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## Assessment of forage production and socio-economic effects of a developed site: the case of the Samtigué sylvo-pastoral site (Western Niger)

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### Abstract

Today's Sahel is a zone of multiple challenges. Security and social crises are compounded by endemic food insecurity. The appropriate response to these problems requires the implementation of integrated activities in several sectors. The aim of this study is to assess the effects of reclaiming the Samtigué plateau (Ouallam/Niger department) on socio-economic and environmental dimensions. The methodology used consists in assessing the forage produced, using the yield square pause technique, followed by full cutting and weighing. Socio-economic effects were assessed in terms of food security, social cohesion and beneficiaries' income. The results show that an average of 1.7 kg of dry fodder is produced per work. This corresponds to a yield of 353.6 kg per hectare and a carrying capacity of 0.068 TLP/ha/Up. In addition to fodder production, small animals are beginning to return. The development of the sylvo-pastoral site has helped to strengthen the capacities of the beneficiaries, as well as improving social cohesion within the population. In terms of income, a participant in the work earns a monthly income of 26,000 CFA francs. The works have had a positive impact on the lives of the beneficiary communities and on the environment.

**Keywords:** Multifunctional half-moon, sylvo-pastoral site, Ouallam

### 1. Introduction

The Sahel is a geographical zone defined by its semi-arid to arid climate. It is a zone rich in resources and potential, making it one of the most coveted areas in the world. If the Sahel is vulnerable, it is first and foremost because of its geography, which creates a context conducive to claims of all kinds (CEREM, 2009) <sup>[1]</sup>. Climatic aridification combined with poor environmental management have led to desertification (Bonnet *et al.*, 2024) <sup>[2]</sup>. The Sahel is also experiencing strong overexploitation of land, due to high population growth and fragile, poorly fertile soils (Descroix *et al.*, 2012) <sup>[3]</sup>. Natural resources are the basis for the productivity of ecological systems and environments. The destruction of natural resources and the loss of land productivity constitute a major obstacle to development, which can lead to major disasters that are difficult to reverse: famine, land abandonment, sudden migration (Cornet, 2000) <sup>[4]</sup>. These socio-institutional constraints have led to the outbreak of social insecurity in the area, forcing thousands of families to move, often away from their homeland. There are also the internally displaced, or IDPs: people from villages subjected to murderous pressures who seek refuge in the nearest towns, abandoning their possessions (land, material goods, food stocks, etc.). Indeed, host areas are just as vulnerable as departure areas. This justifies the implementation of support programs, often referred to as "humanitarian emergency" and/or "resilience". Humanitarian assistance is seen as an operation carried out by one or more States, intergovernmental organizations or non-governmental organizations, aimed at providing relief, in compliance with the principle of non-discrimination, to victims, mainly civilians, of international or non-international armed conflicts, natural disasters or similar emergencies (Robert, 2004) <sup>[5]</sup>. The resilience program implements actions aimed at strengthening the resilience of vulnerable communities by creating sustainable productive assets. As a result, restoring soil productivity and rehabilitating vegetation cover are vital issues for rural populations (Roose *et al.*, 2015) <sup>[6]</sup>.

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This work assesses the forage productivity of reclaimed Half Moon Multifunctional (DLMF) sites and its socio-economic benefits.

## 2. Materials and Methods

### Study site

The study was carried out on the Samtigué plateau, in the Ouallam commune (western Niger). For years, the Ouallam area has been affected by the crises (security, food, nutrition and climate) that have shaken the Sahel. Despite this, the commune is a place of refuge for large numbers of people from

neighboring areas who are victims of insecurity. These include Malian refugees and internally displaced populations, in addition to a native population already living in a context of chronic food insecurity. Soil degradation, poor rainfall distribution and monetary poverty further exacerbate the vulnerability of these populations, whose only alternative is rural exodus. This is why, in response to humanitarian needs, the government of Niger, with the support of the World Food Program (WFP), has undertaken land reclamation activities on the Samtigué plateau, a site with a sylvo-pastoral vocation (Figure 1).

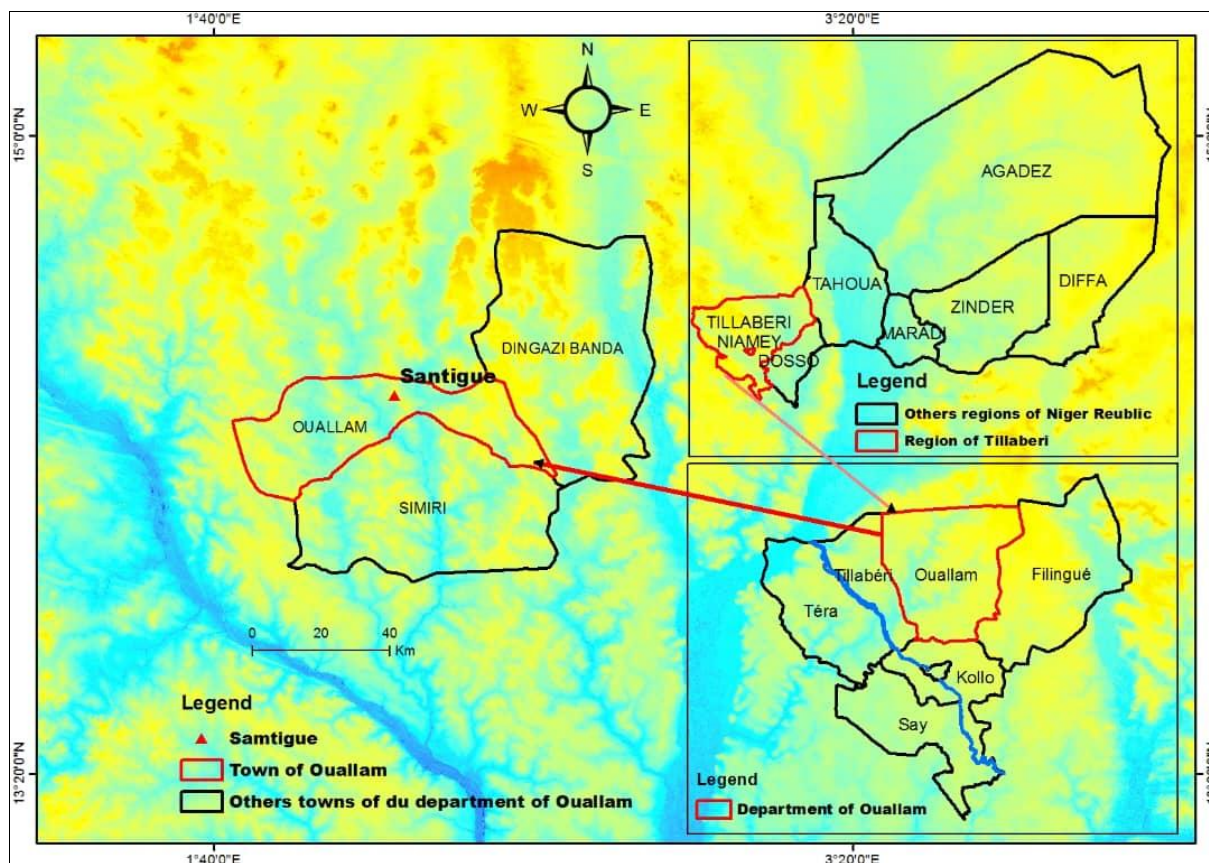


Fig 1: Location of the Samtigué site

### Type of work and standard of construction

Water and Soil Conservation / Soil Defence and Restoration (CES/DRS) techniques group together a range of works to be carried out according to geographical unit (plateau, slope, glaciais, valley), soil type, nature of terrain, slope, etc. (GIZ, 2012) [7]. The whole process follows a logic or watershed approach, which takes into account the treatment adapted to each geographical unit. The model for the work carried out is the Multifunctional Half-Moon (MHD), designed for sylvo-pastoral use over an area of 240 ha (Figure 2). Prior to development, the plateau was characterized by a lateritic, armoured soil. The standard is one structure per person per day (1DLM/H/dr), with the following characteristics:

- Diameter of structure: 4 m;
- Bead height: 0.30 to 0.40 m high and 0.60 to 0.75 m wide;
- Level line spacing: 4 m;
- Line spacing: 6 m;
- Area of each DLM (its section and impluvium): 4 m x 12 m = 48 m<sup>2</sup>;
- Density: 208.33/ha;
- Layout of structures: staggered;
- De-bottlenecking trench 0.30 m wide and 0.30 m deep;

- Operating trough 15 cm deep with manure input.

The work was carried out during the dry season (January to May) of 2023 by refugee communities, displaced populations and local people.



Fig 2: A view of the completed works

### Enhancement of structures

Enhancement began in the rainy season of 2023 with herbaceous seeding and tree planting. The seeding technique consists of

harrowing the bottom of the bowl of the Multifunctional Half-Moon and the top of the bead to lightly bury the herbaceous seeds. The quantity of seed applied is 15 kg/ha. Woody species were planted in the planting holes at a rate of 208 plants/ha after mid-July.

Herbaceous species were selected on the basis of biogeography (Table 1). These species are common in other geographical units of the same watershed.

**Table 1:** Quantities of herbaceous seeds used for enhancement

| Scientific names of species    | Quantity (Kg) |
|--------------------------------|---------------|
| <i>Andropogon gayanus</i>      | 50            |
| <i>Alysicarpus Ovalifolius</i> | 50            |
| <i>Cynchrus biflorus</i>       | 50            |
| <i>Cymbopogon nardus</i>       | 50            |
| <i>Panicum capillare</i>       | 100           |
| <i>Pennisetum villosum</i>     | 50            |
| <i>Zornia glochidiata</i>      | 100           |

### Data collection system

The half-moon in all its components was considered to be the observation unit where all manipulations were carried out. For this purpose, a transect was selected on which ten half-moons (10) were considered, using the “sampling step” method.

### Estimation of biomass

Quantification of the biomass produced (MS) was obtained by systematically cutting all the herbaceous biomass in the half-moon at ground level, then weighing it using a 1g precision

electronic balance. Yield and total production for the site were obtained by extrapolating data from the observation units.

### Determining Animal Carrying Capacity (AC)

In addition, from the dry matter, the Animal Carrying Capacity (CC) was evaluated by the following formula (Kouassi *et al.*, 2014) [8]:

$$CC = \frac{\text{Biomass} \times K}{6,25 \times Up}$$

CC: Carrying capacity in TLU/ha/Dp; K = utilization coefficient (k = 0.33); Biomass (Kg dry matter/ha); 6.25 = daily consumption of a TLU (Tropical Livestock Unit of 250 kg live weight); Up (utilization period): 273 days, i.e. 9 months.

### Determining socio-economic effects

The evaluation of socio-economic effects focused on food security, social cohesion and direct income of beneficiaries.

The various data collected were processed using Excel spreadsheets.

## 3. Results

### Dry biomass production

The amount of biomass per structure varied from 1.02 to 2.06 kg (Figure 3). The average quantity is  $1.7 \pm 0.285$  Kg per structure, giving a forage yield per hectare of 353.6 Kg/ha.

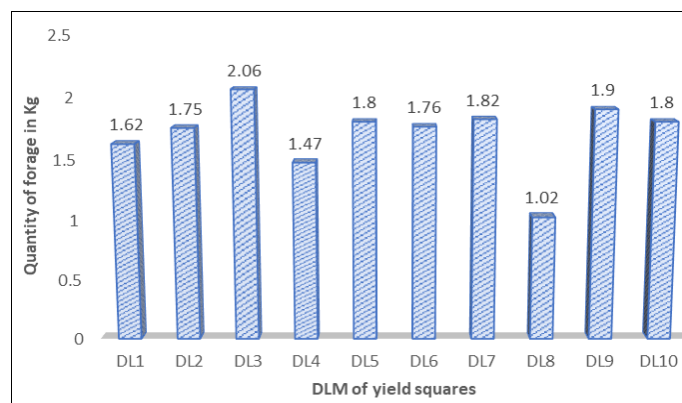


**Fig 3:** Dry biomass production per multifunctional half-moon

The construction of these structures has profoundly altered the physical and biological environment, as illustrated by the before and after images (Figure 4).

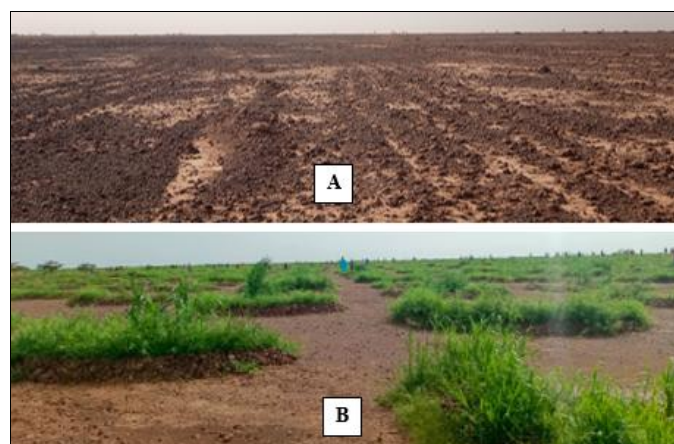


**Fig 4:** View of the site before (A) and after (B) development

### Animal carrying capacity (CC)

Animal carrying capacity is an important parameter to measure in forage production, especially in the Sahelian context where pastoral crises are recurrent. On an area of 240 ha, forage production in the first year of development is 84,864 kg. The CC is 0.068 TLU/ha/Up.

### Socio-economic benefits

The works are part of a nexus, emergency, peace and development program combining integrated activities on several fronts, including environmental protection and rehabilitation of productive soil potential. Participation in these physical activities generates a daily income of 1,300 cfa for each participant. The monthly income per household is 26,000 cfa for 20 days of paid work. In five (5) months of work from January to May, each household earns 130,000 cfa. To this must be added two (2) months of unconditional bridging assistance, during which beneficiaries received 26,000 cfa/month to enable them to participate fully in field work. This sum contributes significantly to improving the food security of beneficiary

households. Food For Asset (FFA) work is well known for its contribution to the occupation of the rural labor force, thereby helping to build resilience and reduce exodus. Social cohesion between target populations has been strengthened by the creation and maintenance of a framework for interaction and social integration. Weekly awareness-raising sessions on peaceful coexistence, income-generating activities (IGAs), community nutrition and good agricultural practices have helped to build community capacity and resilience.

### Environmental benefits

Among today's major environmental challenges, climate change, loss of biodiversity, deforestation and pollution are of prime importance. The transformation of a totally degraded, rocky, encrusted and denuded environment into a restored environment with a permeable structure favoring water infiltration and root fixation has enabled the re-greening of the treated area. This plays an important role in the local ecosystem, modifying the roar and flow of the watercourses in the watershed. It has also been noted that wildlife (classified as small fauna) has returned to a suitable habitat.

### 4. Discussion

Social, economic and food insecurity are new problems characterizing the study area. As a result, populations are living in an uncertain environment in terms of sustainability. Climate change is hitting hard and the degradation of productive potential is exacerbating, putting a strain on any hope of self-rising (Moussa *et al.*, 2024) <sup>[9]</sup>. Building resilience through the creation of sustainable productive assets in this context seems an appropriate solution, as it meets the immediate and future needs of the population. During Participatory Community Planning (PCP), priority needs are expressed and taken into account. Protecting the environment by restoring degraded land has a direct impact on the economy of poor households (REUNIR and WFP, 2020) <sup>[10]</sup>. Indeed, agro-sylvo-pastoral exploitation of restored sites leads to the production of marketable agricultural products (Fourera *et al.*, 2019; Jangorzo *et al.*, 2019; Moussa *et al.*, 2023) <sup>[11, 12, 13]</sup>. Pastoral sites produce significant quantities of fodder or straw, which strengthens the capacity of the terroirs to meet the needs of livestock and thus reduces feed shortages during the pastoral lean season (Laminou *et al.*, 2020; Moussa *et al.*, 2022; Soubeiga *et al.*, 2024) <sup>[14, 15, 16]</sup>. Evaluation of production at the Samtigué site gives an average production of 1.7.

Total forage production on the Samtigué site in 2023, corresponding to the 1st year of development, is estimated at 84,864 Kg. This production from seven (7) forage species could increase from year to year if the site is secured and operating conditions comply with the development and management plan for restored sites (Douma *et al.*, 2011) <sup>[18]</sup>. Development has encouraged the return of vegetation, but also of small fauna. This has led to the regeneration of ecosystem services (Moussa *et al.*, 2023; Amani, 2021) <sup>[13, 19]</sup>.

In terms of knowledge transfer, the activities carried out, in particular the techniques for reclaiming degraded land (construction of structures and biological treatment) and the awareness-raising sessions carried out, have strengthened the capacities of the beneficiaries. The capacity building of populations, following the development of a site, was found by several works (Ousseini, 2018; Moussa, 2018; Gouné, 2018) <sup>[20, 21, 22]</sup>. In addition, the development of the sylvo-pastoral site has also contributed to the strengthening of social cohesion within the population as obtained by works (Ali, 2013, Adama, 2013)

[23, 24]. In terms of social cohesion and living together, the Samtigué site development activities have further united the refugee, displaced and indigenous populations. In terms of income, participation in the construction activities has enabled each beneficiary to earn a living.

### 5. Conclusion

At the end of this study, we note that humanitarian interventions to strengthen community resilience play two main roles, responding to the urgent needs of communities and preparing them to take charge of their own future. The yield of 353.6 Kg. ha<sup>-1</sup> of fodder in the multifunctional half-moons and the production of 84,864 Kg, show that the Samtigué site makes a significant contribution to animal feed. Other ecosystem services are also provided (reduction of erosion, return of biological diversity, etc.). Finally, the sustainability of the benefits of restored sites depends on the harvesting technique and the level of ownership by the beneficiary communities.

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