

Perception of Producers on the Importance of Restoration Works for Degraded Pasture Areas in Niger

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ABSTRACT

In Niger, pastoral rangelands have experienced a decline in production since the 1970s. To combat this degradation of pastoral lands, the State and its partners have popularized water and soil conservation and defense and restoration works among producers. Soils (CES/DRS). The main objective of this study is to assess the importance of pastoral developments on the restoration of degraded pastures in Niger. To achieve this objective, a survey was conducted to measure individual preferences regarding the importance of these innovations. The innovations were selected on the basis of the training themes of the RED SAACC II project which popularizes CES/DRS techniques in the context of sustainable production of live livestock feed. The study is carried out in the regions of Dosso and Tillabéri. The method consists of collecting data from 15 focus groups, bringing together 77 producers. The group is openly questioned about the importance of the works in the restoration of degraded pasture areas. The preferences of farm managers in terms of works to restore pasture areas indicate pastoral half-moons (22%) and sylvopastoral (25%) and mechanical control of *sida cordifolia* (18%) are the most important. Regarding the least important structures, producers identify stone cords (1%) and manual tracheas (3%). The coefficients of w of the proportional stacking show a concordance of the appreciation of the CES/DRS works for all the groups of producers. The results of this empirical approach must be deepened by scientific studies to assess the socio-economic impact and understand the modifications induced on the ecosystem before any pasture restoration actions.

Keywords: Perception, Producers, Works, Restoration, Pastures, Niger.

INTRODUCTION

In Niger, the management of extensive livestock farming is essentially based on the exploitation of natural standing pastures. Thus, this breeding is marked by a transhumance activity regulating access to these pastoral resources at the start of the season from the agricultural zone to the pastoral zone. Despite the strategic importance of transhumance in the lives of pastoralists, it is subject to the vagaries of climatic conditions, notably the degradation of pastoral areas, agricultural pressure on the land and difficulties linked to access to drinking water. Which make it

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difficult for transhumants to stay in reception areas [1,2]. Then, pastoralists highlight structural factors such as chronic livestock diseases due to lack of effective veterinary services and worrying insecurity linked to local cross-border conflicts [1]. These different socio-ecological factors often act chronically on mobile livestock management practices, as well as on herd productivity. The frequency of events mentioned on different transhumance sites shows the importance of the cumulative phenomena which leave little grazing space and time for transhumant herds in the reception areas. Furthermore, growing insecurity, notably animal thefts and fairly frequent disputes between indigenous pastoral communities, on the one hand, and transhumant pastoralists, on the other hand, are reducing the amplitude of seasonal transhumance movements during rainy season in their host areas [3]. These socio-climatic factors push many transhumant pastoralists to settle down in the agricultural zone where pastoral conditions are more lenient than those in the pastoral zone. However, this sedentarization is not without consequences for this agricultural area which was formerly the reception area for breeders affected by natural calamities, particularly drought. Thus, numerous authors have documented the consequences of this sedentarization, notably the practice of agricultural activities of sedentary breeders by eating away at pasture areas and pastoral enclaves, the excessive cutting of green wood for heating and making houses and the pressure of animals on pastures [1]. Thus, the cumulative effects of these degrading actions result in a low contribution of rangelands to the feeding of livestock which are forced to travel quite significant distances in search of pasture. In addition to the low productivity of livestock, the degradation of rangelands has other negative consequences on the biodiversity of pasture areas, notably the disappearance of woody, perennial herbaceous plants and the proliferation of invasive species, notably *sida cordifolia* [2,3]. Since 1970, Niger has experienced major droughts with very similar frequencies. These years of drought were a turning point in the political and economic life of Niger [4]. The pressure of populations and livestock on the land has now reached its maximum stage. Conflicts over access to natural resources between farmers and especially between farmers and breeders are permanent and sometimes dramatic. To ensure the sustainability of the exploitation of pastoral resources, the State and its partners have initiated CES/DRS work since the 1970s. As part of the improvement of pastoral resources, various works and techniques have been popularized in areas with much degraded lateritic plateaus and glacis (indurated, stony, desertified) [4,5]. These CES/DRS techniques have allowed rural populations to manage their ecosystems and develop their pastoral and agricultural production spaces. This has helped to better

prepare populations for environmental changes (climate change, land degradation) and shocks, particularly droughts. All the anti-erosion works presented as part of this study are part of adaptation measures designed, developed and popularized since 1980 as part of projects and programs to combat desertification and manage natural resources in Niger. All the techniques for combating erosion, recovering and restoring degraded land have proven themselves on a large scale on the various lateritic plateaus treated. The results of these projects in terms of degradation on a country scale show that the process of degradation has been slowed over vast agro-pastoral areas, but that an overall reversal of degradation has not yet been achieved [6-8]. However, rural populations having invested in the recovery of degraded land have a better capacity to overcome periods of crisis: picking fruit and collecting wood serves directly to the survival of the household.

These techniques have made it possible to improve fodder production on pastoral rangelands which were formerly out of use for pastoral purposes [4,8,9]. Numerous studies have shown the positive impact of CES/DRS actions on improving soil quality and reconstituting herbaceous and woody vegetation in degraded pastoral and agricultural ecosystems in the Sahel [5,9,10]. But little of this work has focused on a better understanding of how producers perceive the multiplicity of techniques and their effects on forage production on rehabilitated rangelands. Furthermore, this understanding is necessary in order to identify the most and least important adaptation techniques at the beneficiary level in the face of the effects of climate change. The objective of this study is to analyze the perception of producers of the effects of CES/DRS works on the production of fodder biomass from degraded plateaus in the regions of Dosso and Tillabéri.

MATERIALS AND METHOD

Study zone

As part of this study, the choice of sites is based on the training program for members of heads of integrated family farms (EAFI) from the Tillabéri and Dosso regions on the management of natural resources in the face of the risks of climate change. For the team of component III (livestock) of the research and development project for food security and climate adaptation of rural production systems in Niger (RED/SAACC-Niger II), it is a question of taking advantage of this opportunity to evaluate the perception of beneficiaries on CES/DRS techniques on biomass production in the face of the risks of climate change. Thus, the study covered only the areas where the learners came from, namely the departments of Boboye (communes of N'Gounga, Koygolo and Harikanassou), Tibiri in the region of Dosso and

Kollo (communes of N 'Dounga, Liboré, Hamdalaye and Dantchandou) in that of Tillabéri. All these departments enjoy a Sahelian climate with a dry season lasting 7 to 8 months and a rainy season lasting a maximum of 4 months. This area is mainly characterized by a rainfall deficit. Agriculture and livestock breeding are the main activities of the majority of the population. This area contains spaces with a pastoral vocation and passage corridors which are part of the "transhumance system" in Niger making it possible to accommodate thousands of transhumants coming from Benin on the one hand and Nigeria on the other but also from the regions of Dosso, Maradi and Tahoua. These transhumants stay in these rest areas before continuing their route which ends in the pastoral zone in the Departments of Abala and Banibangou (Tillabéri Region in Niger) and Ménaka (Mali border) [11]. This area is therefore experiencing the phenomenon of overgrazing, degradation of natural resources, disappearance of pastoral enclaves and narrowing of passage corridors, resulting in the outbreak of violent conflicts to access water and pasture. CES/DRS techniques are increasingly used in this area to overcome these difficulties in the context of resilience to climate change [4,12].

Participatory survey7

Participatory survey: proportional stacking

A participatory survey involved a total of 15 focus groups, bringing together 77 breeders (median=7, min-max=4-8 people) (16.9% women and 83.1% men). Focus groups (fg) are formed randomly among learners at the training sites on degraded land restoration techniques. Thus, several focus groups are formed according to age (3 fg of young people and 3 fg of elderly people) and gender (3 fg of women and

3 fg of men) and 15 mixed fg (all young and old people of both sexes) for both training sites. Each group must classify the CES/DRS works according to their perception of its importance in the restoration of degraded pasture areas.

Thus, the relative importance of each work is then determined at the level of each discussion group by proportional stacking by sharing a pile of 100 counters between the photos of the CES/DRS works. If a consensus is reached through discussion, the counters are distributed through an iterative process involving all stakeholders. The motivations for choices and possible disagreements are systematically the subject of open questions by the investigators.

Preference survey: maximum difference

The purpose of this empirical research is to classify the list of innovative practices for restoring degraded pasture areas based on the evaluation of individual user preferences in order of importance. To achieve this objective, a survey was conducted to measure these individual preferences for these innovations. The latter were selected on the database of CES/DRS works from the technical services of the study area.

The preference survey was conducted through face-to-face interviews with a Best and Worst Scaling (BWS) questionnaire containing 8 questions. Each question is made up of 4 of the eight works. The appearance of innovations in choice sets followed a design of balanced incomplete blocks, constructed using support packages. BWS [13]. An example of a set of choices has been illustrated in Table 1. By answering these 8 questions, the respondent will choose at the level of each question the technique that he considers the most important and the one that he considers the least important. On a subjective utility scale [14].

Table 1. Example of maximum difference questionnaire from this study

Most important	Works	Less important
[]	Pastoral half moon	[]
[]	Pastoral bench	[]
[]	Manual trenches	[]
[]	Grass strips	[]

Data analysis

Proportional Stacking Analysis

The statistical analysis of the results of the participatory survey was carried out using the software R -3.0.1 (version). Differences in appreciation of the works between the two zones and the focus groups according to demographic

variables were sought by applying the t test for each criterion separately. A descriptive analysis was carried out to describe the qualitative results (means, medians, minimum/maximum). To estimate the concordance of the importance of CES/DRS works, the statistical test used is a non-parametric test: the Kendall W concordance coefficient with the R-3.0.1 software (under the irr package and the function

scoring). In the case of the present study, it seeks to analyze the concordance between the results of the arrangement of CES/DRS works from the different discussion groups on the importance of the works in the restoration of degraded rangelands.

Maximum difference analysis

The so-called Maximum Difference (Max Diff) method or choice of extremes “Best Worst scaling” has been applied in an interesting way in several studies measuring the importance of the attributes of objects or products based on individual declarations from respondents for all of the choices presented [15,16,17,18, 19]. In this study, this analytical technique is applied to the evaluation of CES/DRS works. Thus, the relative preference of each CES/DRS work indicates its importance on a ratio scale deriving the probability that a chosen work is more important than another. The relative preference (RP) of a work i is represented by the equation:

$$PR_i = \exp(V_i) / \sum_{i=1}^m \exp(V_i)$$

$$\text{With } V_i = B_i - W_i / 4N$$

B_i = the number of times that work i was chosen as the most important

W_i = the number of times that work i was chosen as less important

N = number of respondents (=77)

V_i = weight of work i

exp = exponential function

The BWS support package of the R software was used for the analysis of the maximum difference questionnaire. To evaluate and normalize relative preference, the exponential function of Microsoft Excel was used (sum of PRs equals 1) [20].

RESULTS

Demographic and socio-economic profile of respondents

Table 2. Socio-economic characteristics of respondents

Variables of farm managers		Number	Percentage
Site	Dosso	44	57.1
	Tillaberi	33	42.9
Sex	feminine	13	16.9
	male	64	83.1
	young	17	22.1
Age	old	60	77.9
Education	primary level and above	46	59.7
	Without level	31	40.3
Core business	agropastoral	65	84.4
	trader	7	9.1
	pastoral	5	6.5
Source of income	agricultural	52	67.5
	trade	10	13.0
	breeding	15	19.5

The majority of respondents are men constituting 83.1% of the total sample (77 respondents) compared to 16.9% women (table 2). 40.3% of respondents have no formal education in French compared to 59.7% of respondents who have a basic education diploma. The distribution of

respondents by age shows that 23.1% are young people compared to 77.9% elderly people. This result indicates the involvement of many older people in CES/DRS activities. This shows that young people are less involved in the restoration of degraded lands.

Relative preferences of CES/DRS works

Analyzes of the scores at which a work is selected as “more” and “less” important degraded land restoration factor from a set of eight choices by all respondents are presented in Table 3. A positive score indicates that the technique is more preferred while a negative score shows a less preferred technique in the repertoire of degraded land restoration techniques. Eighteen percent (18%) of the farm managers in the sample believe that the sylvopastoral half-moon is the

most important work in the fight against the degradation of pastoral lands. The pastoral half-moon (17%) and the mechanical fight against *sida cordifolia* (14%), the grassy strips (13%) are perceived respectively by 17%, 14% and 13% of respondents as important works in the recovery of pastoral areas degraded after the sylvopastoral half-moon. However, 7% of respondents consider manual trenches and stone cordons to be important in the restoration of degraded pasture areas.

Table 3. Preferences for CES/DRS works

Works/techniques	Most important	Less important	Difference ^[1]	Weight	PR
Pastoral half moon	135	15	120	0,4	17
Pastoral bench	60	86	-26	-0,1	11
Manual trenches	16	174	-158	-0,5	7
Stone cord	7	175	-168	-0,5	7
Grass strips	64	41	23	0,1	13
Assisted natural regeneration	70	55	15	0,0	12
Mechanical fight against <i>sida cordifolia</i>	113	54	59	0,2	14
Sylvopastoral half-moon	151	16	135	0,4	18

Relative preferences of CES/DRS works according to gender

As part of the restoration of the plant cover of pasture areas, 16% of the women in the sample think that assisted natural regeneration is the most important technique compared to 12% of men (table 4). For (18%) of men and (15%) of women, the pastoral half-moon is indicated as an important technique for restoring the availability of fodder in pastoral

areas. It is interesting to note that respondents of both sexes (18%) have the same point of view on the importance of the sylvopastoral half-moon. Grass strips are considered an important technique in the restoration of degraded rangelands among 12% of men compared to 14% of women. For both sexes, the manual trenches, the stone cordon and the pastoral bench are the only works which present negative weights. Thus, they are considered less important works in the restoration of degraded spaces.

Table 4. Influence of genre on preferences for CES/DRS works

Works	Men					Women				
	Most important	Less important	Difference	Weight	PR	Most important	Less important	Difference	Poids	PR
DLP	119	12	107	0,42	18	16	3	13	0,25	15
BP	57	66	-9	-0,04	11	3	20	-17	-0,33	8
TM	14	146	-132	-0,52	7	2	28	-26	-0,50	7
CP	6	144	-138	-0,54	7	1	31	-30	-0,58	7
BE	48	34	14	0,05	12	16	7	9	0,17	14
RNA	45	46	-1	0,00	12	25	9	16	0,31	16
LM	95	48	47	0,18	14	18	6	12	0,23	15
DLSP	128	16	112	0,44	18	23	0	23	0,44	18

^[1]Difference = “more important-less important”; PR= relative preference

²Difference = “more important-less important”; PR= relative preference; Pastoral half-moon (DLP), Pastoral benches (BP), Manual trenches (TM), Stone cordon (CP), Grassy strips (BE), Assisted natural regeneration (RNA), Mechanical control against *sida cordifolia* (LM), Half -sylvopastoral moon (DLSP)

Assessment of the works: results of proportional stacking

In total, 15 focus groups were organized (8 for the Dosso region and 7 for Tillabéri), bringing together 77 producers, 16.9% of whom were women and 84.1% of whom were men. Among the CES/DRS works, the major technique was the sylvopastoral half-moon, with an average score of 23 with a median score of 25 (range: 1–54). Mechanical control of *sida cordifolia* had a mean score of 20.47 and a median score of 19 (range: 3–50). The pastoral half-moon obtained an average focus group score of 21.14 with a median score of 12 (range: 5–43). Most proportional stacking scores showed no statistical difference between regions ($p > 0.05$) (Table 5). Two techniques, notably the stone cordon and the pastoral bench, showed a significant difference between the regions. The stone barrier is less appreciated in Dosso (mean score 2.14; median 2; ranges: 1–4) in comparison with the

Tillabéri region (mean score 6.25; median 4.5; ranges: 2–15) ($p < 0.009$). Pastoral benches are less appreciated in the two regions of Tillabéri (average score 6.47) and Dosso (average score 5.38) ($p < 0.002$).

The Kendall concordance coefficients (W) of the different focus groups of producers evaluating the importance of the structures by proportional stacking in the two zones showed average and highly significant values ($p < 0.001$), i.e. 0.31 for the region of Dosso and 0.68 for that of Tillabéri. Within the zones, the concordance coefficients of the focus groups pairs of gender (female gender: $W=0.48$; male gender: $W=0.39$), age (young: $W=0.70$; old: $W=0.38$) give moderate to high values, slightly homogeneous and significant ($p < 0.05$). This indicates that there is agreement in the assessment of the attributes of the CES/DRS structures and techniques in the two zones.

Table 5. Proportional stacking scores from discussion groups on book appreciation

Works	Men					Women				
	Most important	Less important	Difference	Weight	PR	Most important	Less important	Difference	Poids	PR
DLP	119	12	107	0,42	18	16	3	13	0,25	15
BP	57	66	-9	-0,04	11	3	20	-17	-0,33	8
TM	14	146	-132	-0,52	7	2	28	-26	-0,50	7
CP	6	144	-138	-0,54	7	1	31	-30	-0,58	7
BE	48	34	14	0,05	12	16	7	9	0,17	14
RNA	45	46	-1	0,00	12	25	9	16	0,31	16
LM	95	48	47	0,18	14	18	6	12	0,23	15
DLSP	128	16	112	0,44	18	23	0	23	0,44	18

DISCUSSION

CSE/DRS technological actions have an impact on the daily experience of beneficiary populations in the Sahel living in a self-subsistence economy based largely on the exploitation of natural resources. Thus, the various CES/DRS programs in the Sahel have allowed not only an increased awareness of the seriousness of the phenomenon of agro-pastoral land degradation but also a wide dissemination of CES/DRS techniques. The various awareness-raising actions supporting the dissemination of these techniques have raised awareness of their responsibility in the degradation

of their ecosystem on which populations depend daily [4,21,22]. As a result, local populations are able to choose the types of structures well suited to their fight against land degradation in order to mitigate the consequences and repair environmental damage. In this study, the importance of a CES/DRS work only concerns its role in the restoration of degraded lands and the production of fodder resources on rangelands outside of pastoral use.

The sylvopastoral half-moon, the pastoral half-moon and the mechanical fight against *sida cordifolia* are perceived as the most important works/techniques in terms of increasing

³Pastoral half-moon (DLP), Pastoral benches (BP), Manual trenches (TM), Stone cordon (CP), Grassy strips (BE), Assisted natural regeneration (RNA), Mechanical control against *sida cordifolia* (LM), Half -sylvopastoral moon (DLSP), not significant (ns), number of respondents (N)

the production of fodder biomass. In the BWS approach (individual) and proportional stacking (collective), these works obtained the best and positive scores. During the open interviews following the participatory survey, these works were also appreciated and appeared as works making it possible to increase the forage yield on the rangelands constituting the major constraint of livestock breeding which is their second activity after agriculture. This preference for these works through their impacts on fodder production is in agreement with the problem of livestock breeding in the Sahel in general and in particular in Niger where one season in two is dry. Many studies have shown similar results. Thus, in their participatory study in Niger, [23] also report a certain importance given to half-moons as a structure having enabled the recovery of spaces completely out of use for pastoral purposes on the Koutere plateau which is once again becoming suitable silvo-pastoral activities. Despite some shortcomings in their implementation, the CES/DRS works have brought numerous benefits to local populations, notably the increase in fodder resources and the limitation of land degradation [24].

In interviews with producers, they explain that the strength or importance of the half-moons also lies in their ability to capture linear runoff water from the plateaus which develop into large koris ending in their courses in the fields and the villages by creating flooding and silting of waterways. These phenomena are not without consequences on the lives of local populations who draw their substance from these fields and waterways. This hypothesis is supported by numerous works which explain that CES/DRS structures are effective against land degradation by delaying the effects of climate change by reducing the degradation of soils and vegetation by reducing the speed of water runoff and stabilizing agricultural and fodder yields [4,23,25].

Manual trenches, the pastoral bench and the stone barrier are considered less important works in the recovery of degraded land for fodder production. In focus group interviews, producers explain that manual trenches and pastoral benches are generally used for the production of woody plants in pastoral areas whose growth is slow with several years of maintenance and guarding. By comparing manual trenches and the pastoral bench to the half-moons, producers believe that the mainly herbaceous vegetation grows abundantly from the first year with the half-moons unlike that of the manual trenches and the pastoral bench. Furthermore, in the implementation of these three techniques, the population mentions the lack of labor, the difficulty in terms of digging work and transporting stones. These difficulties explain the low scores given to these works

in participatory surveys. However, the economic impact of these works in cash for work or food for work (which is not the subject of this study), the producers affirm that the creation of manual trenches, pastoral benches and stone bunds provides them with more income than half-moons. This explains why producers are well aware of the importance of these works in the fight against land degradation. Many studies have found similar results. In a participatory study conducted in Niger and Burkina Faso [26] showed that low scores were given to CES/DRS structures whose installation is difficult in terms of work and maintenance. Similarly, [27] showed that financial and material constraints are the main obstacles limiting the adoption of certain CES/DRS works. Several studies capitalizing on CES/DRS work in Niger, Burkina Faso and Mali [4,23] have shown that land recovery developments have proven effective in the fight against land degradation but financial difficulties in implementing the works limit their replication by the communities without the help of partners.

The constraints raised in the analyzes of this study justify the need for the governments of Sahelian countries to make these adaptation strategies more accessible and easily feasible for rural populations by giving them the necessary means to implement these practices. This will certainly help to make the effects of these anti-erosion practices more sustainable on the one hand, and on the other hand would facilitate their dissemination on a large scale. On this basis, the food insecurity of households living in agro-pastoral production systems linked to land degradation could contribute well to improving the survival of households during periods of crisis.

CONCLUSION

CES/DRS works have demonstrated success in stopping the causes of land degradation. In this study, the most important works are the half-moons. The producers' perception of the importance of the different works depends on their implementation condition in terms of difficulty of work, technicality and financial cost. Thus, to preserve these achievements in sustainable land management, populations and partners must work together more to identify the obstacles limiting the replication of works requiring great mobilization in terms of human, financial and technical resources.

CONTRIBUTIONS FROM AUTHORS

All authors contributed to the study design, data collection and writing of the manuscript.

CONFLICT OF INTEREST

The authors declared no conflicts of interest.

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