forests

MDPI

Article

Farmers' Preferences for Conservation and Breeding Programs of Forestry Food Resources in Niger

Dolores Agúndez [1,2,*], Sitou Lawali [3], Ali Mahamane [4], Ricardo Alía [1,2] and Mario Soliño [5]

1 National Institute for Agriculture and Food Research and Technology (INIA), Forest Research Centre (CIFOR), Ctra de La Coruña km. 7.5, 28040 Madrid, Spain; alia@inia.es
2 iuFOR, Sustainable Forest Management Research Institute, University of Valladolid (Palencia), Avda. Madrid 44, 34071 Palencia, Spain
3 Faculté d'Agronomie et des Sciences de l'Environnement, Université Dan Dicko Dankoulodo de Maradi, BP 465 Maradi, Niger; sitoulawali@yahoo.fr
4 Faculé des Sciences Agronomiques, Université de Diffa, BP 78 Diffa, Niger; alimahamane3@gmail.com
5 Department of Economic Analysis & ICEI, Complutense University of Madrid, Campus de Somosaguas, 28223 Pozuelo de Alarcón, Spain; msolino@ucm.es
* Correspondence: agundez@inia.es

Received: 17 May 2020; Accepted: 19 June 2020; Published: 23 June 2020

Abstract: In a less-favored area such as the Sahel, promoting sustainable management, breeding, and conservation of forestry resources would result in improvements for agroforestry systems and food security. A contingent ranking exercise allowed us to estimate the preferences and the values given by the rural population to the attributes that would be comprised in a conservation program. The resulting preferred program is farmer-managed natural regeneration (FMNR) based on the species *Adansonia digitata* (baobab), with plantation, stone bunds, or tassa, and selected or bred seeds. The proposed actions to improve the tree density and the seed quality were highly valued by the respondents. Nevertheless, no clear differences were found between tassa and stone bunds, or FMNR and plantation. The main effects of the program, according to the surveyed population, include an increase in crop production and soil conservation, and higher income from tree products. This study allowed us to identify the program that would provide the greatest well-being for farmers, since it would allow them to simultaneously improve both the production of their crops and the production of the woody food species. It was shown that farmers were particularly willing to contribute to a program based on baobab, mainly because its products are used for food in the home and can be sold in markets. In this sense, the yield and production of the system would be improved by increasing the number of baobab trees. Farmers would contribute to this production system and would be willing to invest sustainable effort in the long term. The conservation and breeding program can be directed at conserving and propagating the genetic resources of *A. digitata* in an initial phase, selecting trees with good production, growth, and adaptation characteristics.

Keywords: choice modeling; ranking; tree improvement; non-wood forest product; Africa

1. Introduction

In arid regions of Africa, as in other parts of the world, trees and shrubs in marginal land or in agroforestry systems have great ecological, economic, and food value for the homes of rural communities [1–6]. Agroforestry systems and their non-wood forest products (NWFPs), also called non-timber forest products (NTFPs), are sources of food, such as fruits, fats, oils, leafy vegetables, and condiments, which complement the basic food crops in local diets [7,8]. Agroforestry is considered one of the few solutions that provides a combination of food security and resilience to climate change

and is considered one of the best possible solutions that contributes to conserving the environment and biodiversity [9,10]. The practice of agroforestry has been identified as an adaptation strategy constructing livelihood resilience to flood and drought in Kenya [11], combining food crop production with other tree-mediated ecosystem services in semi-arid West Africa [12] and directly improving household food security by integrating trees into farms to enhance soil fertility in Malawi [13]. In Ethiopia, local communities performed land rehabilitation programs such as tree regeneration on farmland and hill-side planting [14]. Adverse ecological conditions normally pose a lower risk to forestry production than to agricultural production, wherefore trees and forests constitute a kind of safety net in situations of lost annual crop production, as well as in periods of food scarcity between two crops [15]. Nevertheless, availability and adding value of indigenous tree products and services is still required [16].

Changes that affect the density, quality, and distribution of the tree cover have a direct impact on the genetic diversity of a species [17]. This diversity is related to the adaptability to the changing environment and to the potential to improve the production traits of a species. Patterns and levels of genetic diversity are available for only a few native woody food species in the Sudanese zone [18,19], but no specific information is included for the Sahelian-Sudanese zone. Generally and in light of a lack of knowledge about the genetic diversity of forest species, precaution is initially suggested. The idea would be to conserve the largest possible quantity of important genetic resources at the local level. This would make it possible to assure the conservation of woody species that currently have value or that could be a source of values (unknown up to now) and/or of products and services for future generations [20].

Conservation, defined as the rational and sustainable management of natural resources, has often come into conflict with survival and human development [17,21–23]. In recent years, an excessively utilitarian perspective of managing and conserving nature has transformed into a more dynamic, "man–nature" perspective. From this new point of view, there is an emphasis on developing sustainable interactions between human societies and the natural environment [24]. The success of forestry management plans is based on the intervention of local communities, including local knowledge and the capacity of local members to observe the processes and gather key information [25]. Moreover, acknowledging how and why people value resources and react to management programs reduces conflict between players and promotes the acceptance of programs [26].

The Sahel is a good model for studying and proposing management and conservation strategies, thereby considering the high importance of NWFPs in the region, the environmental changes there, and the high human interaction due to management and use in the ecosystems. The predominant hypothesis is that the region has experienced dramatic climate change, driven mainly by a decrease in annual precipitation, although it is not the only cause of the observed changes that are affecting the environment. Land management strategies, local practices, micro- and macro-economic factors, specific local characteristics, population fluctuation, and policies are factors that have contributed to environmental changes in the Sahel [27]. Currently, there is a major revegetation effort in the Sahel, and various initiatives are being carried out, such as the Great Green Wall [28], to promote the restoration and renovation of forests and to successfully revert deforestation locally [29,30].

An increased general interest in conserving woody species in Niger can be perceived, mainly due to the loss of natural forests. This has been partially caused by human pressure, which requires a considerable area of land for agricultural production. Cooperation projects have been highly appreciated both by national agencies and local populations in terms of restoration of degraded lands [2], especially regarding erosion control, farmer-managed natural regeneration (FMNR), and afforestation programs [31]. Social participation must be the focal point of any effective activity to conserve natural sources, including forest genetic resources. Our study establishes the basis for a program that seeks to make people participate in their own development, to favor both the recovery and improvement of food tree resources for human consumption.

For this purpose, understanding the adoption of the agroforestry system and taking into account the "view of the farmer" is a challenge. The study of the preferences of farmers as well as their availability to participate in sustainable management actions facilitates the success of the implementation of the programs and the improvement of the whole socio-ecological system [32–36]. Thus, the aim of this paper was to estimate the preferences for participation by local communities in conservation and improvement programs for their agroforestry systems, more specifically regarding the trees that are present in those systems. We conducted an analysis of the preferences and values that the rural population attach to the different attributes as the species, the technique to increase tree density and water soil conservation, and the quality of the seeds.

2. Materials and Methods

2.1. Area of Study

The Republic of Niger is a country with an area of 1,267,000 km^2 and approximately 18 million inhabitants. Over two-thirds of its surface area is desert. The climate is dry tropical, with two seasons: a dry season with high temperatures and a rainy season. From north to south, rains vary from under 100 mm/year to somewhat over 800 mm/year, and there are five agro-ecological zones in the country (Figure 1): (1) Sub-Saharan zone (74% of the total surface area): it has a dry and desert-like climate, and the vegetation, when it exists, is the steppe shrub type that takes shelter in depressions or oases. There is a predominance of nomadic livestock farming and agriculture at the disperse oases. The majority of the northeastern region is extremely arid and uninhabitable. (2) Sahel-Saharan zone (10% of the territory): it is marked by arid conditions, with livestock grazing and woody vegetation in the form of pseudo-steppes. (3) Sahelian zone (8% of the surface area): it has semi-arid conditions, clearly formed by shrubs or woodland. The agro-pastoral system predominates. (4) Sahel-Sudanese zone (7% of the surface area): the vegetation consists of a savannah of shrubs or trees with highly varied rates of production. This is an area with high agricultural potential, both dryland and irrigated farming. Livestock is also present, heavily mixed with agriculture. (5) Sudanese zone (1% of the territory): the vegetation is composed of one, more or less continuous, herbaceous layer and a woody layer formed by trees and shrubs that can form populations or small woods locally. The climate is favorable for more intensive agricultural activities and for irrigated farming in the proximity of the Niger River.

In 2014, the Human Development Index (HDI) of Niger was ranked last of 187 countries [37], with 76% of the population living on less than USD $2 a day. Agricultural and livestock production is mainly used for family subsistence. The beginning of the rainy season, of major importance for growing cereals, arrives increasingly later, wherefore agricultural production is frequently insufficient to cover the needs of the local populations. Floods are often followed by periods of drought. These conditions cause the existence of an annual season of food scarcity, which generally lasts 4 months, but it can even reach up to 8 months in certain zones. One study conducted in Kollo (Tillaberi, Sudanese zone) illustrates this situation, where the majority of homes were found to be involved in agriculture as the main activity [38]. Nevertheless, all the homes were net buyers of food, because they did not produce enough to cover their annual food needs. Some even sold part of the production as soon as it was harvested (when prices were low) to cover other needs, later having to purchase food when the prices had risen. A total of 92.6% of homes stated that they suffered from food scarcity at some point during the year.

2.2. The Sample

The target population included households from five villages selected according to different ecological characteristics and agroforestry practices. All the villages are subject to food vulnerability and need to improve the quality of the environment as they are highly affected by negative consequences of climate change. Figure 1 shows the location of the five studied villages and are referred here

from wetter to drier agro-ecological conditions: Mollé-Haussa (commune of Tamou) in the Sudanese zone, Dan Gao (commune of Aguié) between the Sahel-Sudanese and Sudanese zones, Roubassaou (commune of Madarounfa) and Djabou (commune of Tamou) in the Sahelo-Sudanese zone, and Guessé Gao-Banda (commune of Simiri) in the Sahelian zone.

A minimum sample size of 42 individuals was estimated for our experimental design [39]. A total of 47 surveys were taken of people likely to participate in and make decisions about the proposal of a conservation and breeding program.

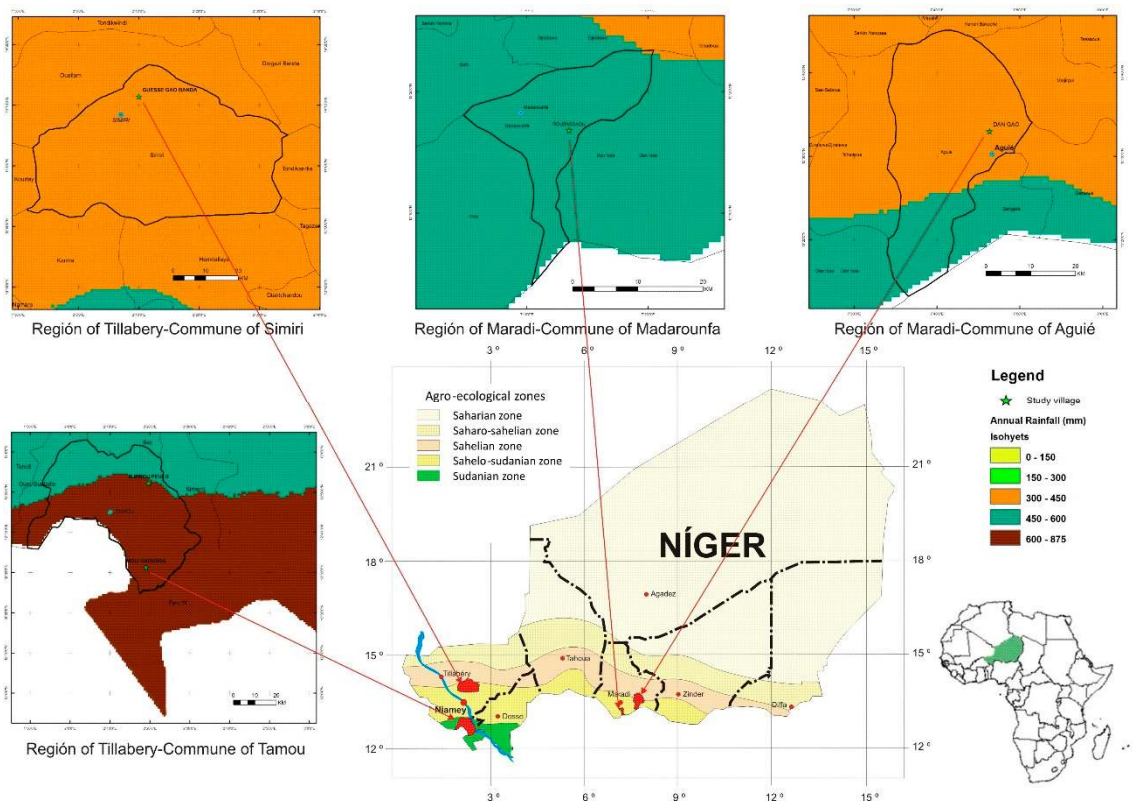

Figure 1. Study area.

2.3. The Questionnaire and Contingent Ranking Design

In order to gain a more in-depth understanding of the local population's preferences, we designed a questionnaire targeting land managers (farmers who are owners or who have rights of use). The questionnaire was divided in three different sections: (1) the information about the respondent, their home, and resources; (2) the information about the production of the four food tree species proposed; and (3) the ranking exercise and effects of the conservation and improvement program. The respondents were offered several management actions for their land. The ranking exercise was designed, taking into account the potential amelioration of the living conditions of the rural inhabitants of Niger. The suggested solution varied from sustainable management to conservation and improvement of forestry resources, such that existing resources were conserved and the quantity and quality of the system's production was raised. We selected the attributes and levels, and we created an experimental design that allowed us to obtain the necessary choice cards to obtain the individual preferences for each element of the program. In summary, Table 1 presents the attributes and levels that the study was composed of (see an example of the cards in Figure 2). Each respondent started by selecting her best and worst choices, and then she was asked to identify her preferred choice between the remaining two alternatives. Thus, we obtained a full list of ranked alternatives for each respondent. The attributes and levels are as follows:

(1) The tree species that provide human food: *Adansonia digitata* (baobab), *Boscia senegalensis* (anza), *Balanites aegyptiaca* (desert date), and *Ziziphus mauritiana* (ber). The selection was made considering the common tree species that provide human food that were cited the most in a study on Niger [40], thereby considering the fact that they represent a different degree of presence and/or interest in all the studied communes (municipalities) due to their food outputs. Moreover, the questionnaire included questions to confirm the selection of these species, its ranking, and its type of regeneration. For each species, two more questions were addressed: all the different uses as well as its more important use or priority use and the perception by the respondent of the threats of degradation on each species and its main perceived threat, in terms of times of citation.

(2) Actions for increasing tree density: FMNR is an approach for arable land restoration and reforestation that seeks to reconcile food production, soil conservation, and the protection of biodiversity. It involves protecting natural regeneration that originates from the seed bank existing in the soil, on stems regrown from the live stumps of felled trees, and on pruning to achieve straight trunks [31].

(3) Water Soil conservation actions (WSC): half-moon, zaï/tassa, and stone bunds. Previous studies [41–43] showed that in Niger, seedlings tend to burn if water conservation techniques are not applied. In degraded soils, stone bunds, zaï/tassa, and half-moon techniques are used to capture rain water through collection or to slow the run-off and improve efficiency in water use, therefore reducing evaporation to a minimum and increasing percolation to favor plant growth. Stone bunds improve water retention and filtration into the ground, thereby increasing the quantity of water available for plants and guaranteeing a good harvest. They also provide protection against wind erosion if there is good growth of plant cover. They are limited by the availability of stones in the area. Simultaneously, tassa/zaï is a water collection technique to improve water retention and prevent the loss of organic fertilizer due to run-off. It has the advantage of allowing crops to be sewn even in periods of low rainfall. It involves preparation of the land in holes covered with mulch and organic fertilizer. This technique has been used successfully to increase the quantity and yield of millet in Niger. Preparing the soil in the form of half-moons is advantageous when rain is scarce and there is a slight slope. The structure slows run-off and allows collected water to infiltrate the soil. It is used to restore degraded soils for vegetable crops, grazing, or forest plantations [44].

(4) The quality of the tree seed to be used in actions: The various levels of seeds are non-selected, selected, and bred seeds. The changes that affect the density, quality, and composition of the tree cover cause a direct impact on the genetic diversity of the species that are present and on the corresponding current or potential value of this diversity. Regarding NWFPs, there is high variability in the desirable traits, such as the size of the fruit, the proportion of pulp, the content of vitamins, and the oil composition, which is an essential prerequisite for breeding and domestication. It also provides an excellent opportunity to develop cultivated varieties of phenotypically superior trees, although a greater understanding of the genetic aspects of production is currently required [17].

The genetic inter- and intra-specific genetic diversity and quality of a seed and, in this case, the origin or source where it is collected are going to have an influence, first, on the adaptation of any new plants, and second, on the production and the results expected from using it [45,46]. In Africa, different breeding and domestication programs are being developed, for example for the adaptation of *B. aegyptiaca* [47]; the fruit production of *Parkia biglobosa*, *Tamarindus indica*, and *Vitellaria paradoxa* [48]; the production of *A. digitata* leaves and fruits [47–51]; or the production of *Z. mauritiana* [8–52].

Table 1. Attributes comprised in the program and choice levels.

Species		Tree Density Action		Water and Soil Conservation		Seed Quality and Demonstration Action		Work Force	
Adansonia digitata		*None* *		*None* *		Non-selected *		12 days/year	
Balanites aegyptiaca		Farmer-managed natural regeneration FMNR		Half moon		Selected		18 days/year	
Boscia senegalensis		Plantation		Tassa/Zaï		Bred		24 days/year	
Ziziphus mauritiana *				Stone bunds				30 days/year	

* Reference level used for the discrete choice modeling approaches.

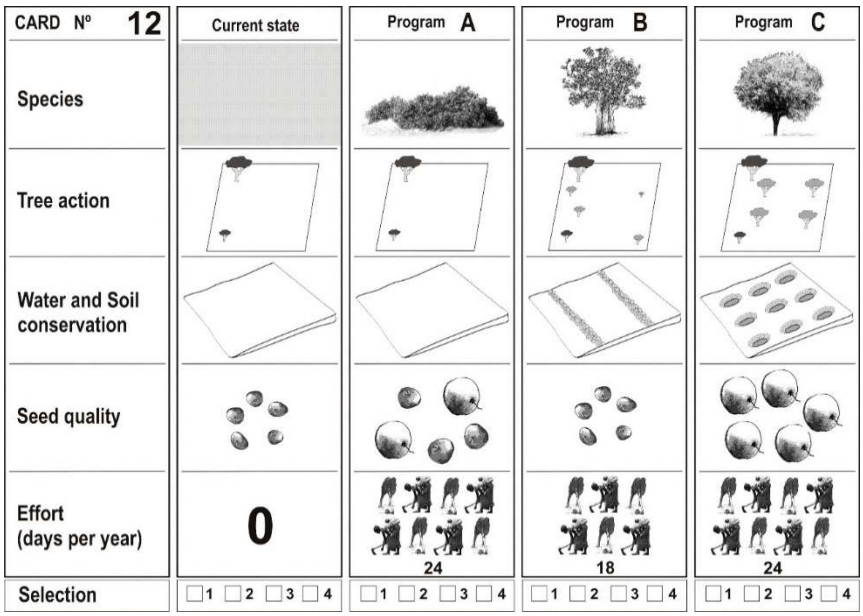

Figure 2. Example of ranking card.

By "non-selected" seed, we mean a seed whose origin is unknown, and farmers could even have acquired it in the market as a food product, later to be sewn. In the case of *A. digitata*, the pulp is purchased with seeds, but only the pulp is used for food and the grains could be used for seeding. There is no certainty about the behavior of the plants obtained from the purchased seeds, in terms of adaptation or in terms of production quality or quantity. A "selected" seed is one that is collected from trees known to have good production, growth, and/or adaptation, normally by an officially recognized provider of seeds, wherefore we can forecast similar behavior. Finally, a "bred" seed comes from tree improvement programs, with recommendations and guarantees for subsequent planting under certain ecological conditions.

(5) Task force: In order to be able to evaluate the preferences of the local populations in terms of willingness to make sacrifices for implementing conservation and improvement programs (in this case, non-monetary sacrifices, rather sacrifices in the form of effort), the number of work days that the local population must work in order to succeed with the proposed programs has been included as an attribute (12, 18, 24, or 30 work days per year).

Work time was chosen instead of a monetary measure due to the fact that the majority of the population is subject to a subsistence economy. Other previous studies have already demonstrated the suitability of using work time and non-monetary units to evaluate the willingness to pay in developing countries [53–56] or when the sample is formed by people not earning an income [57]. Posing a monetary attribute, which is normal in economic assessment exercises in countries with greater economic development, would hardly be credible for a population that experiences major periods of food scarcity. Nevertheless, follow-up questions that allow us to transform effort into a monetary cost were included.

2.4. Estimation Approach

A pivot design based on D-efficiency criteria was performed using the Ngene software [58]. In this design, the attribute levels were pivoted from the reference alternative (the status quo). In addition, we followed a D-0 approach [59], i.e., null priors were considered due to lack of prior information. A total of 12 choice cards were designed with a ranking format, each of which included 4 programs (including status quo), and they also provided the possibility that the respondent might not respond

(does not know, does not answer). In each card, the four proposed programs were ranked from 1 to 4, with 1 representing the preferred program and 4 the least-preferred. An example of the ranking cards is shown in Figure 2.

Farmers (i = 1, . . . , I) are assumed to be rational and maximizing their utility when chosen from a set of alternatives (j = 1, . . . , J) in each choice card (C). For each alternative j, the farmer indirect utility function (Uij) depends on a deterministic element (Vij) and a stochastic or random component (ε_{ij}), which cannot be observed by the researcher.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

In terms of probabilistic inference, the choice probability of an alterantive k in a choice card C is

$$\mathrm{P}(U_{ik} > U_{ij}) = P[(V_{ik} - V_{ij}) > (\varepsilon_{ij} - \varepsilon_{ik})] \quad k \neq j, \quad k,j \in C \tag{2}$$

In order to extend the usual conditional logit derived by [60,61], we developed the econometric model to analyze the data obtained from a ranking exercise. Moreover, random parameter logit models (RPL) allow us to deal with unobserved preference heterogeneity [62] and avoid restrictive assumptions such as the independence of irrelevant alternatives [63]. Thus, if individual preference values β vary in the population with density $f(\beta|\Omega)$, with Ω denoting the parameters of density, the probability of farmer i's rankings [$y1$, $y2$,...,yT] can be calculated by solving Equation (3) through simulation. The software NLOGIT 6.0 [57] was used for the estimation of the model. We used Halton sequences in simulations and 1000 replications [64,65].

$$\boldsymbol{P_i}^{[y1,\ y2,\ldots,yT]} = \int \ldots \int \prod_{t=1}^{T} \prod_{j=1}^{J-1} \frac{\mathbf{exp}\left(\boldsymbol{V_{ij}}\right)}{\sum_{k=j}^{J} \mathbf{exp}(\boldsymbol{V_{ik}})} f(\beta|\Omega) d\beta \tag{3}$$

The effort attribute is assumed as a fixed parameter and the other attributes are assumed to be random and follow a normal distribution [66]. The willingness to work (WTW) was calculated on the basis that the coding of attributes j and levels l were in the form of effect codes and not as dummies [67,68]. Therefore, the WTW was calculated as

$$\mathrm{WTW}_1^{\mathrm{j}} = \frac{\beta_1^{\mathrm{j}} - \beta_{\text{ref level}}^{\mathrm{j}}}{\beta_{\text{effort}}} \tag{4}$$

where $\beta^j_{ref\ level} = -\sum \beta^j_l$ represents the estimated coefficient associated with the reference level of the attribute j.

3. Results

The respondents belonged to three main ethnic groups, the Hausa, Zarma, and Gourmantche, with the surveyors speaking the Zarma and Hausa languages. The Gourmantche communicated in Zarma with the surveyor. The gender balance of the respondents were two-thirds men (32 individuals) and one-third women (15), and practically all of them were married (44). Nearly all the respondents were men (27) or female heads of household (15). The respondents stated that they suffer from a 4-month period of scarcity (from March to June) per year, and half of them migrate seasonally. Approximately, one-third of the surveyed population was found to be illiterate (15 individuals), and 11 farmers had studied the Qur'an. In Niger, Qur'anic schools represent the traditional institutions of basic education in rural areas. Their function is not merely limited to reading and memorizing versus of the Qur'an, rather it also includes broader and more fundamental areas of civic education, community life, and spirituality.

Regarding property, the majority of respondents had acquired the cultivated land through inheritance (33 individuals), borrowed from others (head of the land or the family, neighbors; 10 individuals), or through purchase (7 individuals), with an average surface area of 2.8 hectares per respondent. The mean distance from the home to the land was found to be 2.5 km. The main crops were millet, cowpeas, sorghum, sesame seeds, and peanuts.

Among the four tree species considered in this study, *A. digitata* was the only one planted by farmers. FMNR was applied to cultivated land where *B. aegyptiaca* and *Z. mauritiana* were present, and *B. senegalensis* was normally found naturally occurring without planting or specific care (Table 2). The main use of these four woody species is human food, although they are also used for animal feed. *A. digitata* is also used for medicinal purposes, and the wood from *B. aegyptiaca*, *B. senegalensis*, and *Z. mauritiana* is used for various purposes (Table 3). The main threats to these trees were identified as unsustainable use (harvesting of leaves, flowers, fruits, wood, and bark). For example, *B. aegyptiaca* and *Z. mauritiana* are subject to over-grazing and excessive harvest of the wood, and *B. senegalensis* has suffered from land clearing and drought (Table 4).

Table 2. Scores of the different species cited as the first (Sp-1), second (Sp-2), third (Sp-3), or four species (Sp-4) and for the total of the sample (Sp-T), and management of the species in agroforestry systems.

	Sp-1	Sp-2	Sp-3	Sp-4	Sp-T	Wild	FMNR	Planted
Adansonia digitata	16	5	4	3	28	2	11	24
Balanites aegyptiaca	3	14	4	11	32	9	29	1
Boscia senegalensis	3	0	3	5	11	19	11	0
Ziziphus mauritiana	6	8	13	4	31	12	25	0

Table 3. The current use of the species (X) and priority use for each species (+) in terms of number of responses.

	A. digitata		*B. aegyptiaca*		*B. senegalensis*		*Z. mauritiana*	
	X	+	X	+	X	+	X	+
Human food	42	39	43	25	29	22	42	33
Cattle feed	29	2	36	7	33	12	41	10
Wood construction	2	0	31	2	4	0	22	0
Firewood	6	0	34	3	17	1	23	2
Tools, handicrafts, musical instruments	4	0	29	5	2	0	10	0
Human health	37	1	35	1	20	0	33	0
Animal health	31	0	21	0	16	0	18	0
Products against the enemies of crops	3	0	1	0	1	0	0	0

Table 4. Perception of the threats of degradation of the species (x) and the main threat (+) in terms of number of responses.

	A. digitata		*B. aegyptiaca*		*B. senegalensis*		*Z. mauritiana*	
	X	+	X	+	X	+	X	+
Land clearing	14	0	34	3	19	5	24	4
Fire	1	0	4	0	10	2	7	2
Over-grazing	14	0	27	5	16	2	24	9
Wood construction over-exploitation	8	1	28	8	11	1	23	7
Flower/fruit over-exploitation	21	13	21	9	19	7	18	4
Leaf over-exploitation	22	4	19	1	15	1	12	0
Bark over-exploitation	19	6	19	0	11	0	17	1
Charcoal/firewood over-exploitation	2	0	26	4	11	1	11	0
Root over-exploitation	16	4	16	2	8	3	13	5
Insects and diseases	22	3	17	1	16	1	18	3
Drought	20	2	17	2	14	3	18	2
Wind	13	3	11	2	13	2	13	1
Aged trees	17	0	15	0	10	1	14	1
Depleted soils, fertilizer influence	13	1	14	0	6	0	10	0

The contingent ranking allowed us to analyze the preferences of the local farmers according to the various attributes and resulting levels of the experimental design. Two models are presented (see Section 2.4). Model 1 corresponds to the traditional conditional logit proposed by McFadden et al. [60] and extended to ranking data by Beggs et al. [61]. The second is a random parameter model constituting the basis of ulterior analysis since it better explains the preferences of the farmers (see log likelihood figures in Table 5).

Forty five (45) out of the 47 respondents preferred one of the proposed programs as opposed to leaving the crop fields in their current state (status quo). The preferred conservation program is based on the species *A. digitata* with selected seeds. In regard to the tree action, and water and soil conservation attributes, little differences were shown at the FMNR and plantation levels, respectively, and for the tassa and stone bunds. The main effects of the program, according to the respondents, are an increase in crop production and soil conservation, as well as an increase in income from tree products.

In terms of WTW, the actions on soil conservation to improve the yield of the system represents the greatest contribution to payment: 22.19 work days for tassa and 22.22 work days for stone bunds. The use of *A. digitata* contributes 18.35 working days, while the WTW is significant and negative for the other three species, indicating that respondents would require compensation if any of the other species were cultivated on their lands. Regarding an increase in tree density, similar values were observed for FMNR (16.80 work days) and plantation (15.51 work days). The quality of the selected seed contributed a WTW value of 13.38 work days, versus bred seeds, which had a WTW value of 10.68 work days. In addition, the respondents were asked about the time horizon during which they would maintain their effort, and the results indicated that half the population would participate in the program for an indefinite period, while the other half would do so for a period of 5 years.

Finally, the questionnaire included questions that allowed us to convert the WTW into monetary terms. The respondents were asked about the number of hours that an agricultural work day represents in their village and about the corresponding wage that they would receive. The mean agricultural work day was represented as 4 hours, with a remuneration of XOF 1889 (similar to 20 chicken eggs (XOF 2000), a chicken XOF (1500–3000), or 4 kg of millet (XOF 2000) in the Katako-Niamey Market) [69]. Considering these values, the WTW can be transformed into WTP (willingness to pay), thereby obtaining an assessment, in monetary terms, of the preferences for the proposed program. This information is presented in Table 5 as a reference for future comparisons for other studies.

Table 5. Ranking experiment results.

	MODEL 1					*MODEL 2*					
	Coefficient	**WTW (Days/Year)**	**95% CI**		**WTP (Euros/Year)**	**Coefficient**	**SD of RPs**	**WTW (Days/Year)**	**95% CI**		**WTP (Euros/Year)**
A. digitata	0.788 ***	14.71 ***	11.05	18.38	42.36	1.434 ***	1.150 ***	18.35 ***	11.85	24.86	52.84
B. aegyptiaca	−0.378 ***	−7.07 ***	−9.95	−4.18	−20.36	−0.766 ***	0.641 *	−7.04 **	−12.41	−1.68	−20.27
B. senegalensis	−0.281 ***	−5.26 ***	−8.85	−1.66	−15.15	−0.513 ***	0.835 **	−4.12	−10.92	2.67	−11.86
FMNR	0.226 ***	4.23 ***	1.82	6.63	12.18	0.522 ***	0.730 **	16.80 ***	11.12	22.46	48.38
Plantation	0.300 ***	5.60 ***	3.21	8.00	16.13	0.410 ***	0.354	15.51 ***	10.55	20.47	44.67
Tassa	0.372 ***	6.95 ***	2.44	11.46	20.01	0.644 **	0.530	22.19 ***	14.27	30.12	63.90
Half moon	−0.116	−2.17	−5.57	1.23	−6.25	−0.012	0.332	14.62 ***	8.83	20.40	42.10
Stone bunds	0.477 ***	8.90 ***	5.90	11.90	25.63	0.647 ***	0.526	22.22 ***	15.85	28.60	63.99
Selection	0.291 ***	5.43 ***	2.81	8.06	15.64	0.464 ***	0.254	13.38 ***	7.61	19.15	38.53
Breeding	0.090 *	1.67 *	−0.31	3.66	4.81	0.231 **	0.624 ***	10.68 **	5.85	15.53	30.76
Effort	0.054 ***					0.087 ***	fixed				
No. individuals	47					47					
No. observations	564					564					
Log likelihood	−1106.055					−1088.7468					
AIC	2234.1					2219.5					

Notes: Significance at *** 1%, ** 5%, and * 10% level. 1 euro = OXF 655.957 (fixed exchange rate).

4. Discussion

In Niger, the most important crops for human consumption are sorghum and millet [70]. Increasing production requires adequate agricultural techniques for conserving the soil and moisture. This results in an increase in food security. Furthermore, in recent years, the perception of local communities regarding natural resources has undergone a change in favor of conserving natural and native vegetation [40]. The Nigerien Rural Code and other institutional reforms, international and technical support from civil society (NGOs), as well as incentives for planting or conserving trees have caused an impact on communities, thereby allowing them to be the owners of the trees and benefit from their products [71]. Therefore, stakeholders (farmers, merchants, consumers, civil society, local and national decision-makers, etc.) should be consulted when planning the implementation of the voluntary agroforestry program.

We focused first on the farmer's uses and perception of the threats of degradation of the four species proposed in the program. *A. digitata* is the only one planted, *B. aegyptiaca* and *Z. mauritiana* are FMN regenerated, and *B. senegalensis* is kept at wild stage or even removed when clearing the land, as already reported in the region [72–74]. In concordance with previous findings in Niger [40], the main use of all four species is human food and the overexploitation due to food consumption is considered the main threat. Other factors related to climate change (such as drought) are also considered the cause of the increasing vulnerability of the tree species in different regions [75–77].

A previous study analyzed the willingness of rural and urban consumers to contribute to the conservation of baobab resources in Niger. The majority of the respondents (61%) were willing to pay a mean of 24.7% above the current market prices towards the conservation of this food species [78]. Farmers of our study showed higher interest—96% of the respondents were willing to contribute to a conservation and breeding program of forestry food resources in Niger.

The respondents demonstrated a positive willingness to contribute, ranging from 13 to 22 working days, attending to different proposed actions. We can conclude that these figures are relatively high if compared with other studies. In Ghana, 59% of the farmers were willing to pay in order to integrate timber trees on farmlands to enhance agricultural production [33]. Seventy eight percent (78%) of farmers were willing to support water and soil conservation measures in agricultural lands in India [79]. Farmers' willingness to contribute to water and soil conservation was about 60% in Ethiopia [80].

The type of agroforestry management that the local population applies depends to a large extent on the forest species selected. According to the responses from the farmers, the species *A. digitata* is mainly chosen as the preferred species because its products are used traditionally in home cooking, but they can also be sold in the markets. Planting actions or actions that favor regeneration are justified by generating an increased number of trees in the field. The soil conservation technique is chosen with the aim of yielding better trees, meaning trees that are more productive and resistant to dry agro-ecological conditions. Finally, the type of seed is identified with better-quality production (selected seed) and greater production (bred seed).

In general, the local population selects the superior trees of *A. digitata* on the basis of the quality of the leaves, and in order to be able to provide some care and increase leaf production, they take young trees selected from those in the crop field to transplant them to their homes [49]. Conserving, protecting, and managing trees of *A. digitata* in the crop fields has an impact on the economy and well-being of the rural populations of the Sahel. Binam et al. [81], in a study conducted in Burkina Faso, Mali, Niger, and Senegal, found an increase of USD $72,000 in annual income for 1000 homes that continuously apply FMNR. The income derived from the sale of leaves from one tree of *A. digitata* in Zinder (Niger) can represent between USD $27 and USD $75 per tree, depending on the location and frequency of markets. Haglund et al. [82] calculated crop production values, and in the fields where FMNR was practiced, the values were nearly 60% higher than in fields where this practice was not applied. Binam et al. [81], found that the yields of crops where FMNR was applied were between 15% and 30% higher than where FMNR was not applied. In general, adopting the practice of

FMNR in the Sahel in West Africa could mean an increase of USD $300 per home per year in strict economic terms [83].

Moreover, if soil conservation techniques are used, agricultural production increases. One comparative study of WSC techniques in the region of Tillabéri (Niger) clearly showed that these techniques improve the growth of millet crops, regarding both straw and grain yields. The greater grain yield came from using zaï/tassa, which was approximately 2.5 times greater than the yield using the half-moon technique [43].

The farmers from all the sampled agro-ecological areas would like to improve their production system and invest sustainable effort for a minimum of 5 years, or even indefinitely. Clearly, it is essential to ensure the sustainability of the agroforestry system and to increase agricultural production, and the yield and production of the system would be improved by increasing the number of trees of *A. digitata*. The preference for a certain type of action to increase the tree density is not clear. Education may lead to a better understanding of how to practice FMNR, or a greater openness toward innovation in general [82]. The results are based on a small sample size (although at the minimum of the formal required values), and additional research can further clarify results and nuances, including more in depth analysis of data heterogeneity [67] to understand the influence of the specific local conditions on these issues.

5. Conclusions

Results show that selection and breeding programs can be directed at conserving and propagating the genetic resources of *A. digitata*, selecting trees with good production, growth, and adaptation characteristics in an initial phase. The preference for a certain type of action to increase the tree density is not clear, due probably to the specific local conditions of each zone, a lack of resources, and a lack of technical knowledge for applying the actions. Technicians of extension services and NGOs should make the effort to spread knowledge of and training on these techniques so that farmers can adopt them.

Finally, it has been shown that these selection and breeding programs, which could be executed initially by universities and research institutions, can be supported to a large extent by local knowledge and can be directed at conserving and propagating the genetic resources of *A. digitata*, in an initial phase selecting trees with good production, growth, and adaptation characteristics. This could be the first step towards the sustainable management of tree resources of interest for human food in one of the least favored zones of the world.

Author Contributions: Conceptualization, D.A., S.L., and M.S.; formal analysis, D.A. and M.S.; funding acquisition, D.A. and R.A.; investigation, D.A.; methodology, D.A., S.L., and M.S.; project administration, D.A. and R.A.; software, M.S.; supervision, A.M., R.A., and M.S.; validation, S.L.; writing—original draft, D.A. All authors have read and agreed to the published version of the manuscript.

Funding: This work has been financed by the project access to, conservation of, management of, and recovery of woody food species in Niger, funded by the Spanish Agency for International Cooperation and Development (AECID 2014/ACDE/003520).

Acknowledgments: We would like to thank all the people who participated in this study—mainly the interviewed farmers and the countless people who cooperated selflessly in the field work, including the local interviewers and researchers at Dan Dicko Dankoulodo University of Maradi, Abdou Moumouni University of Niamey, and at Diffa University.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Assefa, A.; Abebe, T. Wild edible trees and shrubs in the semi-arid lowlands of Southern Ethiopia. *J. Sci. Dev.* **2011**, *1*, 5–19.
2. Larwanou, M.; Saadou, M. The role of human interventions in tree dynamics and environmental rehabilitation in the Sahel zone of Niger. *J. Arid Environ.* **2011**, *75*, 194–200. [CrossRef]

3. Thiombiano, D.N.E.; Lamien, N.; Castro-Euler, A.M.; Vinceti, B.; Agundez, D.; Boussim, I.J. Local Communities Demand for Food Tree Species and the Potentialities of Their Landscapes in Two Ecological Zones of Burkina Faso. *Open J. For.* **2013**, *3*, 79–87. [CrossRef]
4. Pingali, P.; Schneider, K.; Zurek, M. Poverty, Agriculture and the Environment: The Case of Sub-Saharan Africa. In *Marginality: Addressing the Nexus of Poverty, Exclusion and Ecology*; von Braun, J., Gatzweiler, F.W., Eds.; Springer Nature: Basel, Switzerland, 2014; pp. 151–168. ISBN 978-94-007-7061-4. [CrossRef]
5. Rowland, D.; Blackie, R.R.; Powell, B.; Djoudi, H.; Vergles, E.; Vinceti, B.; Ickowitz, A. Direct contributions of dry forests to nutrition: A review. *Int. For. Rev.* **2015**, *17*, 45–53. [CrossRef]
6. Jacobi, J. Agroforestry in Bolivia: Opportunities and challenges in the context of food security and food sovereignty. *Environ. Conserv.* **2016**, *43*, 307–316. [CrossRef]
7. Faye, M.D.; Weber, J.C.; Abasse, T.; Boureima, M.; Larwanou, M.; Bationo, A.B.; Diallo, B.O.; Sigué, H.; Dakouo, J.M.; Samaké, O.; et al. Farmers' Preferences for Tree Functions and Species in the West African Sahel. *For. Trees Livelihoods* **2011**, *20*, 113–136. [CrossRef]
8. Kalinganire, A.; Weber, J.C.; Uwamariya, A.; Kone, B. Improving Rural Livelihoods through Domestication of Indigenous Fruit Trees in the Parklands of the Sahel. In *Indigenous Fruit Trees in the Tropics: Domestication, Utilization and Commercialization*; Akinnifesi, F.K., Leakey, R.R.B., Ajaui, O.C., Sileshi, G., Tchoundjeu, Z., Matakala, P., Kwesiga, F.R., Eds.; CABI: Oxfordshire, UK, 2007; pp. 186–203.
9. Mbow, C.; Van Noordwijk, M.; Luedeling, E.; Neufeldt, H.; Minang, P.A.; Kowero, G. Agroforestry solutions to address food security and climate change challenges in Africa. *Curr. Opin. Environ. Sustain.* **2014**, *6*, 61–67. [CrossRef]
10. Roshetko, J.M.; Slender, D.J.; Lasco, R.D.; van Noordwijk, M. Future Challenge: A Paradigm Shift in the Forestry Sector. In *Smallholder Tree Growing for Rural Development and Environmental Services*; Snelder, D.J., Lasco, R., Eds.; Springer Science + Business Media B.V.: Berlin, Germany, 2008; pp. 453–485.
11. Quandt, A.; Neufeldt, H.; MCabe, J.T. The role of agroforestry in building livelihood resilience to floods and drought in semiarid Kenya. *Ecol. Soc.* **2017**, *22*, 10. [CrossRef]
12. Félix, G.F.; Tittonell, P.; Clermont-Dauphin, C. Enhancing agroecosystem productivity with woody perennials in semi-arid West Africa. A meta-analysis. *Agron. Sustain. Dev.* **2018**, *38*, 57. [CrossRef]
13. Coulibaly, J.Y.; Chiputwa, B.; Nakelse, T.; Kundhlande, G. Adoption of agroforestry and the impact on household food security among farmers in Malawi. *Agrofor. Syst.* **2017**, *155*, 52–69. [CrossRef]
14. Nwawulu, S.; Florent, C.; Zenebe, A.; Abadi, N.; Birhane, E. Transformation of degraded farmlands to agroforestry in Zongi Village, Ethiopia. *Agrofor. Syst.* **2018**, *92*, 1317–1328.
15. Blackie, R.; Baldauf, C.; Gautier, D.; Gumbo, D.; Kassa, H.; Parthasarathy, N.; Paumgarten, F.; Sola, P.; Pulla, S.; Waeberand, P.; et al. *Tropical Dry Forests: The State of Global Knowledge and Recommendations for Future Research*; Discussion Paper; CIFOR Bogor: Bogor, Indonesia, 2014; 32p.
16. Amare, D.; Wondie, M.; Mekuria, W.; Darr, D. Agroforestry of Smallholder Farmers in Ethiopia: Practices and Benefits. *Small-Scale For.* **2019**, *18*, 39–56. [CrossRef]
17. Dawson, I.K.; Leakey, R.; Clement, C.R.; Weber, J.C.; Cornelius, J.P.; Roshetko, J.M.; Vinceti, B.; Kalinganire, A.; Tchoundjeu, Z.; Masters, E.; et al. The management of tree genetic resources and the livelihoods of rural communities in the tropics: Non-timber forest products, smallholder agroforestry practices and tree commodity crops. *For. Ecol. Manag.* **2014**, *333*, 9–21. [CrossRef]
18. Kyndt, T.; Assogbadjo, A.E.; Hardy, O.J.; Kaka'Ï, R.G.; Sinsin, B.; Van Damme, P.; Gheysen, G. Spatial genetic structuring of baobab (*Adansonia digitata*, *Malvaceae*) in the traditional agroforestry systems of West Africa. *Am. J. Botany* **2009**, *96*, 950–957. [CrossRef] [PubMed]
19. Tom-Dery, D.; Eller, F.; Reisdorff, C.; Jensen, K. Shea (*Vitellaria paradoxa* C. F. Gaertn.) at the crossroads: Current knowledge and research gaps. *Agrofor. Syst.* **2018**, *92*, 1353–1371. [CrossRef]
20. Bozzano, M.; Jalonen, R.; Thomas, E.; Boshier, D.; Gallo, L.; Cavers, S.; Bordács, S.; Smith, P.; Loo, J. (Eds.) *Genetic Considerations in Ecosystem Restoration Using Native Tree Species*; State of the World's Forest Genetic Resources—Thematic Study; FAO and Bioversity International: Rome, Italy, 2014; 281p.
21. Colfer, C.J.P.; Elias, M.; Jamnadass, R. Women and men in tropical dry forests: A preliminary review. *Int. For. Rev.* **2015**, *17*, 70–90. [CrossRef]
22. Trimble, M.J.; Van Aarde, R.J. Supporting conservation with biodiversity research in sub-Saharan Africa's human-modified landscapes. *Biodivers. Conserv.* **2014**, *23*, 2345–2369. [CrossRef]

23. Paulson Priebe, M.E.; Müller, J.G. Extant forest plantations as a potential bridge between social needs and ecological management: A comparative case study analysis. *J. Environ. Manag.* **2013**, *129*, 608–614. [CrossRef] [PubMed]
24. Mace, B.G.M. Whose conservation? Changes in the perception and goals of nature conservation require a solid scientific basis. *Science* **2014**, *345*, 1558. [CrossRef]
25. Rodríguez-Izquierdo, E.; Gavin, M.C.; Macedo-Bravo, M.O. Barriers and triggers to community participation across different stages of conservation management. *Environ. Conserv.* **2010**, *37*, 239–249. [CrossRef]
26. Ives, C.D.; Kendal, D. The role of social values in the management of ecological systems. *J. Environ. Manag.* **2014**, *144*, 67–72. [CrossRef] [PubMed]
27. Mbow, C.; Mertz, O.; Diouf, A.; Rasmussen, K.; Reenberg, A. The history of environmental change and adaptation in eastern Saloum-Senegal–Driving forces and perceptions. *Glob. Planet. Chang.* **2008**, *64*, 210–221. [CrossRef]
28. Sacande, M.; Berrahmouni, N. Community participation and ecological criteria for selecting species and restoring natural capital with native species in the Sahel. *Restor. Ecol.* **2016**, *24*, 479–488. [CrossRef]
29. Tougiani, A.; Guero, C.; Rinaudo, T. Community mobilisation for improved livelihoods through tree crop management in Niger. *GeoJournal* **2009**, *74*, 377–389. [CrossRef]
30. Sendzimir, J.; Reija, C.P.; Magnuszewski, P. Rebuilding Resilience in the Sahel. *Ecol. Soc.* **2011**, *16*, 1–29. [CrossRef]
31. Rinaudo, T. The development of farmer managed natural regeneration. *LEISA Mag.* **2007**, *23*, 32–34.
32. Chirwa, P.W.; Mala, W. Trees in the landscape: Towards the promotion and development of traditional and farm forest management in tropical and subtropical regions. *Agrofor. Syst.* **2016**, *90*, 555–561. [CrossRef]
33. Bani, K.B.; Damnyag, L. Farmers' Willingness to Pay for the Provision of Ecosystem Services to Enhance Agricultural. *Small-Scale For.* **2017**, *16*, 451–467. [CrossRef]
34. Tadesse, S.; Woldetsadik, M.; Senbeta, F. Attitudes of Forest Users towards Participatory Forest Management: The Case of Gebradima Forest. *Small-Scale For.* **2018**, *17*, 293–308. [CrossRef]
35. Fleming, A.; Grady, A.P.O.; Mendham, D.; England, J.; Mitchell, P.; Moroni, M.; Lyons, A. Understanding the values behind farmer perceptions of trees on farms to increase adoption of agroforestry in Australia. *Agron. Sustain. Dev.* **2019**, *39*, 9. [CrossRef]
36. Soe, K.T.; Yeo-chang, Y. Forest Policy and Economics Perceptions of forest-dependent communities toward participation in forest conservation: A case study in Bago Yoma, South-Central Myanmar. *For. Policy Econ.* **2019**, *100*, 129–141. [CrossRef]
37. UNDP. *Human Development Report 2016: Human Development for Everyone*; United Nations Development Programme 2016; Regional Bureau for Africa: New York, NY, USA, 2016; 286p.
38. Zakari, S.; Ying, L.; Song, B. Factors Influencing Household Food Security in West Africa: The Case of Southern Niger. *Sustainability* **2014**, *6*, 1191–1202. [CrossRef]
39. Cranford, M.; Mourato, S. Credit-Based Payments for Ecosystem Services: Evidence from a Choice Experiment in Ecuador. *World Dev.* **2014**, *64*, 503–520. [CrossRef]
40. Agúndez, D.; Douma, S.; Madrigal, J.; Gómez-Ramos, A.; Vinceti, B.; Alía, R.; Mahamane, A. Conservation of food tree species in Niger: Towards a participatory approach in rural communities. *For. Syst.* **2016**, *25*, 1–13. [CrossRef]
41. Wildemeersch, J.C.J.; Timmerman, E.; Mazijn, B.; Sabiou, M.; Ibro, G.; Garba, M.; Cornelis, W. Assessing the constraints to adopt water and soil conservation techniques in tillaberi, niger. *Land Degrad. Dev.* **2013**, *501*, 491–501. [CrossRef]
42. Wildemeersch, J.C.J.; Garba, M.; Sabiou, M.; Fatondji, D.; Cornelis, W.M. Agricultural drought trends and mitigation in Tillaberi, Niger. *Soil Sci. Plant Nutr.* **2015**, *61*, 414–425. [CrossRef]
43. Wildemeersch, J.C.J.; Garba, M.; Sabiou, M.; Sleutel, S.; Cornelis, W. The effect of water and soil conservation (WSC) on the soil chemical, biological, and physical quality of a plinthosol in Niger' Land. *Degrad. Dev.* **2015**, *26*, 774–784. [CrossRef]
44. Maisharou, A.; Chirwa, P.W.; Larwanou, M.; Babalola, F.; Ofoegbu, C. Sustainable land management practices in the Sahel: Review of practices, techniques and technologies for land restoration and strategy for up-scaling. *Int. For. Rev.* **2015**, *17*, 1–18. [CrossRef]

45. Dawson, I.K.; Vinceti, B.; Weber, J.C.; Neufeldt, H.; Russell, J.; Lengkeek, A.G.; Kalinganire, A.; Kindt, R.; Lillesø, J.B.; Roshetko, J.M.; et al. Climate change and tree genetic resource management: Maintaining and enhancing the productivity and value of smallholder tropical agroforestry landscapes. A review. *Agrofor. Syst.* **2011**, *81*, 67–78. [CrossRef]
46. Roshetko, J.M.; Dawson, I.K.; Urquiola, J.; Lasco, R.D.; Leimona, B.; Weber, J.C.; Bozzano, M.; Lillesø, J.P.B.; Graudal, L.; Jamnadass, R. To what extent are genetic resources considered in environmental service provision? A case study based on trees and carbon sequestration. *Clim. Dev.* **2018**, *10*, 755–768. [CrossRef]
47. Ræbild, A.; Larsen, A.S.; Jensen, J.S.; Ouedraogo, M.; de Groote, S.; van Damme, P.; Bayala, J.; Diallo, B.O.; Sanou, H.; Kalinganire, A.; et al. Advances in domestication of indigenous fruit trees in the West African Sahel. *New For.* **2011**, *41*, 297–315. [CrossRef]
48. Ræbild, A. Improved management of fruit trees in West African parklands. *Agroforest. Syst.* **2012**, *85*, 425–430. [CrossRef]
49. Jensen, J.S.; Bayala, J.; Sanou, H.; Korbo, A.; Ræbild, A.; Kambou, S.; Tougiani, A.; Bouda, H.N.; Larsen, A.S.; Parkouda, C. A research approach supporting domestication of Baobab (*Adansonia digitata* L.) in West Africa. *New For.* **2011**, *41*, 317–335. [CrossRef]
50. Korbo, A.; Kjær, E.D.; Sanou, H.; Ræbild, A.; Jensen, J.S.; Hansen, J.K. Breeding for high production of leaves of baobab (*Adansonia digitata* L) in an irrigated hedge system. *Tree Genet. Genomes* **2013**, *9*, 779–793. [CrossRef]
51. Anjarwalla, P.; Ofori, D.; Owino, A.; Matuku, D.; Adika, W.; Njogu, K.; Kehlenbeck, K. Testing different grafting methods for vegetative propagation of baobab (*Adansonia digitata* L.) in Kenya to assist its domestication and promote cultivation. *For. Trees Livelihoods* **2016**, *26*, 85–95. [CrossRef]
52. Ibrahim, A.; Pasternak, D.; Guimbo, I.D.; Saidou, A.S.; Amadou, M. Rain-Fed Plantations of the Domesticated Ziziphus Mauritiana in the Sahel: Effects of Varieties and Rootstocks on Yields and Fruit Quality. *J. Hortic. Res.* **2015**, *23*, 33–38. [CrossRef]
53. Abramson, A.; Becker, N.; Garb, Y.; Lazarovitch, N. Willingness to pay, borrow, and work for rural water service improvements in developing countries. *Water Resour. Res.* **2011**, *47*, 1–12. [CrossRef]
54. Rai, R.K.; Scarborough, H. Economic value of mitigation of plant invaders in a subsistence economy: Incorporating labour as a mode of payment. *Environ. Dev. Econ.* **2012**, *18*, 225–244. [CrossRef]
55. Rai, R.K.; Scarborough, H. Nonmarket valuation in developing countries: Incorporating labour contributions in environmental benefits estimates. *Aust. J. Agric. Resour. Econ.* **2015**, *59*, 479–498. [CrossRef]
56. Gibson, J.; Rigby, D.; Polya, D.; Russell, N. Discrete Choice Experiments in Developing Countries: Willingness to Pay Versus Willingness to Work. *Environ. Resour. Econ.* **2016**, *65*, 697–721. [CrossRef]
57. Durán-medraño, R.; Varela, E.; Garza-Gil, D.; Vázquez, M.X.; Soliño, M. Economic valuation of terrestrial and marine biodiversity losses caused by forest fires. *J. Behav. Exp. Econ.* **2017**, *71*, 1–28. [CrossRef]
58. ChoiceMetrics. *Ngene 1.2 User Manual & Reference Guide*; Choice Metrics: Sydney, Australia, 2018.
59. Nordén, A.; Coria, J.; Maria, A.; Lagergren, F.; Lehsten, V. Divergence in stakeholders' preferences: Evidence from a choice experiment on forest landscapes preferences in Sweden. *Ecol. Econ.* **2017**, *132*, 179–195. [CrossRef]
60. McFadden, D. Conditional Logit Analysis of Qualitative Choice Behaviour. In *Frontiers in Econometrics*; Zarembka, P., Ed.; Academic Press: New York, NY, USA, 1973; pp. 105–142.
61. Beggs, S.; Cardell, S.; Hausman, J. Assessing the potential demand for electric cars. *J. Econom.* **1981**, *17*, 1–19. [CrossRef]
62. Hausman, J.; McFadden, D. Specification Tests for the Multinomial Logit Model. *Econometrica* **1984**, *52*, 1219–1240. [CrossRef]
63. Train, K. *Discrete Choice Methods with Simulation*; Cambridge University Press: Cambridge, UK, 2009.
64. Hensher, D.A.; Rose, J.M.; Greene, W.H. *Applied Choice Analysis*, 2nd ed.; Cambridge University Press: Cambridge, UK, 2015.
65. Mariel, P.; Meyerhoff, J. A More Flexible Model or Simply More Effort? On the Use of Correlated Random Parameters in Applied Choice Studies. *Ecol. Econ.* **2018**, *154*, 419–429. [CrossRef]
66. Lusk, J.L.; Roosen, J.; Fox, J.A. Demand for Beef from Cattle Administered Growth Hormones or Fed Genetically Modified Corn: A Comparison of Consumers in France, Germany, the United Kingdom, and the United States. *Am. J. Agric. Econ.* **2003**, *85*, 16–29. [CrossRef]

67. Varela, E.; Giergiczny, M.; Riera, P.; Mahieu, P.-A.; Soliño, M. Social Preferences on Fuel Break Management Programs in Spain: A Choice Modelling Application to Preventing Forest Fires. *Int. J. Wildland Fire* **2014**, *23*, 281–289. [CrossRef]
68. Domínguez-Torreiro, M.; Soliño, M. Provided and Perceived Status Quo in Choice Experiments: Implications for Valuing the Outputs of Multifunctional Rural Areas. *Ecol. Econ.* **2011**, *70*, 2523–2531. [CrossRef]
69. USAID. Niger price bulletin. *FEWS NET*, 31 January 2019; 3p.
70. Moussa, B.; Nkonya, E.; Meyer, S.; Kato, E. Economics of land degradation and improvement in Niger. In *Economics of Land Degradation and Improvement—A Global Assessment for Sustainable Development*; Nkonya, E., Mirzabaev, A., von Braun, J., Eds.; Springer open: Basel, Switzerland, 2016; pp. 499–539.
71. MESU/DD. *Stratégie et Plan d'Actions de Promotion des Produits Forestiers Non Ligneux (PFNL) au Niger*; document de travail; MESU/DD: Niamey Niger, 2006.
72. Bationo, B.A.; Lamien, N.; Demers, N.; Kandji, S. Culture du baobab *Adansonia digitata* L. *(Bombacaceae)* en planche maraîchère: Une méthode pour simplifier sa récolte et favoriser sa propagation au Sahel. *Bois For* **2009**, *299*, 79–86. [CrossRef]
73. Douma, S.; Chaibou, R.; Mahamane, A.; N'da, D.H.; Saadou, M. État actuel de dégradation des populations de quatre espèces ligneuses fruitières en zone sahelo soudanienne du Niger: Réserve Totale de Faune de Tamou. *Rev. Ivoir. Sci. Technol.* **2010**, *16*, 191–210.
74. Valette, M.; Vinceti, B.; Traoré, D.; Traoré, A.T.; Yago-ouattara, E.L.; Kaguembèga-müller, F. How Diverse is Tree Planting in the Central Plateau of Burkina Faso? Comparing Small-Scale Restoration with Other Planting Initiatives. *Forests* **2019**, *10*, 227. [CrossRef]
75. Gaisberger, H.; Kindt, R.; Loo, J.; Schmidt, M.; Bognounou, F.; Da, S.S.; Diallo, O.B.; Ganaba, S.; Gnoumou, A.; Lompo, D.; et al. Spatially explicit multi-threat assessment of food tree species in Burkina Faso: A fine-scale approach. *PLoS ONE* **2017**, *12*, e0184457. [CrossRef] [PubMed]
76. Vinceti, B.; Termote, C.; Thiombiano, N.; Agúndez, D.; Lamien, N. Food tree species consumed during periods of food shortage in Burkina Faso and their threats. *For. Syst.* **2018**, *27*, 2. [CrossRef]
77. Birhane, E.; Tadesse, K.A.; Tadesse, T.; Hishe, H.; Abrha, H.; Noulèkoun, F. Vulnerability of baobab (*Adansonia digitata* L.) to human disturbances and climate change in western Tigray, Ethiopia: Conservation concerns and priorities. *Glob. Ecol. Conserv.* **2020**, *22*, e00943. [CrossRef]
78. Agúndez, D.; Lawali, S.; Alía, R.; Soliño, M. Consumer Preferences for Baobab Products and Implication for Conservation and Improvement Policies of Forest Food Resources in Niger (West Africa). *Econ. Bot.* **2018**, *72*, 396–410. [CrossRef]
79. Gulati, A.; Rai, S.C. Farmers' willingness-to-pay towards soil and water conservation measures in agro-ecosystems of Chotanagpur Plateau, India. *Water Environ. J.* **2015**, *29*, 523–532. [CrossRef]
80. Asrat, P.; Belay, K.; Hamito, D. Determinants of farmers' willingness to pay for soil conservation practices in the southeastern highlands of Ethiopia. *Land Degrad. Dev.* **2004**, *15*, 423–438. [CrossRef]
81. Binam, J.N.; Place, F.; Kalinganire, A.; Hamade, S.; Boureima, M.; Tougiani, A.; Dakouo, J.; Mounkoro, B.; Diaminatou, S.; Badji, M.; et al. Effects of farmer managed natural regeneration on livelihoods in semi-arid West Africa. *Environ. Econ. Policy Stud.* **2015**, *17*, 543–575. [CrossRef]
82. Haglund, E.; Ndjeunga, J.; Snook, L.; Pasternak, D. Dry land tree management for improved household livelihoods: Farmer managed natural regeneration in Niger. *J. Environ. Manag.* **2011**, *92*, 1696–1705. [CrossRef]
83. Weston, P.; Hong, R.; Kaboré, C.; Kull, C.A. Farmer-Managed Natural Regeneration Enhances Rural Livelihoods in Dryland West Africa. *Environ. Manag.* **2015**, *55*, 1402–1417. [CrossRef]

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).