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# EVALUATE THE SOCIO-ECONOMIC IMPACT OF THE REALIZATION OF HALF-MOONS AND FOREST BENCHES, THEIR DURABILITY AS WELL AS THEIR INFLUENCES ON THE PLANTATIONS OF *Eucalyptus camaldulensis* AT THE VILLAGE OF SATARA, COMMUNE OF SIMIRI, DEPARTMENT OF OUALLAM, REGION OF TILLABERY IN NIGER, WEST AFRICA.

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## ABSTRACT

This study was conducted in the rural commune of Simiri, village of SATARA, located north of Niamey (capital city of Niger) at about 70 km. Its general objective is to evaluate the socio-economic impact of the realization of half-moons and forest benches, their durability as well as their influences on the plantations of *Eucalyptus camaldulensis*. The specific objectives are:i) To evaluate the socio-economic impact of cash for work on the beneficiary population, ii) To evaluate the level of degradation of half-moons and forest benches, iii) To evaluate the behavior of *Eucalyptus camaldulensis* in half-moons and benches, iv) Characterize the structure of the root system developed by *Eucalyptus camaldulensis* in half-moons and forest benches.

The methodology adopted during this study was to rely on precise data collected through the socio-economic survey, measures of design of the structures, the dendrometric measurements, and the excavations of the root systems of *Eucalyptus camaldulensis*. The results obtained from the exploitation of these data are as follows: 1) The benefits derived from cash for work have contributed to the strengthening of the resilience of the beneficiary populations, 2) The technical standards for the construction of the works have been respected to more than 90% on the half-

  

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moons as on the forest benches, on the other hand the phenomena of sagging of the beads and silting of the channels are more visible on the half-moons than on the benches, 3) *Eucalyptus camaldulensis* planted in the forest half-moons grew much in circumference, height, crown diameter as that planted in the benches, 4) The structure of the root systems of *Eucalyptus camaldulensis* was more favorable to the absorption of water in the half only in the benches.

**Keywords:** *Ouallam, Simiri, Satara, socio-economic survey, Evaluation*, half-moons and forest benches, *Eucalyptus camaldulensis, dendrometric parameters, excavation*

## INTRODUCTION

Renewable natural resources (land, forests, fauna and water) are the fundamental basis for the economic and social development of the predominantly rural Sahelian population (USAID, 2006). They contribute to the livelihood of 70% of the population and represent a key to rural development and good governance (Kelly, 2007).Niger has an accelerated population growth with the highest fertility rate in the world at 7.6 children per woman (INS, 2012). Thus, this population doubles every twenty years, four out of five people belong to the rural world and 80% of the active population engage in agriculture and livestock (Guengant and Banoin, 2003).

In fact, this demographic and social situation leads to an anthropic pressure on natural resources, particularly the accelerated cultivation of land either by shortening the fallow period or by clearing the last pastoral and forest reserves, including the least developed soils suitable for agriculture (P. Torrekens et al 1997), overexploitation of woody vegetation, overgrazing etc. As a result, soils undergo accelerated erosive dynamics leading to reduced vegetation cover, crust formation, reduced soil permeability, increased compactness and limited rooting (Zougmore et al., 1999). ). In addition, the decrease in vegetation cover following the excessive cutting of wood exposes the soil to the combined actions of wind and water erosion (Moussa et al, 2011).

In the face of this gradual degradation of land that can affect the living conditions of vulnerable groups and jeopardize sustainable development efforts, several donor interventions focusing on the protection and protection of the environment have been made in Niger, including: the Integrated Keita Project (PIK 1984-1999), the Agro-Sylvo-Pastoral Project (PASP 1986-2003), the Tahoua Rural Development Project (PDRT 1988-2003). In addition to donor efforts, the Niger state has also contributed to the protection and preservation of the environment. Thus, between 1984 and 2002, more than one hundred and thirty-three (133) billion CFA francs were mobilized from the investment budget for this component (Sector Consultation on the Environment, 2003).

Despite the efforts made by these projects and programs of the State, many difficulties still remain and the damage to the environment has attracted serious attention of the authorities for

  

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several years. The municipality of Simiri perfectly illustrates this situation. It has several trays for grazing animals, gathering firewood, service and other secondary products. Due to their misuse, the lands and vegetation of the plateaus are often in a state of high degradation. According to Karim et al (2010), this area has experienced a significant increase in bare soil area over the last thirty years. It is therefore imperative to find other alternatives that can maintain a level of production that meets the growing food needs of the population.

The fight against erosion becomes an imperative. It is therefore essential to reorient scientific research towards solutions to the degradation of the plateau in the rural municipality of Simiri and to adapt them to the needs of the community. Indeed, the recovery of degraded plateaus can not only contribute to the preservation of the environment but also and above all to increase the resilience of vulnerable populations. It is for all these reasons that this study was elaborated on the problematic of the land degradation through the study entitled «Evaluate the socio-economic impact of the realization of half-moons and forest benches, their durability as well as their influences on the plantations of *Eucalyptus camaldulensis* at the village of SATARA, commune of Simiri, Department of Ouallam, Region of Tillabéry in Niger, West Africa»

## I. PRESENTATION OF THE STUDY AREA

The study was conducted in the rural commune of Simiri (Ouallam Department, Tillabéry region), north of Niamey. It is located between latitude 14 ° 08'10.1 " North and longitude 2 ° 07'55.6 " East. It covers an area of 2,233 km². It is surrounded in the North by the urban commune of Ouallam and the rural commune of Dingazi, in the South by the rural commune of Karma and that of Hamdallaye, in the West by the rural commune of Kourthéye, in the East by the rural commune of Tondikandia and that of Tagazar (PDC Simiri., 2010-2015).

  

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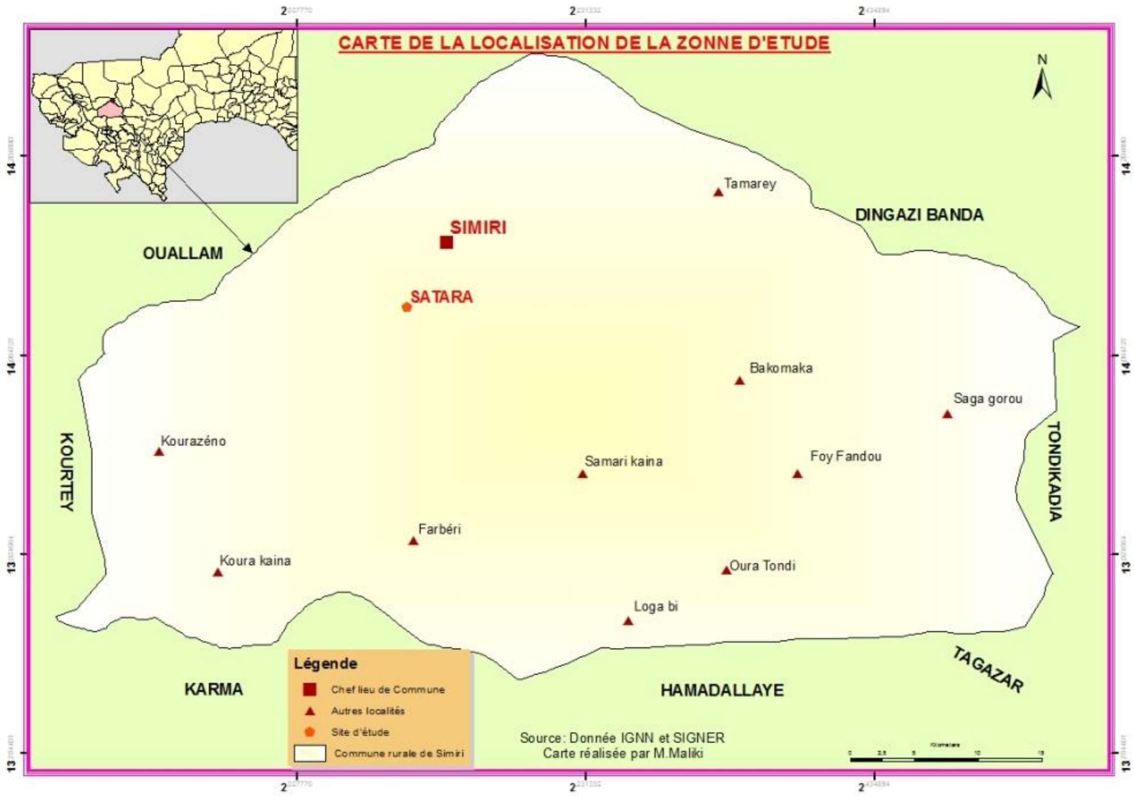


**Figure 1: Location map of the study area (M. Maliki, 2016)**

This zone is characterized by continental terminal formations dated to the Pliocene (J. Greigert1979). The soils are poor in organic matter (MO), calcium (Ca), phosphorus (P) assimilable, in cation exchange capacity (CEC), (Ambouta and Dan Lamso, 1996). The climate is of dry tropical type characterized by a short rainy season (3 to 4 months) and a long dry season (8 to 9 months), the maximum temperatures reach 45 ° C between April and May and the minimum 24 ° C to 26 ° C between December and February (Maiga, 2005). The natural vegetation consists of shrub steppe on the glacis and shrub to tree in the lowlands while a contracted training subject to severe degradation is observed on the plateaus. The main woody species encountered are Guiera senegalensis, Combretum micranthum and *Combretum glutinosum*. The herbaceous layer is dominated by *Mitracarpus scaber*, *Eragrosti stremula* and *Cenchrus biflorus* (M.M. BOUBACAR et al., 2013). The population is estimated at 110, 458 inhabitants of which 50.79% are women and 49.21% are men with an average growth rate of 3.1% (INS-Niger, 2011).

## II. MATERIALS AND METHODS

### 2.1. Choice of the study site

  

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The study site is that of Satara located in the rural town of Simiri about 70 km north of Niamey. It is located between latitude 14 ° 04'35.1 " North and longitude 2 ° 05'46.6 " East. It is a vast plateau on an area of twenty-three (23) hectares of which ten (10) hectares are treated in forest half-moons and thirteen (13) hectares treated in forest benches. It has been protected from animals raving and human usedsince its development. The choice of this site is explained by the fact that it constitutes the first site of the municipality where exotic species (*Eucalyptus camaldulensis*) were planted as species of reforestation in anti-erosive works on a degraded plateau but also and especially by the fact that no study has been done on this site.

For materiel a GPS has been used for the geo-referencing of the site. So, all the pictures were taken using a digital camera.

**Photo 1: Site of Satara before rehabilitation**

  

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**Photo 2: Site of Satara after rehabilitation**

### 2.2. Socio-economic survey

It took place in the four (4) villages benefiting from the cach for work, namely Satara, Koum, Lima and BamanaGorou. Thus, it concerned twenty six (26) people including thirteen (13) men and thirteen (13) women out of one hundred and thirty (130) beneficiaries, a survey rate of 20%. The choice of people surveyed was random.

Thus, this survey was conducted in order to identify the organizational and technical constraints of implementation notably on the working conditions, remuneration, and to collect the perception of the populations on the works of developments realized on the site of Satara. Indeed, the choice of Beneficiaries have been focused on low-income populations on the assumption that the benefits they derive from this work will contribute fully to reducing their level of poverty and food insecurity. For this task, a survey form was used.

### 2.3. Sampling and data collection

The density of the forest half-moons is 313 per hectare either 3130 half-moons for the 10 hectares and that of the benches is 6 per hectare, either 78 benches for the 13 hectares. The sampling rate is 20% both at the level of half-moons than on the benches.

On the forest half-moons 50 plots of 2000 $m^2$ (50m × 40m) equidistance of 4 m were delimited. A total of 10 plots were randomly selected to be inventoried corresponding to the sampling rate.

  

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On the forest benches, 78 plots of 600 $m^2$ (60m × 10m) equidistance of 10 m on the alignment and 25 m on the rows have been defined (each plot contains a bench). A total of 16 plots were randomly selected to be inventoried corresponding to the sampling rate. At this level a tape measure of 50 m and stakes were deployed for the delimitation of the plots.

### 2.4. Measurements of the sizing of half-moons and benches

It is a question of checking the concordance between the physical measurements made in the field and the theoretical measurements of the half-moons and benches.

On all the half-moons included in the 10 inventoried plots, the following technical standards were measured: the diameter, the spacing between two rows of half-moons, the spacing between two half-moons aligned the width at the top and the height of the bead, and finally the width and depth of the channel.

Also, on all the benches included in the 16 inventoried plots, the following technical standards were measured: the length and the width of the benches, the spacing between two (2) rows of benches, the spacing between two aligned benches, the width at the top and the height of the bead, and finally the width and depth of the channel.

For these tasks, a 50 m tape measure was used.

### 2.5. Dendrometric measurements of *Eucalyptus camaldulensis*

On all the feet of *Eucalyptus camaldulensis* found in the inventoried plots, the following dendrometric measurements were made.

- **Circumference measurement**

Expressed in (cm), the circumference of a tree designates the perimeter of the convex hull of the section (Thomas Cordonnier, 2014). In this study, circumference measurements were made at two levels: first at the base called the collar circumference and then at 1.30 m from the ground called the reference circumference.

- **Height measurement**

Expressed in (m), the height of a tree corresponds to the vertical distance separating the ground level and the top of the tree (terminal bud). Indeed, after the circumference, height is one of the most important characteristics to measure in order to determine the volume or various shape parameters. It also plays a vital role in characterizing the productivity of forest stations.

- **Diameter measurement of the crown**

  

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Eucalyptus camaldulensis is a species that grows in length with a more or less uniform crown. In this case, the diameter of the crown is determined by averaging between the large diameter of the crown called $D_1$ and the small $D_2$. It is expressed in (m) and is given by the following formula:

$$di = \frac{D_1 + D_2}{2}$$

**With**$di$ **:** crown diameter of the tree to be measured.

In fact, the circumference measurements at the collar, at 1.30 m from the ground, as well as those of the diameter of the crown were made using a tape measure of 50 m. As for the measurement of the height, it was made using a metal milestone graduated 10 m.

**2.6. Dendrometric parameters of *Eucalyptus camaldulensis***

On all inventoried plots, the following dendrometric parameters were calculated:

- **Survival rate (Tr)**

The survival rate is the ratio of the number of live plants to the total number of plants planted multiplied by one hundred. This is an important factor in assessing the quality of a reforestation activity. It is expressed as a percentage and is given by the following formula:

$$\mathbf{Tr} = \frac{\sum \mathbf{PV}}{\mathbf{NTPP}} \times \mathbf{100}$$

**With:Tr :** Survival rate,$\sum$ **PV :**Sum of Live Plants, et**NTPP** :Total number of planted plants.

- **Density in stems (N)**

Expressed in stems per hectare (stems / ha), it is determined by the total number of stems in each plot. It is given by the following formula:

$$N = \frac{\mathbf{n}}{\mathbf{s}}$$

$N$**:** Density in stems,

**n:** Total number of stems or trees inventoried in plots

**s:** Total area of the plots in hectare.

**NB: Number of stems = number of trees**

- **Basal area (g, G)**

  

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Expressed in (m2), the basal area of a tree (g) is the area of the circle whose circumference is the circumference of the tree at 1.30 m from the ground (Thomas Cordonnier, 2014). It is given by the following formula:

$$\mathbf{g} = \frac{\boldsymbol{C^2}}{\boldsymbol{4\pi}}$$

**With g:** basal area of a tree,

**c:** circumference at 1.30 m from the soil of the tree to be measured (converted to m)

The basal area of a stand or any set of trees (G) is obtained through the sum of the basal areas of all trees making up this stand (or set). It is given by the following formula:

$$\mathbf{G} = \sum_{i=1}^{n} \mathbf{g}$$

**With G:** basal area of a stand and
**g:** basal area of a tree

- **Recovery rate (R)**

The recovery rate for woody species is expressed as a percentage (%). It is obtained by the following formula:

$\mathbf{R}(\%) = \frac{r}{s} * \mathbf{100}$ With $\quad \boldsymbol{r} = \frac{\boldsymbol{\pi}}{\mathbf{4}} \sum_{i=1}^{n} \boldsymbol{di^2}$

**R (%):** Recovery rate (in percent)

**r:** Recovery of all individuals included in inventoried plots (m2),

**S:** Total area of inventoried plots (m2),

**di:** Diameter of the crown of the individual i (m),

- **Structure in circumference classes at 1.30 m**

From the ground for the structure in circumference classes at 1.30 m from the identified groups, the individuals were divided into 6 circumference classes of 6 cm amplitude.

- **Structure in height classes**

  

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At this level, the individuals were divided into 10 classes of height of 1 m amplitude.

### 2.7. Excavation of the root system of *Eucalyptus camaldulensis*

Roots play a vital role in plant life. To characterize the structure of the root system of *Eucalyptus camaldulensis*, excavations were made at the level of two large feet called *Eucalyptus camaldulensis* with normal growth respectively in half-moons and benches. Also, two small-sized called *Eucalyptus camaldulensis* with abnormal growth have been excavated to find an explanation for their stunting. To carry out this excavation, rifles, pickaxes, ropes, water cans and GPS were used.

## III. RESULTS

This chapter is dedicated to the presentation of the results obtained through the specific objectives selected for this study.

### 3.1. Results of the socio-economic survey

This study shows that the age of the people surveyed varies between 25 and 60 years, and 90% of them have never participated in erosion control work, let alone in tree plantations before the development from the Satara site. For this, training sessions were conducted during the information-awareness phase. The beneficiaries were paid in cash (cash for work). Thus, for the production of forest half-moons, they worked individually with three (3) works per day for a sum of 1,300 FCFA per day per person. In the case of the making of benches, the work was organized in a team with a staff of twenty (20) people per book; the unit price per seat was 20,800 FCFA. As for the plantation, the work was done individually with a remuneration of 25 FCFA per foot of planted *Eucalyptus camaldulensis*. Indeed, the benefits gained through this development work have fully contributed to the development of the living conditions of the populations because they served to meet their needs in several socio-economic areas. Figure 2 below shows the distribution of sums received by men in percentage through the cash for work according to the different items of expenditure.

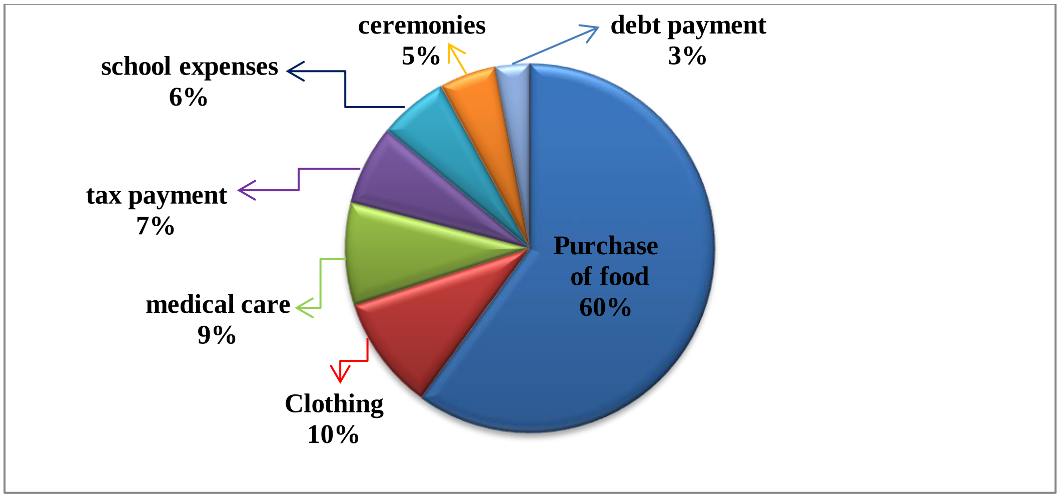


**Figure 2: Distribution of sums received by men through cash for work according to expenditure items (Noma, A. S, 2016).**

The results from Figure 2 show that 60% of the money received by men was used to purchase food, 10% for clothing, 9% for medical care, 7% for tax payments, 6% for school expenses, 5% for ceremonies and finally 3% for the payment of debt.

As for Figure 3 below, it shows the distribution of sums received by women in percentage through the cash for work according to the different items of expenditure.

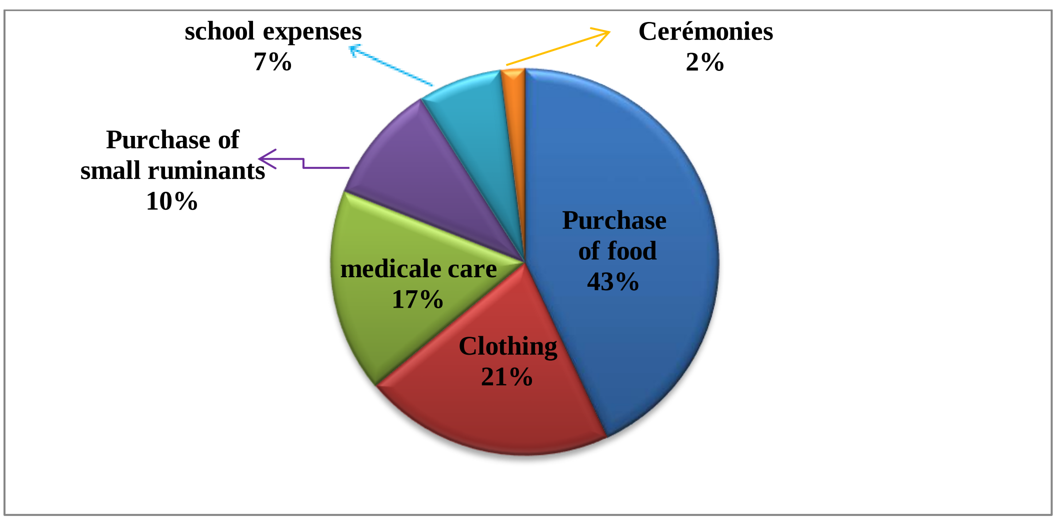


**Figure 3: Distribution of sums received by women through cash for work according to expenditure items (Noma, A. S, 2016).**

  

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The results from Figure 3 show that 43% of the sums received by women were allocated to the purchase of food, 21% for clothing, 17% for medical care, 10% for the purchase of small ruminants., 7% for school expenses and finally 2% for ceremonies.

### 3.2. The current state of half-moons and forest benches

It is determined through a comparative study between the theoretical values and the physical values measured in the field. Thus, Tables 1 below present the results found through the measurements of half-moon and forest bank sizes.

**Table 1: Results of forest half-moons design measurements**

| **Measurement of technical standards ofHalf moons and benches** | **Rate of respect of standards** | | **Rate of non-respect of standards** | |
|---|---|---|---|---|
| | **Half moons** | **benches** | **Half moons** | **benches** |
| | **93,21 %** | **92,17 %** | **6,79 %** | **7,83 %** |
| **Measurements of sagging of beads** | sagging rate of beads | | Non-sagging rate of beads | |
| | **Half moons** | **benches** | **Half moons** | **benches** |
| | **53,81 %** | **49,16 %** | **46,19 %** | **50,84 %** |
| **Measurements of sand silting** | Sand silting rate | | Non-silting rate of the channels | |
| | **Half moons** | **benches** | **Half moons** | **benches** |
| | **83,33 %** | **24,35 %** | **16,67 %** | **75,65 %** |

  

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**Photo 3: Forest Half moons design**

**Photo 4: Forest bench design**

The results from Table 1 show that at the level of half-moons, the rate of compliance with technical standards is 93.21% while that of non-compliance is 6.79%. In the case of the size of the beads, the collapse rate of the beads is 53.81% while 46.19% are not affected by this phenomenon. Thus, at the level of the channel depth 83.33% of the channel depth is silted and only 16.67% is unaffected.For the manufacture of forest benches the rate of compliance with technical standards is 92.17%, while the rate of non-compliance is 7.83%. Thus, 49.16% of the dimension of the beads are affected by the phenomenon of sag while 50.84% are not affected by this phenomenon. At the level of the channel depth, 24.35% are silted, however, 75.65% are not affected by the phenomenon of silting.

  

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### 3.3. Dendrometric characteristics of *Eucalyptus camaldulensis*

At planting, the density of planted plants is one (1) individual per half-moon and sixteen (16) per bench. The total number of plants planted in the ten (10) plots inventoried on the half-moons is 626. The total number of plants planted in the sixteen (16) plots inventoried on the benches is 256. However, the total number of live plants in inventoried plots is 403 on the half-moons and 112 on the benches. So the mortality rate of plants is 35.62% on the half-moons and 56.25% on the benches.

#### 3.3.1. Results of the dendrometric parameters of *Eucalyptus camaldulensis*

Table 2 below presents the results of the various dendrometric parameters of *Eucalyptus camaldulensis* planted on half-moons and forest benches.

**Table 2: Results of the dendrometric parameters of *Eucalyptus camaldulensis***

| **Species and structures** | **Dendrometric parameters** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Tr** (%) | **N** (stems/h) | **$C_{mb}$** (cm) | **$C_{m1,30}$** (cm) | **$H_m$** (m) | **$D_{mh}$** (m) | **G** ($m^2$) | **R** (%) |
| **Eucalyptus camaldulensis on half-moon** | **64,38** | **202** | **30,71** | **19,6** | **4,71** | **2,4** | **1,46** | **9,87** |
| **Eucalyptus camaldulensis on bench** | **43,75** | **43** | **27** | **17,72** | **4,34** | **2,28** | **0, 36** | **5,42** |

With: **Tr:** Survival rate (%), **N**: Stem density (stems / ha), **$C_{mb}$:** Mean circumference at base (cm),

**$C_{m\ 1.30m}$:** Average circumference at 1.30 m from the ground (cm), **$H_m$:** Mean height (m), **$D_{mh}$:** Average crown diameter (m), **G:** Basal area ($m^2$), **R (%):** Recovery rate (%).

The overall analysis in Table 2 shows that there is a difference between the results of the different dendrometric parameters of *Eucalyptus camaldulensis* planted in half-moons and forest benches. Eggplant *Eucalyptus camaldulensis* is characterized by low values of survival (43.75% vs 64.38%), stem density (43 vs 202 stems/ha), average circumference at base (27 cm vs 30.71 cm), average circumference at 1.30 m from the ground (17.72 cm vs 19.6 cm), average height

  

(4.34 m vs 4.71 m), average diameter crown (2.28 m vs 2.4 m), basal area (0.36 m2 vs 1.46 m2), and recovery rates (5.42% vs 9.87%) compared to *Eucalyptus camaldulensis* planted in the half-moons.

### 3.3.2. Growth of *Eucalyptus camaldulensis*

On half-moons and benches, it is structured in two points: the growth in circumference to 1.30 m of the ground and that in height.

#### 3.3.2.1. Growth in circumference at 1.30 m from the ground

Figure 4 below shows the circumference class structure at 1.30 m from the soil of *Eucalyptus camaldulensis* on half-moons and benches.

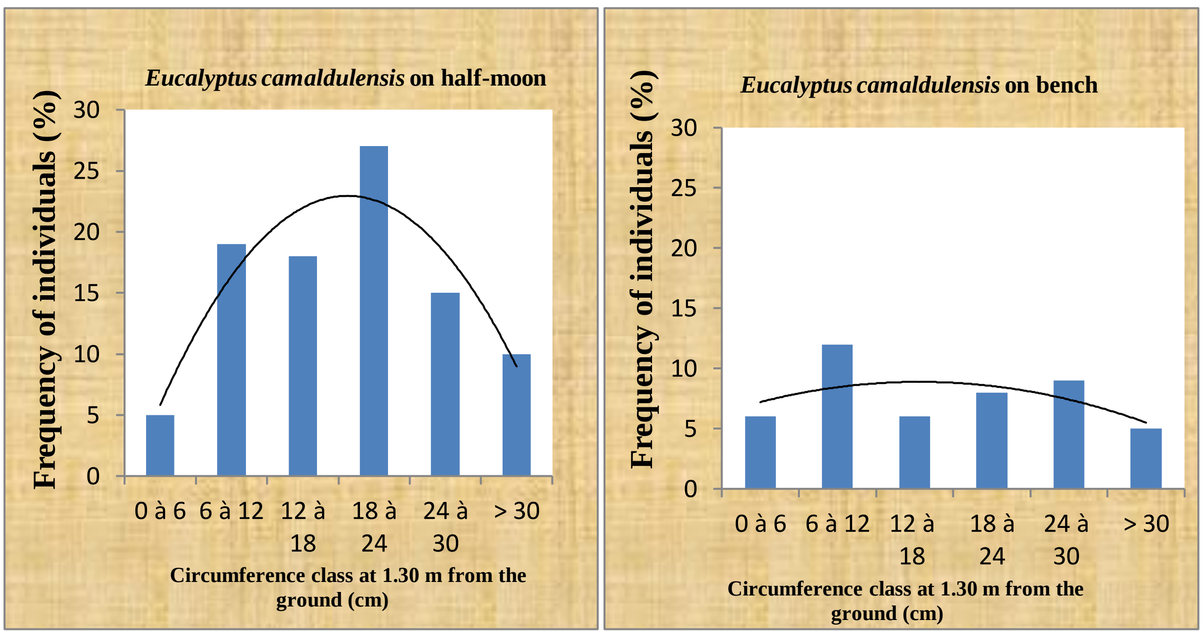


**Figure 4: Circumference class structure at 1.30 m *Eucalyptus camaldulensis* ground in half-moons and forest benches**

The analysis of Figure 6 shows that in the case of *Eucalyptus camaldulensis* planted in half-moons, the circumference-class structure is characteristic of an "u-shaped" distribution. Individuals with a circumference of between 18 and 24 cm have the largest population at 28.72%. On the other hand, the small numbers are recorded at the level of the individuals of circumference class between 0 to 6 cm and > 30 cm representing respectively 5,32% and 10,64% of the individuals.

  

As for the *Eucalyptus camaldulensis* planted in the banquettes, it has an erratic or irregular distribution, with moderately high growth rates of 26.1% in the circumference class between 6 to 12 cm, and 19.57% in the from 24 to 30 cm. In contrast, individuals with a circumference of between 0 to 6 cm, 12 to 18 cm, 18 to 24 cm, and > 30 cm are poorly represented. Their percentages are 13.04%, 13.04%, 17.4%, 10.88% respectively.

### 3.3.2.2. Growth in height

Figure 5 below shows the height class structure of *Eucalyptus camaldulensis* in half-moons and forest benches.

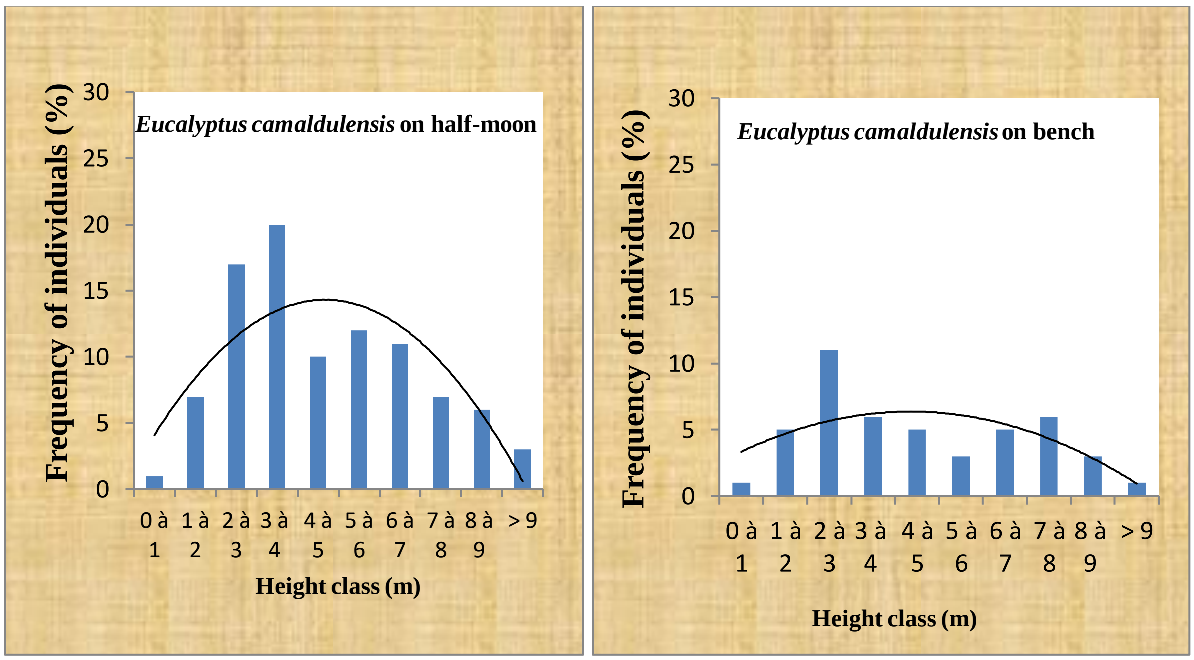


**Figure 5: Height class structure of *Eucalyptus camaldulensis* in half-moons and forest benches**

The analysis in Figure 5 shows that in the case of *Eucalyptus camaldulensis* planted in half-moons, the height class structure of individuals is also characteristic of an "u-shaped" distribution. Individuals with height classes between 2 to 3 m and 3 to 4 m have the largest population at 18.1% and 21.28% respectively. The low numbers are recorded at the level of individuals of height class between 0 to 1 m and> 9 m representing respectively 1.1% and 3.2% of individuals. The height class structure of *Eucalyptus camaldulensis* planted in the benches is characteristic of an "inverted J" distribution. Individuals with height classes between 2 and 3 m have the largest population with 24%. Indeed, the small numbers are recorded at the level of

  

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individuals of height class between 0 to 1 m and> 9 m presenting the same percentage 2.17% each.

### 3.4. Description of the structure of the root system of *Eucalyptus camaldulensis*

Photos 5,6,7,8 below show the structure of the root systems of the various excavated feet

**Photo 5: Root system of a normal growth *Eucalyptus camaldulensis* on half-moon(Noma, A. S, 2016)**

**Photo 6: Root system of a normal growth *Eucalyptus camaldulensis* on bench (Noma, A. S, 2016)**

  

**Photo 7: Root system of an abnormal growth of *Eucalyptus camaldulensis* with on half-moon (Noma, A. S, 2016)**

**Photo 8: Root system of an abnormal growth of *Eucalyptus camaldulensis* on bench (Noma, A. S, 2016)**

In the case of *Eucalyptus camaldulensis* with normal growth on half-moon (photo 5), the root survey varies between 60 to 70 cm deep. The roots have a high density, a medium size and a heterogeneous spatial distribution, spreading in all directions. However, for *Eucalyptus camaldulensis* with normal growth on the bench (Photo 6), the root survey varies between 25 and 35 cm deep. Thus, the density and the size of the roots are less important than in the preceding case, with an almost homogeneous spatial distribution, propagating largely towards the

  

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impluvium, whereas on the bead part the roots are almost absent or very little developed. .As for the *Eucalyptus camaldulensis* with abnormal growth in half-moons and benches (Photo 7 and 8), the roots have the same characteristics, low density, small size, and a very reduced branching. Also, in these two cases, all the main roots have a curvature.

## IV. DISCUSSIONS

The results of the socio-economic survey showed that the remuneration of the beneficiaries through cash for work was in accordance with the payment regulations. The results of the distribution of expenditures show that 60% of the money received by men was used to buy food, for women it is 43%. Thus, these figures show that the satisfaction of food needs is the primary concern of the people surveyed. Because women do not pay taxes, this has allowed them to save their money through the purchase of small ruminants allowing them to assist the family especially during the rainy season (June to September). Indeed, the distribution of expenditures according to gender has made it possible to assess the priority needs of the men and women surveyed in this rural area where the resilience of the community deserves to be reinforced. Indeed, the development of the plateau of Satara, have helped stabilize the bases of existence of beneficiary populations, reduce their vulnerability to external shocks (climate change), strengthen their resilience. They also helped reduce runoff in the fields around the plateau, returning the flora and fauna to the site that was once bare. These findings confirm those of Joëlle Ramage, and Hassane Moussa (2014) done on the making of half-moons and benches in the rural commune of Tondikiwindi (Ouallam Department, Tillabéry Region) through the final evaluation of the project "Implementation of PANA priority interventions to strengthen the resilience and capacity adaptation of the agricultural sector to climate change ". Thus, it follows from all the above that it is necessary to continue the activities of development of degraded plateaus in the department of Ouallam in general and in the town of Simiri in particular. The results from measurements of the dimensioning of the structures show that the technical standards have been respected in large part as well on the half-moons as on the benches. The level of degradation of structures is more advanced in the case of half-moons than benches. Thus, this degradation of the structures following the collapse of the ridges and the silting of the channels is explained by the fact that these structures have been affected by the phenomenon of erosion (water and wind).

The survival rate of *Eucalyptus camaldulensis* is 64.38% in the half-moons against 43.75% in the benches. As for the dendrometric measurements (circumference at the base, circumference at 1.30 m of the soil, height, diameter of the crown) they are also higher in the half-moons than in the benches. Indeed, these findings can be explained by several factors: in half-moons, *Eucalyptus camaldulensis* was able to develop root systems with structures(size, density, distribution, and prospection) favorable to their growth. This confirms the results of Mongi Ben M'hamed (1979) found in DjebelSidi-Zin (Northern Tunisia), where the *Eucalyptus camaldulensis* of good production had deep roots (case of *Eucalyptus camaldulensis* planted in the half-moons) whereas that of medium production had developed lateral roots (case of *Eucalyptus camaldulensis* planted in the benches). In addition, the high stem density (202 stems / ha) recorded at the level of the half-moons would have led to an improvement in the structure of the soil and its biotope which could favor the infiltration of water. This confirms the results of (Barbier et al., 2006).The curvatures noted at the level of the main roots of *Eucalyptus camaldulensis* with abnormal growth could be due to a technical error during the plantations (lack of cut of one cm of the bottom of the pot). This phenomenon has hindered the normal development of secondary roots. It should also be noted that the use of the site since its development has contributed to the protection of plant species against the stray animals, which confirms the results of Tidjani (2008) obtained from the observation of a defenseless area and another similar free grazing in Tchado (dune area of Manga).

## CONCLUSION

The results of this study show that the benefits derived from cash for work enabled beneficiaries to meet their priority needs (food, clothing, health). The half-moons and forest benches were made with respect for standards and topo-sequence. However, it should be noted that the sagging of the beads and the silting of the channels are more noticeable on the half-moons than on the benches. As for the behavior of *Eucalyptus camaldulensis*, production was greater in the half-moons where the roots had developed a good structure than in the benches.

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