CRITERIA AND APPROACHES FOR EVALUATING THE IMPACT OF LAND RESTORATION PROJECTS AND THEIR APPLICABILITY TO NIGER

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ABSTRACT

Increasing knowledge about the extent of land degradation and its alarming consequences for human well-being has led to continuous efforts to combat this global phenomenon. Land restoration, which is one of the most commonly adopted responses to land degradation, has received increasing attention. The importance of evaluating restoration activities has also been gradually understood; and this understanding has resulted in the development and continuous improvement of approaches for the evaluation of restoration, as well as the criteria used for that purpose.

This paper describes and discusses criteria and approaches for evaluating land restoration and examines which of these are appropriate for use in the Sahel region, especially in the Niger Republic. Two main kinds of criteria are used for evaluating restoration success: ecological and socio-economic. These diverse criteria can be applied through different approaches, which fall into two broad categories, technical and participatory, that differ mainly by the degree of stakeholders' involvement in the evaluation process. The study concludes that a participatory approach is more appropriate for this purpose, both in general terms and in the specific context of Niger.

Keywords: land restoration, evaluation criteria, evaluation approaches, Sahel, Niger.

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1. INTRODUCTION

Land degradation is one of the most disturbing problems the world is facing. The results of the 1991 *Global Assessment of Human-induced Soil Degradation* (GLASOD) assessment indicated that 15% of the land surface was degraded. More recent estimates of the *Global Assessment of Land Degradation and Improvement* (GLADA) have revealed that 24% of land is degrading, of which 20% are cultivated areas; 23% broadleaved forests, 19% needle-leaved forests, and 20–25% rangelands (Bai Dent, Olsson & Schaepman, 2008). This same assessment pointed out that more than 1.5 billion people depend directly on these degrading areas for their livelihood. The loss of carbon fixation from the atmosphere, associated with land degradation over the period 1981–2003, amounts to about a thousand million tonnes (Bai et al., 2008).

Fortunately, multiple efforts were and are still being made to address this global phenomenon, both at conceptual and operational levels. According to GLADA, some 16% of the land area shows improvement in term of re-greening, though land restoration is not the sole contributing factor to this positive change (Bai et al., 2008).

Both developed and developing nations in the world participate in this global endeavour. In Niger for example, although it is a poor country, more than 200 billion West African francs have been invested in the last three decades by government and its development partners in programmes to promote sustainable land management and poverty alleviation (Republic of Niger/World Bank, 2009).

However, land restoration cannot achieve its full potential when it is not subjected to objective evaluation. By conducting such evaluation and widely disseminating the results, lessons can be learned from success and failures which will then lead to advances in the field of restoration (Davis & Mulhberg, 2002). Kondolf and Micheli (1995) added that the unhappy results of not adequately monitoring and assessing projects includes the repetition of mistakes and a lack of understanding of the larger effects of individual projects. For Stem, Margoluis, Salafsky and Brown (2005), monitoring and evaluation are fundamental for sound decision-making.

Post-project monitoring and evaluation provide us with the information we must have to further our ability to effectively assist the repair of damaged ecosystems (Davis & Muhlberg, 2002). In addition, documenting the evaluation methods and results will allow others to determine whether the findings apply to their specific situations and help to overcome mistakes in many other locations (Everest, Sedell, Reeves & Bryant, 1991). The continued failures of some projects can be attributed in part to our failure to monitor and learn from past projects (Downs & Kondolf, 2002).

Another rationale behind evaluation is the uncertainty characterizing the attainment of restoration goals and objectives because pathways toward targets are in most cases not predictable (Zedler & Callaway, 1999). We are unable to fully and accurately predict our efforts to restore physical and biological processes once they have been altered (Kondolf & Micheli, 1995).

Furthermore, restoration practitioners must be committed to learning whether they are on the right track, whether they are succeeding or failing in their efforts, and whether they are achieving the intended impact (CPM, 2007).

Different approaches and methods for measuring land restoration impacts have been developed and are still under continuous improvement. However, differences exist between developed and less developed countries concerning the development of and access to this scientific knowledge. Industrialized nations, for instance, have easy access to up-to-date scientific information while developing nations have inadequate science resources.

To fill the gap, scientists in less developed countries have to draw from the scientific resources of the developed world. This study about approaches and methods for evaluating the impact of land restoration is expected to help meet this need. The goal of this review is to contribute to the knowledge of land restoration impact assessment in Niger by providing a set of methods and approaches developed by scholars throughout the world as well as specifying the suitable conditions for the use of any particular approach.

More specifically the study is intended to be an opportunity to:

- discover the ecological and socio-economic criteria that are to be considered when evaluating restoration projects or programs;
- explore the existing approaches for assessing the impacts of restoration projects and programs;
- find out how practicable and suitable each method or approach is to the context and realities present in my home country, Niger, as well as the required conditions for their use.

2. CRITERIA FOR EVALUATING LAND RESTORATION PROJECTS

One important step in evaluating restoration success is a clear definition of the criteria to be used for this purpose. Various authors have made important contributions in this regard by suggesting some criteria that could be considered when evaluating restoration projects. These criteria belong to two broad categories: the *ecological* and the *socio-economic*. It is however important to note that even in the same category, the type and number of criteria used differ from one author to another.

The ecological criteria used to evaluate restoration relate to either the ecosystem function or structure. The recovery and stabilization of these ecosystem characteristics are the real proofs of restoration success (Ehrenfeld & Toth, 1997).

According to Walters (2000) for example, evaluation could be based on vegetation characteristics, while Passell (2000) and Rhoades, Eckert & Coleman (1998) suggested the use of species diversity and ecosystem processes, respectively. For other authors there is a need to measure multiple criteria to obtain a better appreciation of restoration success (Hobbs & Norton, 1996; Neckles et al., 2002).

The Society for Ecological Restoration International (SER) (2004) has produced a *Primer on Ecological Restoration* that presents a list of nine ecosystem attributes to be used when measuring restoration success. They suggested that a restored ecosystem should meet the following attributes: (1) similar diversity and community structure when compared to the reference ecosystems; (2) presence of indigenous species; (3) presence of functional groups that

can allow long-term stability; (4) suitable physical environment to sustain reproductive ability of the biological component; (5) normal functionality; (6) integration with its surrounding landscape; (7) absence or highly reduced threats to its health and integrity; (8) sufficient resilience; (9) self-sustainability.

An important contribution in detailing the ecological characteristics to be considered when evaluating restoration projects in desert and dry land was made by Bainbridge (2007). In his *Guide for Desert and Dry Land Restoration*, this author provided a checklist of functional and structural ecosystem characteristics to be assessed when evaluating dry land restoration projects. The functional characteristics include: (1) the soil moisture, which can be tracked by monitoring the flow of water in the site, stream flow monitoring and, plant moisture stress monitoring; (2) soil strength; (3) soil organic matter; (4) estimates of bacterial population; (5) ant and termite populations; (6) mycorrhizal and rhizobial species and their density; (7) soil crypto biotic crust; (8) soil chemistry; and (9) litter decomposition. The structural characteristics include: (1) plant cover; (2) plant density; (3) plant diversity; (4) seedling establishment; (5) seed set; (6) seed quality; (7) establishment of native and invasive species; (8) dynamics of keystone species; (9) faunal species (invertebrates, reptiles, birds and mammals) population dynamics and their reproductive ability.

Assessing all these ecosystem characteristics can give an excellent measure of restoration success, but it is also evident that the financial, human and time resources required will be enormous. To cope with this challenge, most restoration evaluators focus their measurements on biodiversity, the structure of vegetation, and ecological processes (Ruiz-Jaen & Aide, 2007). The richness and abundance of organisms within different trophic levels are usually determined to assess the biological diversity (Weiermans & Aarde, 2003; Nichols & Nichols, 2003). Diversity within different functional groups is also measured because it can provide information about ecosystem resilience (Peterson, Allan & Holling, 1998). Vegetation cover, woody plant density, biomass or vegetation profile are usually measured to determine the structure of the vegetation (Wilkins, Keith & Adam, 2003; Salinas & Guirado, 2002). A measurement of the structure of the vegetation can provide information about the direction of plant succession (Ruiz-Jaen & Aide, 2007). As for the ecological processes, they are usually determined by measuring the nutrient cycling and the biological interactions (e.g. mycorrhizae, herbivory, pollination, seed dispersal), and are important in predicting the resilience of a restored ecosystem. Nutrient cycling, for example, indicates the availability of the organic and inorganic components that are necessary to sustain organisms in an ecosystem (Davidson et al., 2004). Nutrient cycling is usually determined by measuring nutrient availability (Fuhlendorf, Zhang, Tunnell, Engle & Cross, 2002). The recovery of biological interactions is also of great importance for sustaining the function of a restored ecosystem (Ruiz-Jaen & Aide, 2007). For example, the poor success of many forest restoration projects is attributed to insufficient seed dispersal (Holl, Loik, Lin & Samuels, 2000; Donath, Holzel & Otte, 2003; White, Tucker, Meyers & Wilson, 2004). Seed dispersal is usually estimated by measuring the diversity and density of seedlings present on a site (Vallauri, Aronson & Barbero, 2002).

Williams (1993) and Longcore (2003) evaluated restoration success by measuring arthropods' trophic guilds. Measures of seedlings, millipedes, beetles, birds, rodents, and birds have been

used by van Aarde et al. (1996) to evaluate the recovery of a coastal dune restoration in South Africa. Nichols and Nichols (2003) measured ants, reptiles, birds and mammals to assess the recovery of Jarrah forests after mining in Australia. Parrota and Knowles (1999) assessed crown cover, plant density, tree basal area, canopy height and litter depth to evaluate the recovery of a moist tropical forest after mining. Measurement of vegetation cover, density, height, and tree basal area were used by Clewell (1999) to assess the success of riparian forest restoration after mining. Moynahan, Zabinski and Cannon (2002) measured arbuscular mycorrhizae colonization to assess the recovery of metal-contaminated land after mining. Rhoades et al. (1998) measured soil organic carbon, soil nitrogen, soil organic matter, and litter dynamics to assess the recovery of tropical mountain forest in Ecuador. Bowker et al. (2007) suggested the use of the biological soil crust to measure the recovery of dry land ecosystems.

For some authors, restoration project evaluation must go beyond the ecological evaluation to include project implementation (Davis & Muhlberg, 2002). In this case there is need to assess the appropriateness of the abiotic structures and the effectiveness and efficiency of the degradation control techniques employed. In dry land, for example, most restoration measures include the construction of physical features (e.g. sand dune fixation structures, run-off water harvesting techniques, etc.) and a variety of seeding and planting methods. Evaluation of these physical and biological measures provides an essential opportunity for determining the reasons behind the failure or success of a particular restoration project (Davis & Muhlberg, 2002).

Although more importance has been given to ecological criteria when evaluating restoration, some evaluations involve measurement of socio-economic aspects. For example, many restoration programs in China were launched to address poverty and improve the availability of natural resources for human well-being (Yin, Guiping & Lanying, 2010).

Evaluation of these projects must necessarily include such factors as: employment created, poverty status changes, revenue generated, degree of public participation, and so on. Education and capacity building appear in many restoration objectives (Smith et al., 1997). To evaluate such restoration projects, the degree of awareness created and any behavioural change in the targeted group ought to be included in the criteria. Similarly, the evaluation of projects involving restoration in use (i.e., restoration including grazing, farming, harvesting or recreational activities) should provide information on change in productivity, economic return and the social cohesion of the participant community (Bainbridge, 2007).

Another important contribution in the standardization of indicators to be considered when evaluating restoration – though specific to forest ecosystem – was provided by the REACTION (Restoration Actions to Combat Desertification in the Northern Mediterranean) research project (Bautista, Alloza & Vallejo, 2004). The particularity of REACTION's method of restoration evaluation is the combination of both ecological and socio-economic criteria. The project provided a set of indicators and criteria as a guideline for measuring forest restoration success. Table 1 presents these criteria and indicators.

As mentioned earlier, it is not realistic to measure all the ecosystem attributes when evaluating restoration. However, Ruiz-Jaen et al. (2007) indicated the need to include at least two variables within each of the three attributes of ecosystem function and at least two reference sites for

establishing the existing variation in an ecosystem. Moreover, it is necessary to compare the values of characteristics found in the restored site with those of the reference sites (SER, 2004). In addition, it is important to consider the effectiveness of these indicators. According to Bautista et al. (2004), for a particular indicator to meet that quality it should be simple, measurable, and adapted to the context, reliable, relevant and timely. Furthermore, an indicator should be sensitive to small change in an ecosystem trajectory as expressed in structure, composition and functioning, and broadly generalizable to other systems and situations across a range of ecological, and socio-economic conditions (Aronson, Floret, Le Floch, Ovalle & Pontanier, 1993).

Table 1. *Example of a set of criteria and indicators used for monitoring a forest restoration project (Source: Bautista et al., 2004).*

Criteria	Example of specific indicators
Indicators relating to biodiversity and naturalness	
Forest composition and patterns	• Proportion/ amount of natural forests (i.e., forest made up of natural species and allowed to develop natural characteristics) • Proportion of forests containing several different succession stages
Forest ecosystem function and processes	• Distribution of rare or threatened forest-dependent species • Species indicating natural forest processes- e.g. over matured trees, amount of dead wood, cavity trees
Forest fragmentation and extent	• Area of forest in the landscape compared with the original extent • Median size of the forest stand
Indicators relating to ecosystem services	
Environmental services Environmental resistance and resilience	• Water quality and quantity • Changes in stream sediment load
Socio-economic indicators	
Increased livelihood opportunities	• Indicators of forest economy and uses (production, green tourism) • Number of jobs supported by forests in the landscape • Number of Non-Timber Forest Products (NTFPs) available on a sustainable basis
Reduced human vulnerability	• Indicators relating to the specific pressure points within the landscape
Increased equity	• Number of traditional livelihoods supported • Opportunity for participation in management decisions
Enabling political and institutional environment	• Enabling legislation • Funding • Positive government incentives
Indicators relating to cultural aspects	
Maintenance of cultural values	• Restoration/protection for sacred sites in the forest • Number of recreational visits to forest and landscape • Forest/restoration action as part of the local culture • Sensitivity to forest restoration and protection

The above review reveals the existence of a wide variety of criteria and indicators that can be used for evaluating land restoration. Most of the evaluators have focused on ecological criteria and indicators (mostly quantitative) to measure restoration success while others added to these the socio-economic evaluation of the projects which goes beyond the quantitative appreciation to include qualitative information such as the perceptions of local communities. The two different groups of criteria and indicators (i.e., purely ecological and the combination of ecological and socio-economic) undoubtedly require different evaluation approaches. These different restoration evaluation approaches will be dealt with in the following section of this study. These approaches will be presented in their historical evolution.

3. FROM TECHNICAL TO PARTICIPATORY APPROACHES

Over recent decades a gradual change has occurred in the philosophy and practice of environmental management at regional, national and international levels. This change involves a shift away from top-down strategies in which planning, implementation, and evaluation of environmental projects is conducted primarily by centralized governmental agencies towards a bottom-up approach which involves all relevant parties, especially local communities, in the process of environmental management and decision making (Smith et al., 1997). In West Africa, for example, the evolution of approaches to environmental management has occurred in four distinct periods: before colonial rule, from colonial rule to the 1970s, from the 1970s to the 1990s, and from the 1990s to the present time (FAO, 2005).

3.1 The pre-colonial situation

Before the advent of colonial rule, environmental resource management was customary and could not be distinguished from land tenure management in the traditional agrarian systems. According to Goudet (1985), natural resource management was the responsibility of 'the land master'. Practical examples of this traditional management of all natural resources existed in West Africa, particularly in Niger, Mali, and Benin (FAO, 2005). In Niger, for example, the King of the Damagram Empire, which was a powerful political entity just before formal colonial rule was established, punished to death any person cutting a Gao (*Faidherbia albida*) tree, probably for the importance that species plays in improving soil fertility.

3.2 From colonial rule to the 1970s

From colonial rule to the 1970s, natural resource management was characterized by the creation and preservation of forest reserves for the interest of the colonial masters. The communities were totally excluded from any decision making concerning the management of natural resources and were subject to severe punishment when they made use of these resources. A paramilitary status was given to the forestry administration for the repression of any act against the established forest reserves. No responsibility was given to the local community in natural resources management at that time. This exclusion continued through the first decade of independence, although local population was then allowed customary use of the natural resources.

3.3 From the 1970s to the 1990s

During this period natural resources management policy underwent some changes due to the devastating impact of a severe drought that afflicted the countries of West Africa in 1973. The strategy at that time consisted of the implementation of projects to combat desertification and the strengthening of laws against natural resource exploitation. Although local communities took part in the implementation of these projects, they were not involved in the decision making. The implementation was made in a very technical manner and more importance was given to repressive actions than relegating some management responsibilities to local communities (FAO, 2005). This approach quickly revealed its limitations.

The inherent assumptions and the resulting characteristics of this technical, expert-oriented type of intervention have been described by Tilakaratna (1988) in FAO (2005) (see Table 2). As can be seen in the table, the approach is considered to be seriously flawed.

When extended to land restoration evaluation, the technical approach shows a multitude of limitations. By excluding some of the stakeholders affected by the intervention this approach

Table 2. *The classical model of technical, expert-based intervention (Source: Tilakaratna, 1988, as cited in FAO, 2005).*

Expert	Population	Nature of relationship
He is educated; he possesses knowledge (he knows everything)	They are not educated; they do not have any knowledge (they are ignorant)	Top-down (hierarchical and unidirectional)
He teaches, give instructions to be executed	Listen, accept and execute	Top-down
Alone he identifies the problems and recommends the solutions to be adopted	They have to accept, and make theirs, these solutions and execute them (those who refuse are considered as ignorant and lazy)	Top-down
He supervises the execution of the solutions he recommended and evaluates the result according to his own criteria	They are object of an evaluation of the execution of the solutions recommended to them by an outsider.	Inegalitarian
He often interacts only with local leaders, elites and dominant groups	The majority of the population (poor and vulnerable groups) are excluded	Elitist
He often has the idea that the population is homogenous, thus he does not take into account differences	The population is economically and socially divided and characterized by diverse and sometimes diverging interests	Elitist
He is the principal actor of any activity to be undertaken	They are composed of passive and naive partners	Dictatorship
He exerts a domination over the partners (population)	They find themselves in a subaltern and dependency position	Dominance, dependency
He is subject	They are object	Dominance, dependency
He is required, he is always necessary	They are not able to continue the project when the expert leaves	Endless assistance

runs the risk of wrongly identifying the criteria for success, and of wrongly appreciating land restoration achievement. Also, the fact that it relies mostly on numerical or quantitative data makes it liable to the failure to capture all the complexities that are involved in a particular problem situation. Another constraint is that the local people may not feel a need or be willing to participate in the subsequent management and protection required by the newly restored site when they are not involved in the implementation and evaluation of these projects. Worse still, the technical approach does not provide opportunity for building the capacity of the local community in aspects related to natural resource protection and management. This insufficiency may limit the adoption of restoration by the local people.

3.4 From 1990 to the present

The period was characterized by the globalisation of environmental questions as a result of the United Nations Conference on the Environment in 1992. After this conference, desertification control, management of biological diversity and climate change and variability were adopted as new policies and strategies in the different countries, thus recognizing the limitations of the previous approaches which were very directive and technical. This was the starting point for the improvement of population involvement in decision making. A participatory approach was therefore widely recognized as the best strategy. However, the concept of participation has been subjected to different interpretations in the practice. FAO (2005) outlines four types of community involvement in natural resources management, which are not true participation. These include:

- Participation that consists of simply transferring to the local people some functions and, material and financial charges that result from decisions taken outside them.
- The situation in which the interveners seek *a posteriori* the approval and adhesion of the beneficiaries to the objectives, programs or approaches that were defined and conceived without involving these populations.
- Participation that consists of briefly informing the population about a project, to obtain their formal adhesion to that project.
- Participation that consists of merely consulting the population when there is dysfunctioning or difficulty in the implementation of programs or projects conceived at the top.

The degree of population involvement in natural resource management in general, and land restoration implementation and evaluation in particular, differs from one country to another. While participatory land restoration is well established in Australia, Iceland and South Africa (Catacutan*,* Nelly, Johnson, Poussard & Youl, 2009), it is still in its infancy in some African countries, including Niger (TERRAFRICA, 2009). For these countries, there is still a lot to do in order to achieve an acceptable participatory land restoration and evaluation. The following description of the true participatory approach will clarify this gap.

3.5 A participatory approach to land restoration

Participation by the population consists of recognizing the power of this population to take initiative and make decisions in the definition and implementation of actions and programs that concern their present and future life. This means that interveners must recognize local people as actors, as key partners. They should not consider them as just targets of a project or the means of implementing decisions that have been taken without their involvement. Participation means that there is well established partnership and contractual relationships between all stakeholders. Therefore a participatory intervention is the one resulting from explicit consensus through negotiation between the different stakeholders. According to Gallard and Koné (1994, p.4),"Participation is a dynamic, functional and pragmatic approach in which development agents and populations combine their knowledge, their know-how and willingness, in concerted actions of partnership in order to sustainably improve the management of these actions". This conception invites the restoration practitioners to recognize that the local people have an important role to play in the conception, planning, implementation and evaluation of restoration activities.

In a more synthetic manner, Gohl (1993) conceived that participation should be understood as a process in which the population learns to gain more and more autonomy, while the practitioners or experts learn to cede more and more power to these populations.

Tilakaratna (1988, as cited by FAO, 2005) described how the practitioner-population relationship should be structured in a true participatory context. Table 3 presents his view of participatory intervention.

Participatory restoration is therefore an approach in which all the stakeholders are involved in the whole project cycle (i.e., situation analysis, planning, implementation, and monitoring and evaluation). It allows interaction and complementarities between traditional and scientific knowledge, thereby giving to the process its iterative character.

3.5.1 Merits of participatory approaches

The necessity for participation is increasingly being recognized on a global scale. The United Nations Convention to Combat Desertification – Ninth Conference of Parties (UNCCD COP9, 2009) stressed the need of joint work among the general public, local governments, research institutes and international financing agencies for the great importance of a collaborative approach in assuring the coherence, depth and continuity of actions to combat desertification. This is opposed to the often fragmentary visions of scientific specialties. Participation of community members in decision-making is also one of the prerequisites for sustainable development.

In the area of land restoration, this approach is advocated by many restoration ecologists and social scientists. For Light (2000), for example, the practice of ecological restoration contains an inherent democratic potential. This idea indicates the inclusive background of ecological restoration. A true restoration project must therefore embrace public participation. Other authors perceive restoration as a value-based activity and it should focus on assisting the recovery of ecosystem attributes and services that are valuable to humans (Davis & Slobodkin, 2003).

Table 3. *A model of participatory intervention (the practitioner as facilitator). (Source: Tilakaratna, 1988, as cited in FAO, 2005).*

Facilitator	Population	Type of relationship
He has knowledge gained through education (school)	They have knowledge gained through experience and practice	Collaboration, complementarity
He teaches and learns (he shares knowledge)	They teach and learn (they share knowledge with the facilitator)	Learning through exchange
He seeks to understand the socio-economic realities of the population and to identify the specificity of each group	They seek to better discover their own socio-economic realities and express their interests and specificities	Collaboration and exchange in the knowledge of local realities
He motivates the population to have a critical reflexion over their present situations, and their own socio-economic realities	They describe and analysis their own realities	Collaboration in the analysis of local realities
He facilitates reflection on the identification of possibilities	They explore the possibility of changing the reality	Collaboration and facilitation in the search of solutions
He facilitates the process of change and offers advisory services	They take initiatives, decide to pass into action, they take practical measures of autonomy	Partnership, advice
He motivates auto-evaluation and facilitates the process	They critically evaluate the actions they have undertaken in order to improve them	Partnership, advice
He acts by motivating, by facilitating and rarely by assistance	They engage to analyse, to decide and to act	Partnership, advisory
He is a simple facilitator	They are actors and beneficiaries	Partnership
He leaves them progressively	They become more and more autonomous and engage a sustainable development process	Transfer of competencies

Thus, for these valued attributes and services to be well understood the involvement of people living in and off the ecosystem is fundamental. Furthermore, public participation in any public activity increases the value of that activity (Light, 2000). This author also outlines two benefits of public participation. First, restoration projects usually require continuous attention after their completion. The involvement of the community adjacent to a site provides an opportunity for its members to develop or expand their long term interests in preserving and protecting that bit of nature into the future. And second, when the community that is in close proximity to the site feels a connection to the project, there is a sense of ownership or attachment that will contribute to the success of the restored site. This indicates that there is an additional benefit to a restoration project that incorporates some sociological elements. In order to ensure that restoration is successful it is important to note that a restoration project is a restoration not only of nature but of a human culture of nature. Light (2000) indicates that it will be inconsistent if we limit ourselves to evaluating restoration only at the level of natural value. We must also consider the value of participating in projects that bring humans into relationship with nature. In addition, participants in a restoration project learn more about the hazardous consequences of anthropogenic impacts on nature because they learn in practice how hard it is to restore something that has been damaged. This positive behavioural change is obvious knowing that, in general, human beings tend to give

more importance and more care to something they gain through some effort. This is probably what development agencies have understood as they now require some financial or physical contribution from the beneficiaries before funding a development project.

Another benefit of participation is the fact that, when people are drawn to natural areas and experience them, they may develop an attachment to these places (Ryan, 2000). Involving communities in restoration can therefore help them to learn how nature works (Miles, 2000). The interaction with scientists can also be an opportunity for local people to learn certain restoration techniques (i.e., planting, pegging, and seeding and so on), and knowledge about topics related to natural areas can cause people to look at nature differently (Kaplan and Herbert, 1987). For example, there is an increasing acceptance of trees on farmland in Niger since the farmers have learned, through interaction with environmental extension agents, about the importance of these woody plants in improving soil fertility and reducing wind erosion. Also, as indicated by Cahalan (1995), participation in ecological restoration enables people to directly experience connections with the plants, air, water, wildlife, ecological processes, and other people of their environment. As an illustration, Miles' (2000) study of 306 volunteers in the Chicago Wilderness restoration project revealed that fascination with nature was the most reported satisfaction. It is however important to note that this issue of fascination with wilderness which may result from participation in a restoration project cannot justify restoration in many developing countries like Niger where the rationale of restoration gravitates around the improvement of the natural capital to meet basic human needs. Participation in restoration projects can even lead to a global appreciation of environmental problems (Light, 2002).

Another advantage of the participatory approach in restoration is the opportunity it provides for the collection of both qualitative and quantitative data. It is important to measure the restoration variables that the intervention is targeting and also the threats and opportunities that may influence these variables (Stem et al., 2005), and these influencing factors can only be tracked with qualitative data resulting from the perceptions of local people. However, it is important to understand the strengths and limitations of both quantitative and qualitative methods and measures and to know when it is appropriate to use each of them. For example, quantitative measures are good to show trends or comparing restoration sites, while qualitative information is good for explaining the context of these trends (Bautista et al., 2004). Thus, omission of some factors may lead to the failure to learn from experience.

Restoration projects are in most cases labour-intensive, and local communities, when sufficiently involved and motivated, can provide a very cheap workforce, both for the implementation of the project and an important contribution to the protection of a restored site.

3.5.2 Limits of participatory approaches

Although there are many arguments in favour of the adoption of a participatory approach to restoration activities, these methods have some disadvantages. One of these is the longer time required for its use than for the technical measurement of some well-defined variables. In most cases, a participatory approach includes many and sometimes long meetings, because local communities may take a long time to well understand the techniques and tools used, and the

interaction which participatory methods engender is itself a time-consuming process. This can be a serious problem in developing countries, where the length of the project cycle is usually between three to five years.

The availability of local populations for deliberation or direct physical work may also be a constraint, due to the high burden of activities characterising them at any time of the year, although this problem can be overcome with sound planning.

The interaction between peoples with diverse and often diverging interests is usually not an easy task. In the case of the evaluation of restoration, the different views of the processes of nature and the natural environment can be a source of conflicts between experts and local people about the design and management of natural areas (Ryan, 2000). The challenge is therefore to find ways to relate the different observations of the various stakeholders.

An excellent work by Annorbah-Sarpei, Duce, Rugumayo, Schearer, and Tomlinson (1993) provides a comparison between technical and participatory land restoration projects, as described in Table 4.

Table 4. *Illustrative differences between conventional and participatory land restoration projects (Source: Annorbah-Sarpei et al., 1993, p. 15).*

Feature	Conventional Projects	Participatory Projects
Focus	Scientifically based solutions; transfer of technology; motivation and training	Cultural and practical; community-based solutions; local self-reliance and self-help; potential bridging organizations
Conception, initiation	Government and donor agencies; external implementing agencies; outside consultants	Partnership between government, local NGOs, local community institutions, and donor agencies
Relationship to local culture and economy	Marginal, sometimes conflictive	Well-integrated, supportive
Goals, objectives	Usually set by governments and donors	Arise from communities or from consensus between communities and other parties
Planning, management and supervision	Government or executing agency	Diverse parties working collaboratively
Sources of technical information	Government experts, contractors and consultants	Communities plus government experts, contractors and consultants
Sources of local cultural and institutional information	Typically not utilized	Local individuals, NGOs and community institutions

The two major approaches described in the preceding sections provide both some information on restoration evaluation. The selection of an approach depends always on the goals and the conditions under which it will be applied. Each approach has some limitations from the economic, social or environmental point of view, or other determinants for its applicability. It is however evident that the participatory approach has become a new paradigm, with large support both from the development agencies and the majority of development scholars for the proven role this approach can play in the continuous struggle for sustainable development.

4. THE CONTEXT OF NIGER

As mentioned earlier in this document, one of the objectives of this review is to propose approaches and methods for the evaluation of land restoration approach that would be suitable for my home country. But, for the purpose of clarity it is useful to present first the actual context of the country, in terms of ecological, political and socio-economic factors which are necessary to consider before making that choice. It is also important to present and judge the way land restoration projects have been evaluated in the country until now.

4.1 The physical context

Niger is located in West Africa and covers an area of 1,267,000 km^2. The country is landlocked and one of the hottest and driest parts of the world. Niger is bordered in the south by Nigeria and Benin, by Tchad in the east, Algeria and Libya in the north and Mali and Burkina Faso in the west.

The physiography is characterized by a high plateau in the north-east (elevation 800 to 1000 m a.s.l.); the Massif of Air in the central north (more than 2000 m in some locations); a low plateau in the west, centre and south; and plains in the larger part of the country.

As for the potential for agriculture, the soils cultivated in Niger have a widespread organic matter and phosphorus deficiency. They are affected by a continuous decrease in fertility, a trend to acidification, and sensitivity to water and wind erosion, a poor water retention capacity, and alkalinization and salinisation events. It must be noted that 80% to 85% of the lands suitable for cultivation are dunes and only 15% to 20% are hydromorphic and slightly clayey (SEDES, 1987). The mountainous areas and great plateaus (Aîr, Ader Doutchi, continental terminal) are dominated by lithosoils. The fossil valleys (Dallols, Goulbi, Korama), the river valleys, the Komadougou, Lake Chad and the Manga basins are mainly dominated by hydromorphic soils and Vertisols.

Niger has a dry tropical climate, with desert constituting more than three-fourths (77%) of the country (ME/LCD, 2005). Four climatic zones characterize this climate (Fig. 1):

- The Saharan zone, receiving less than 150 mm of rainfall per year and which corresponds to the desert part of the country. The vegetation in this zone is very scarce and consists of some spots of degraded steppe around oases. This zone represents 77% of the country.
- The Sahelo-Saharan zone, which covers 10% of the country and receives 150–350 mm of rainfall per year. It is sub-desert with herbaceous steppe vegetation.
- The Sahelian zone, which covers 12% of the country and receives 350–600 mm of rainfall per year. The vegetation in this zone consists of a shrubby steppe.
- The Soudanian zone represents 1% of the country and receives 600–800 mm annually. This zone has savannah vegetation. The figure below presents the four ecological zones of the country.

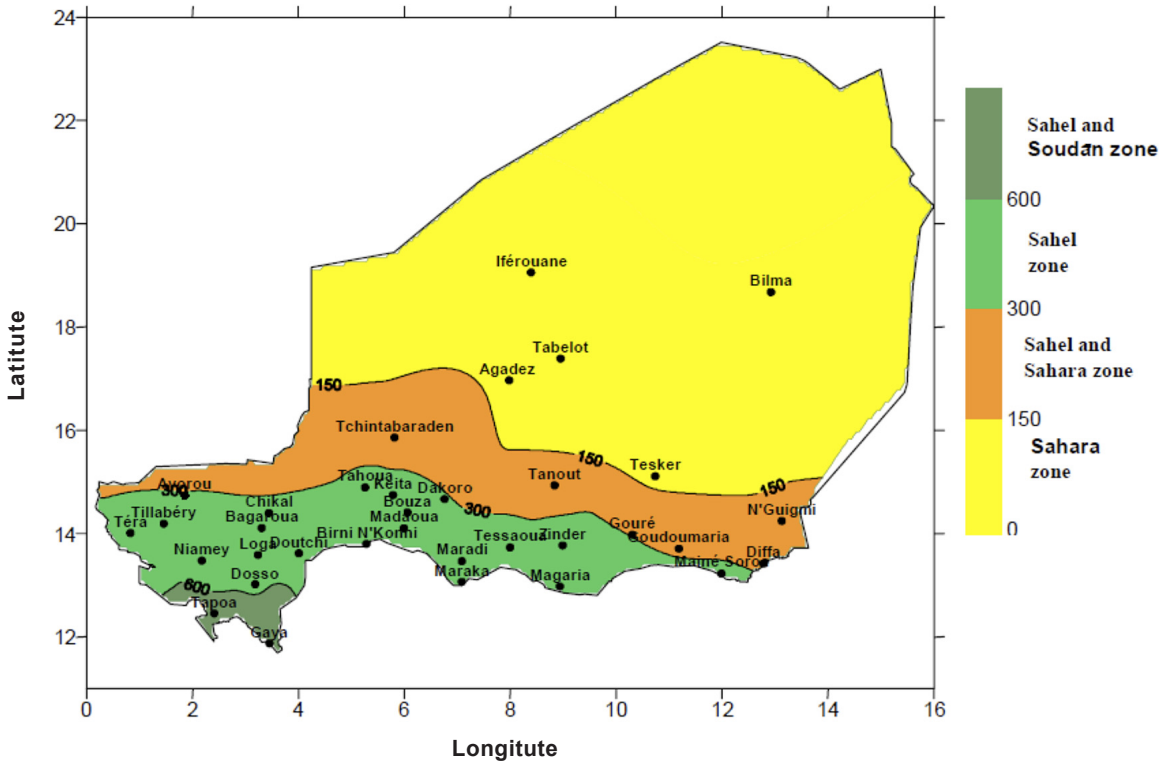

Fig. 1. *Climatic zones in Niger. The coloured bar to the right represents amount of annual rainfall in mm. (Source: National Meteorological Department, average annual rainfall covering the period 1975 to 2004, 2005 edition).*

Niger is also characterized by two seasons, a long dry season going from October to June, and a short rainy season from mid-June to mid-September. The dry season can further be divided into two sub-seasons:

- A cold season which goes from October to February and during which the mean temperature is around 10°C.
- A hot season which covers the period March–June and is characterized by high temperatures mostly around 40°C with reduction during the night time.

The climate of Niger is also characterized by high evaporation, ranging from 579 to 902 mm in the dry season, and 744.5 to 1327.5 mm in the rainy season (CNEDD, 2000). This harsh physical context increases the liability of the country to land degradation as well as impairing the success of many restoration techniques.

4.2 The demographic and socio-economic context

In 2010, Niger's population was estimated at 15,203,822 people (INS, 2010). The population growth rate was 3.3% according to the 2001 census. In 2009, some 80% of this population were living in rural areas (INS, 2010), which is very high by international comparisons. The larger part of this population (three-fourths) is concentrated in a third of the country, more precisely along the southern margin where environmental and climatic conditions are more favourable

(ME/LCD, 2009). The main activities of this rural population include agriculture, livestock farming, and forest resource exploitation. The agricultural population is estimated at 61% of the total population (INS, 2008). This indicates the high reliance of these people on the use and exploitation of natural resources and also the pressures they exert on the environment as a whole.

According to the 2009 Human Development Report, Niger is the poorest country in the world (UNDP, 2009). Other national statistics by INS (2009) indicates that 59.5% of the population is classified as poor. This primary sector contributes to 41% of the gross national product (SDR, 2004). Only 15 million hectares are suitable for agriculture and this arable land is essentially located in the southern portion of the country where the population of the country is concentrated, with more than 200 people per km^2 in some parts (Amoukou, Moussa & Daouda, 2007). This concentration of the population in a relatively small part of the country constitutes an important cause of land degradation. Worse still, the severe poverty of the rural people limits their capacity for investment in soil fertility management and other sustainable land management techniques. Therefore, the expansion of the farmed area is the only alternative strategy available to farmers to meet the food demand of the rapidly increasing population. According to official estimates, the area used for agricultural purposes doubles every 25 years (SDR, 2004). This expansion has led to an increasing use of marginal land and the exacerbation of land degradation. Other factors contributing to land degradation are overgrazing and deforestation for fuel wood. Wood constitutes the main energy source in the country and accounts for 91% of the total energy consumption of the population (ME/LCD, 2005). The pressure of the rural population on land resources has worsened the degradation of this scarce resource. More than a hundred thousand hectares are annually degrading in the country (PAN LCD/GRN, 2000) while restoration efforts presently cover only around 20,000 ha/year (ME/LCD, 2005).

4.3 The political and institutional context

Niger has engaged in a decentralization process starting from the year 2002 which has led to the creation of 265 communes. Act no. 2002–013, of 11 June 2002, dealing with the transfer of competences to regions, states and communes, delegated to these decentralized units important responsibilities and tasks concerning the preservation of the environment and the management of natural resources. These communes are administered by mayors and councillors elected by the corresponding inhabitants. In addition to the communal organization, the authority of traditional leaders is still recognized. The existing traditional titles include *Chefs de province*, *Chefs de canton*, *Chefs de village* and religious leaders. All these leaders play a very important role in the management of local affairs.

At the policy level, the national context is characterized by the existence of many strategic frameworks involving, directly or indirectly, sustainable land management aspects. In 2002 for example, Niger adopted the Strategy for Poverty Reduction (SRP), which assigned to the primary/rural sector the most important role in the effort to boost the economy. In 2003 the strategy for rural development (SDR) was adopted, which constitutes the reference framework for any activity concerning rural development. This strategy stems from the above-mentioned SRP.

In 2006, the Action Plan of the SRD was adopted and contains 14 programs, many of which relate to sustainable land management. These include:

- a local and community development program;
- a local governance of natural resources (land, water, vegetation, etc.) program;
- a program for the reduction of household vulnerability;
- an environmental preservation program;
- a land restoration program;
- a program for range management and securing pastoral systems.

As can be seen from this list of strategies and policies (SRP, SDR, and decentralization), the sustainable land management programs combine both the restoration of the ecological environment and the restoration of human well-being. This is because poverty is seen as both the cause and the consequence of environmental degradation. Moreover, all the above strategies have in common the promotion of local governance.

However, the persisting paramilitary character of the environmental administration limits the participatory implementation of these strategies. The paramilitary feature of environmental administration originated from colonial rule and was established to enforce the repressive regulation aimed at preserving the natural resources for the benefit of the colonialists.

4.4 Land restoration efforts in Niger and their evaluation

Since the early 1980s, more than 50 programs with land restoration and/or sustainable land management components have been carried out. According to the Republic of Niger/World Bank (2009) the total investment for the 31 most important of these programs was more than 200 billion West African francs (FCFA).

However, although sustainable land management is a priority in the country, it is not the only one. For this reason many of the programs are multipurpose, and the importance given to land restoration is to be considered in the light of other competing demands for public and private financing. A rough estimate indicates that one-third of the total expenditure of these programs has concerned natural resource management in total.

Most of these programs have promoted water harvesting and soil and water conservation (SWC) measures, tree planting, and other land restoration measures. The water harvesting and SWC measures that are commonly promoted include improved planting pits (*zai*), half-moons, stone bunds, banquettes (embankment with trenches), small dikes and water-spreading dams. Vegetative measures that have been promoted include tree nurseries and plantations, vegetative bands, windbreaks, assisted natural regeneration, and sand dune fixation.

The reported results of these programs include increased vegetation, reduced erosion, rehabilitation and increased use of degraded land, increased agricultural yields, more fodder for livestock, improved water availability, improved food security, and reduced poverty, among others. For example, Reij and Steeds (2003) reported that an International Fund for Agricultural

Development (IFAD) project in Illela District of Tahoua Region rehabilitated 9,000 hectares of degraded land, mostly using *zai* on private land, leading to an incremental annual economic benefit of $65 (US dollars) per hectare resulting from increased crop production from an annual investment of $250 per hectare. According to Hassane, Martin and Reij (2000), the same project earned an estimated 20% economic rate of return, contributed to the development of local land and labour markets, and led to the diffusion of *zai* techniques to other areas. Ambouta et al. (2000) estimated a 30% reduction in water and wind erosion, as well as reduced runoff and increased water infiltration resulting from interventions in various projects in the Tahoua region. Adam, Reiji, Abdoulaye, Larwanou & Tappan (2006) reported improvement in a wide variety of outcomes in the project villages studied in Maradi, Tahoua and Tillaberi regions, compared with the little improvement shown in the non-intervention villages.

As can be noticed, most of these evaluation studies in Niger focused only on the socio-economic return of the restoration projects and less attention has been given to the ecological impact of these projects. In addition, none of the studies mentioned was conceived for a long-term evaluation; rather they just assess the situation at one point in time. It is however important to note the existence of a newly-established National Centre for Ecological and Environmental Monitoring and Evaluation (CNEE), which has the responsibility for long-term ecological and environmental monitoring and evaluation in the country. The indicators used by this institution include: 1) habitat diversity, 2) floristic composition, 3) biological types, 4) phytogeographical distribution types, 5) dominant species, 6) site productivity, 7) alpha and beta diversity index, 8) soil cover, and 9) rare species. Although these indicators cover most of the ecosystem characteristics, it is evident that less consideration has been given to ecosystem function attributes. Moreover, CNEE seems not to take into account the socio-economic indicators which can help in understanding the relationships between human activities and ecosystem change.

The main findings of the above analysis of the Niger context are as follows:

- The country is characterized by harsh physical and climatic conditions (vast desert, low and erratic rainfall, frequent droughts, short rainy season, high evaporation, etc.);
- The national economy relies on the exploitation of land resources with agriculture and livestock farming as the main economic activities;
- The high pressures on natural resources aggravate land degradation and result in the accentuation of poverty;
- The weak economy of the country does not allow sufficient investment in sustainable land management;
- The existing political and institutional context recognizes the importance of local community involvement in natural resources management and restoration, but this recognition has in many cases not yet been translated into effective implementation;
- Very few land restoration programs have been evaluated and these evaluations are limited in their focus to one rather than both sides of the ecological and socio-economic criteria.

5. CONCLUSION AND RECOMMENDATIONS

Though a young field, restoration ecology has advanced greatly in recent years. In the area of restoration project evaluation, many criteria and indicators have been developed and tested in countries all over the world. What is surprising is the fact that only a little of that rich literature comes from the developing world, where land degradation is most severe.

The approaches used for evaluating the impacts of restoration fall into two broad categories: the technical and the participatory. The participatory approach receives more support nowadays and is being widely advocated. The main reason is that it provides opportunities for a more thorough evaluation of restoration projects, as both the ecological and socio-economic aspects are considered. More efforts have been made to develop the ecological side of restoration evaluation, while there is still much to explore in terms of the social and economic evaluation of land restoration.

Based on the findings of this study, some recommendations will now be made for improving the effectiveness of land restoration and its evaluation in Niger.

- **Adopt a participatory approach of land restoration and implement a system of participatory evaluation of land restoration programs.**

This will provide an opportunity for taking into account the perceptions of major land resource users who are also the main agents of land degradation. It will also provide the local communities the capacity to deal with issues related to sustainable land management, thereby facilitating the adoption of attitudes more respectful to the environment as a whole. This point is supported by Leigh (2005, p.8) when he states that "the practice of participatory restoration [and its evaluation] brings communities together, promotes a conservation ethic, develops a sense of place and reconnects the humanity to the environment."

Participatory land restoration (including evaluation) offers the average citizen not only an insight into how humans impact the immediate landscape but on the larger biotic community as a whole; an insight that can be viewed as more important than the ecological restoration itself. Therefore, community-based restoration carried out in a participatory way not only enhances the environment, but also helps in educating the community.

Community-based restoration serves as an instrument for social change by promoting a deeply committed constituency, which is critical for addressing environmental problems on all geographical scales. By participating in restoration activities, environmental stewardship comes by igniting the passion of those that live in the community to choose environmental sustainability.

Community-based restoration is a powerful instrument to systematically address many of our destructive tendencies, and, in this way, to culturally transform society towards a healthier relationship with the environment. Given the rate of land degradation in Niger resulting from extreme population pressure and reliance on environmental resources, a drastic and immediate revision of our behaviour is needed to mitigate human impacts.

Due to the economic weakness of the country and the resulting limited efforts in land restoration investment, involving local populations in restoration activities will help in maximizing these efforts. This is particularly relevant as the people of Niger are reported to have a positive attitude towards participating in collective activities without monetary remuneration. Voluntary public participation is common in the construction of infrastructures like schools, water wells and village health centres, to name a few (Mahamadou, Boubacar & Adamou, 2009).

Public involvement in restoration activities is necessary, as it creates favourable conditions that are the prerequisite for the conservation and management of the restored site. According to the Ministry of Environment and Desertification Control, the protection and conservation of some newly restored sites is greatly impaired by livestock intrusion resulting from insufficient care (Mahamadou et al., 2009).

It is however important to note that greater success from a participatory approach will be expected if the following principles are sufficiently considered:

- ✓ Allow as much as possible the participation of all stakeholders from the very beginning: in the participatory land restoration activities it is important that all political levels be considered. The local and regional levels are certainly of greater relevance, but stakeholders from national and even international levels should also be involved.
- ✓ Respect local knowledge and experience: the identification of respected key actors and community members with a high degree of influence may play a decisive role in the success of the process.
- ✓ Establish local steering groups, for example, local agenda groups; these are necessary to ensure the smooth running of the process and the continuation of management after the end of a project.
- ✓ Appreciate communication as the most important key factor; the participatory approach requires a great deal of openness, sensitivity, patience, and communication skills appropriate to each target group and social level. A sophisticated public relations concept is essential for good and effective implementation.
- ✓ Not all projects require the same degree of participation; the participatory appraisal should suit the different framework conditions (political and legal conditions, social and economic situation) with respect to the different democratic traditions and the social herarchy.

- **Strengthen and extend the scope of the newly created Centre for Long Term Environmental and Ecological Monitoring and Evaluation (CNEE).**

This can be done by allocating adequate human, financial and material resources so as to increase performance and effectiveness. Human capital can be improved by providing training opportunities in disciplines related to land restoration for the national university and to students from Niger in universities abroad, or recruit faculty and researchers from external universities and research organizations to provide training in relevant fields in Niger. The financial and material resources can be improved by creating a special fund from money earned in mining and other industrial activities having a negative impact on land. Increasing co-operation with technical financial partners may also constitute a good source for technical and financial assistance.

To be more effective, CNEE has to adopt a participatory approach so that the impact of empowering local communities and the ownership of evaluation techniques and tools will be more successful. For this purpose the CNEE has to develop simple techniques and tools that local communities can easily cope with. The creation of local centres of ecological and environmental monitoring can also have an important role to play in the search for the greater effectiveness of the national centre for ecological and environmental evaluation.

- **Combine both ecological and socio-economic criteria for evaluating land restoration.**

This is necessary as only one of the two categories of indicators cannot cover the whole complexity of a restoration site and therefore will fail to give a correct appreciation of the restoration impact. In addition to the ecosystem structural criteria already considered by the National Centre for Ecological and Environmental Evaluation there is need to include easily handled soil measurements of soil properties such as moisture, soil fertility and soil temperature. Good information on soil fertility can be obtained by assessing the availability of ants and termites and other small fauna species, as suggested by some authors already cited in this paper. This is necessary as most restoration projects in Niger include soil and water conservation measures. The socio-economic criteria should include the degree of adoption of a land-friendly attitude; employment created by the project; appreciation of community empowerment resulting from the project; evaluation of the availability of ecosystem goods for the population well-being; information on the contribution of the project to reduce poverty in the community; and other social and economic impacts. When involved, the local community can bring significant contributions in terms of these criteria and indicators, as most of them do not require highly technical skills.

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