali. 2002, 7p.
- Morou, B, Impacts de l'occupation des sols sur l'habitat de la girafe au Niger et enjeux pour la sauvegarde du dernier troupeau de girafes de l'Afrique de l'Ouest, Thèse de Doctorat de l'Université Abdou Moumouni, Niger, 2010, 184 p.
- Nieremberg, D, Reverdir le Sahel en confiant la gestion des ressources naturelles aux fermiers. Innovations qui nourrissent la planète. Extrait du CDURABLE.info l'essentiel du développement durable 2010. [en ligne]. [consulté le 07 Aout 2012]. Disponible sur Internet < <http://cdurable.info/Reverdir-le-Sahel-en-confiant-la-gestion-des-ressources-naturelles-aux-fermiers,3152.html> >
- Ousseini, M. H, Contribution de la Régénération Naturelle Assistée dans les stratégies alimentaires et au niveau des ménages ruraux du Département d'Aguié : cas des villages de GuidanBakoye, GuidanAdamou et Dan Damou. *Option « Protection de l'Environnement et Amélioration des Systèmes Agraires Sahéliens »*. Mémoire de fin d'études pour l'obtention du Diplôme d'Etudes Supérieures Spécialisées (DESS), Université Abdou Moumouni, Niger, 2007, 87p.
- Paré, S, Land Use Dynamics, Tree Diversity and Local Perception of Dry Forest Decline in Southern Burkina

- Faso, West Africa. Doctoral Thesis Swedish University of Agricultural Sciences, Burkina Faso, 2008,78 p.
- Rabé, M. L, Impacts de la Régénération naturelle assistée (RNA) sur l’approvisionnement en bois des ménages dans les terroirs d’Ara Sofoua et Gaounawa (Magaria). Mémoire de fin d’étude Pour l’obtention du diplôme d’Ingénieur des Techniques Agricoles (I.T.A.) *Option : Eaux&Forêts*, Université Abdou Moumouni, Niger,2007, 49p.
- Rabo, Y., Daouda, D. S., Salamou, M. T. And Ali M, "Characteristics, Floristic Diversity and Structures of Stands Resulting from Assisted Natural Regeneration (ANR) in the Agroecozone of Tibiri in Niger", *Asian Journal of Applied Sciences*, 9 (2). 158-166. 2021a
- Rinaudo, T, Une brève histoire de la régénération naturelle assistée l’expérience du niger 2010. [en ligne] Site web : [http:// :www.echonet.org /](http://www.echonet.org/)
- Savadogo, O. M., Ouattara, K., Barron, J., Ouedraogo, I., Gordon, L., Enfors E. et Zombre N. P, "Etats des écosystèmes sahéliens : reverdissement, perte de la diversité et qualité des sols", *Afrique Science*, 11(5). 433-446.2015
- Yamba, B, Ressources ligneuses et problème d’aménagement forestier dans la zone agricole du Niger, Thèse de Doctorat, Tome I. Université Michel Montaigne, Bordeaux III, France, 1993, p 29
