



## RURAL POPULATION PERCEPTIONS ON ANTI-SILTING MANAGERMENTS IN KEBILI GOVERNORATE, SOUTH TUNISIA

Anissa Gara<sup>1+</sup>  
Saber Trabelsi<sup>2</sup>  
Jamel Kailene<sup>3</sup>  
Najeh Dali<sup>4</sup>

<sup>1</sup>National Institute of Agriculture of Tunisia and Laboratory of Rural Economy at National Institute of Agronomic Research of Tunisia.

Email: [anissa.gara@gmail.com](mailto:anissa.gara@gmail.com) Tel: 0021653640274

<sup>2</sup>National Institute of Agriculture of Tunisia.

Email: [sabertrabelsi2011@hotmail.com](mailto:sabertrabelsi2011@hotmail.com)

<sup>3</sup>Ministry of Agriculture, Water Resources and Fisheries, Tunisia.

Email: [jamelkailene@gmail.com](mailto:jamelkailene@gmail.com) Tel: 0021629390886

<sup>4</sup>National Institute of Agriculture of Tunisia and Ministry of Agriculture, Water Resources and Fisheries, Tunisia.

Email: [dali-najeh@hotmail.com](mailto:dali-najeh@hotmail.com) Tel: 0021698336750



(+ Corresponding author)

### ABSTRACT

#### Article History

Received: 16 March 2020

Revised: 20 April 2020

Accepted: 22 May 2020

Published: 24 June 2020

#### Keywords

Population

Perception

Participatory approach

Strategies

Silting

South-Tunisia.

Lambin [1] affirmed that the definition of desertification used by the Convention to Combat Desertification (CCD) makes it clear that, whilst biophysical components of ecosystems and their properties are involved (e.g., soil erosion, loss of vegetation), the interpretation of change as 'loss' is dependent upon the integration of these components within the context of the socioeconomic activities of human beings. The CCD's definition of desertification explicitly focuses on the linkages between humans and their environments that affect human welfare in arid and semi-arid regions. In Tunisia as in many regions of the world, desertification and silting are an adversity to economic development and environment. This study aims to bring out population perceptions determinants about this scourge on the governorate of Kebili, located at the south of Tunisia. Several efforts have been made by the administration since the 1980s to combat silting. We conducted this research with the view to study population's perceptions towards realized management against silting and desertification. We need to know the factors that make these managements not evenly successful at all the governorate zones. Therefore, we conducted a socio-economic survey: among the population with concern to examine the reaction of the inhabitants towards these anti-silting structures and strategies.

**Contribution/Originality:** This study contributes in the existing literature about how Tunisia faced silting scourge by biological and mechanical techniques. This study has investigated on population opinion about these techniques. These techniques were successful and maintained by population in some zones while in other zones population was reluctant and removed them.

### 1. INTRODUCTION

The United Nations Convention to Combat Desertification (UNCCD) has defined desertification as "land degradation in arid, semi-arid and dry sub-humid areas as a result of various factors, including climatic variations and human activities" [2]. Desertification is an important obstacle to any form of development in regions affected by this scourge; it is an adversity to economic development. Masmoudi [3] related that southern Tunisia, covering an area of about 80000 km<sup>2</sup> (or about 50% of the total area of Tunisia), has been under a serious movement desertification and silting for several decades, affecting strongly natural ecosystems, reducing agricultural and

pastoral production and causing large waves of exodus and emigration. According to Kailene [4] 24.6% are areas slightly affected by the desertification, 34.2% are moderately affected areas, 18.3% are very affected and 22.9% are desert areas, noting that the total desert area is about 106,200 km<sup>2</sup>. This scourge caused the annual loss of almost 30000 ha of land; only 11000 ha are productive lands.

Tunisian territory is affected by five forms of desertification: wind erosion, water erosion, soil salinisation, hydromorphic and silting. Silting is one of the most spectacular manifestations of the desertification phenomenon in southern Tunisia [5]. It is currently affecting more than 64% of Tunisia's territory (i.e. more than 10 million ha). Sand dunes already occupy more than 2 million ha [6]. That is why Tunisian government has followed many strategies to combat silting since the 1980s. The Kebili region is one of the southern governorates most affected by the silting problem, it is clearly manifested by the invasion of roads, villages, oases... This is quite visible in the two villages: Sabria village (Fawwar delegation) and Bchelli village (Kebili-south delegation) where we can see threatening dune accumulations.

The participatory approach is often the most important aspect to be considered when we deal with conservation structures stability and durability. We conducted the current research with the view to study farmers' perceptions towards managements built to halt silting and desertification scourges for the last 13 years (from 2003 to 2016). Thus, in this research we try to define the socio economic constraints against the success of the environmental managements in two villages in Kebili governorate. We try to understand why environmental strategies might succeed at one village and not at the other. We collected data from various administrative offices (Kebili forest district, Agricultural studies and statistics district, Public offer services, Water and soil conservation district, Rangelands development services, Kebili weather station) and conducted interviews with farmers from the two villages.

## 2. METHODOLOGICAL FRAMEWORK

### 2.1. The Study Area

The governorate of Kebili was newly created in September 1981. It is located in the south-west of the country, at the Algerian-Tunisian border, and covers an area of 22,454 km<sup>2</sup>, or 13.5% of the country's area. Administratively, Kebili governorate is divided into six delegations: North Kebili, South Kebili, North Douz, South Douz, Fawar and Souk Lahad Figure 1.



Figure-1. Kebili governorate delegations

Source: (Ministry of Industry of Tunisia, web site).

Kebili is characterized by a Saharan climate with semi-desert climate in the north around Chott El Jerid, and desert climate in the center and the extreme south of the region. According to data from the Kebili weather station, the climate of Kebili is characterized by large thermal amplitude of 31.8 °C, the temperature annual average is 23.48 °C, noting that the coldest month is January ( $T_{avg} = 12.65$  °C) and the warmest one is August ( $T_{avg} = 34.05$  °C).

The governorate is characterized, like all the governorates of the Tunisian south, by a strong climatic aridity and deficit water balance over a long period of the year, indicating that the average annual precipitation is 98.04 mm and the windy period (wind speed  $> 4$  m/s) is usually spread over 7 months, starting from March ( $v = 4.91$  m/s) and continues until September ( $v = 4.84$  m/s), the months of May and June correspond to the most windy months (averages of 6.5 m/s). The economic activities of the region are mainly based on the agricultural sector, whose active population is 34.5% (equal to 16.5% nationally). The useful agricultural area covers 17% of the total area of the governorate of Kebili (621,179 ha), of which 50,000 ha are arable land, 567,153 ha are rangelands and 4,026 ha are forests.

## 2.2. The Survey

The population survey concerned households whose dwellings are in the vicinity of fieldwork amenities and reforestation sites. This is in order to identify the situation and the state of progress of these amenities on the one hand and on the other hand to learn about the reactions of the population towards these amenities.

The survey involved 40 households in the two villages, 20 households in each village. (ajouter le % par rapport à la population total) Their activities mainly concern oasis farming and livestock farming. The survey addresses four subjects which are: 1) situation of the village before interventions combating silting, 2) situation of the village after these interventions, 3) behavior of the local population towards the silting control works, 4) degrees of the participative and integrated approach of the local population for the works against silting. Accordingly, the questionnaire consisted of 3 components: farmer's data, farmland's data, data that examines the situation before and after the interventions against silting and their interactions with the relevant amenities.

## 3. RESULTS AND DISCUSSIONS

At the beginning, we conducted an appraisal to evaluate the methods undertaken to combat desertification in this region by establishing a diagnosis of the silting situation based on the inventory and the evolution of adopted techniques against silting. The main objective of the field works are the protection of the oases, the basic infrastructure, such as roads, agglomerations and cities, against sand invasion. In most cases, the nature of the field work relates to mechanical control and biological control

With regard to silting techniques, the choice of technique depends on the wind dynamic, the desired objective and the nature and availability of the materials. At first, they start with the mechanical bolting of sand dunes such as enhancement of *Tabias* [Figure 2](#), then, comes the biological ground bolting by means of the plantation process mostly with *Tamarix*, *Acacia salicina*, *Haloxylon persicum*, *Parkinsonia aculeata*, *Eucalyptus*, Aleppo pine [Figure 3](#).



Figure-2. Tabia endorsement.



Figure-3. Tamarix plantation.

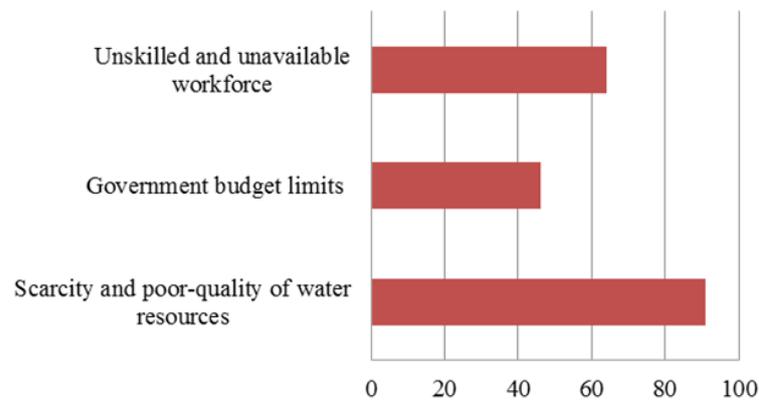
Mechanical control techniques are: counter dune, palisade technique, dune cover, and dredging. Several types of dune cover can be used: land cover, mulching, plant cover, straw mortar cover. Dredging is a curative technique whose object surface is already invaded by sand. This is manual or mechanical removal of accumulated sand. As for biological control, it is found out that workers use vegetal material adapted to the ecological conditions of the work site. This method is applied on the dune front to ensure its ultimate ground bolting or in a deflation zone to stop sand progression. It is carried out to reinforce the effect of the mechanical step. Reforestation goes behind three successive stages: the production of seedlings in the nursery, the planting, the maintenance and the safeguarding of the plantations carried. During the last 13 years, it has been realized: 317 linear km of making Tabias, 6,632.1 km of raising Tabias, 96,600 m<sup>3</sup> of trapped sands mechanically removed, 1,675.5 ha of reforestation and 5,921.5 ha of forest plantation safeguarding. The fieldwork teams include a fieldwork leader and a group of 15 to 30 workers; all of them make part of the local rural population with close relation to agricultural activities. The team can fully commit to maintenance work and raising Tabias and the reforestation and safeguarding works.

The age distribution of workers is diversified. Indeed, 93% of the workers are aged between 20 and 60 years old. This wide distribution is advantageous because it allows the transfer of the know-how from elder workers to newly recruited young people. Elder workers can also benefit from the physical ability of young people. However, during our survey, we found out some constraints in the reforestation work. In fact, there is still a lack of skilled manpower. Most of respondents affirm that the majority of elder skilled worker aged between 45 to 60 years old is very rare (68%). In addition, the water resource is one of the major constraints for reforestation and plantation safeguarding work. Because of climate severity and the scarcity of water resources, the probability of successful plantations raised in nurseries is generally between 20 and 40%. This, justifies why private companies hesitate to take part in reforestation and safeguarding works.

When comparing the completion of enhancement work between the private companies and the public administration, we found out that the public administration manages to carry out improvement works better than private companies, despite the fact that the most important part of these developments has been conferred to private companies. Indeed, the rate of amenities achievement realized by the administration during the period from 2001 to 2011 is 83% while that of private companies is of 56%. The rate of achievements made by private companies dropped to 21% in 2012 and to 6.25% in 2014, compared to the administration which achieved 100% of its development objectives. This could be explained by the state of instability caused by the revolution in 2011, repressing, therefore, private initiative [7].

We also noted that the reforestation pace between 2001 and 2013 has two distinct phases. There is an accelerated pace between 2001 and 2010 when annual reforestation exceeds 100ha/year with a maximum of 181.5 ha in 2001. Then, from 2011, the pace of reforestation slowed down with a level of achievement of 93ha in 2012 and 49 ha in 2013 [7].

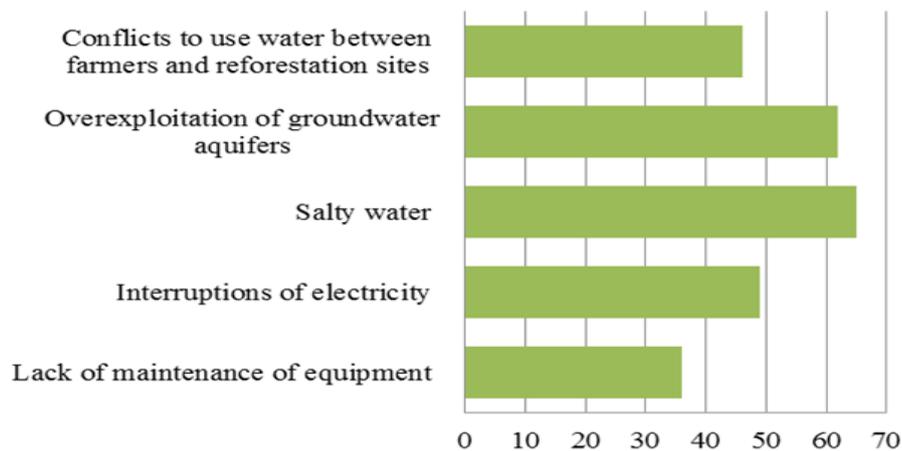
According to rural pollution, this decline of reforestation can be explained by constraints due to scarcity and poor-quality of water resources (91% of respondents), to government budget limits (46%) and to unskilled and unavailable workforce (64% of respondents) [Figure 4](#).



**Figure-4.** Constraint to reforestation as maintained by population (in %).

The problems of water resources, as claimed by population, are due to many difficulties such as lack of maintenance of equipment (horns in breakdowns, broken sinks) and interruptions of electricity causing the pause of pumping water [Figure 5](#). Also, drilling is generally superficial, which explains the poor quality of water. Previously, shallow wells were sufficient to reach fresh sweet water. During the last years and because of overexploitation of the aquifers, water from the superficial drilling becomes more and more salty, thus it requires deeper drilling reaching 100 and 120 m to get the fresh sweet water. It should be noted that one of the causes of overexploitation of aquifers is the extension of illegal oases perimeters whose water management is not approved.

Moreover we note conflicts to use water, in some cases; farmers refuse to share water with the reforestation project, although irrigation canals are available. So the hostility of certain farmers to exploit water commonly has limited water availability which has restricted the creation of reforestation sites.



**Figure-5.** Water resources problems as claimed by population (in %).

Conversely, other analyses revealed affirmative results after facilities installation against silting, it turned out that the economic activities of the region have improved significantly comparing to the pre-development period. In fact, 95 % of rural population notes a positive effect on the diversification of agricultural activities (we quote: oasis agriculture, livestock, honey activities, cultures in greenhouses, irrigated annual crops).

Besides, before interventions of combating silting, the local population suffered a lot of sand invasion. Several houses were totally submerged, or partially silted. The roads are almost completely silted making accessibility to neighboring villages and delegations quite difficult. As a result of this situation, the quality of life of the inhabitants

is very poor: 74% of the inhabitants lived with the sand even inside their houses. They got used to the food containing grains of sand. The problem of silting has also affected their agricultural activities. Besides, 85% of farmers argue that crop loss could reach almost 2/3 of the production of dates with a poor fruit quality due to wind effect, which leads to a deterioration in sales prices. Thus, of farmers assert that there is a social, economic and environmental depreciated welfare of local population.

After amenities, interventions to combat silting are progressing according to the extension of the inhabitants' agglomeration and concern mainly oases and roads. It is clear that the budgetary constraints and the speed of the silting process along with the slow pace of conservation-works have not led to the predictable objectives.

According to the surveyed local population, the situation of the village was enhanced after combating silting intervention: the land and the roads are almost dredged. In fact, 92% of interviewed population declares that sand invasion of villages decreased thanks to the protection provided by huge works of mechanical dredging, establishment of dunes, Tabias structures and reforestation works. The quality of life of the inhabitants is better than that observed before amenities. As well, 65% of interviewed population affirms that transport and accessibility to other villages became easier, it facilitated the access of the inhabitants to the adjacent villages, and growing conditions are improved [Figure 6](#). Also, 73% of the surveyed population states that intervention against silting managed to improve the inhabitants' welfare and to protect oases boundaries from silting resulting in producing dates of good quality better than those of neighboring regions unsupplied with any amenities.

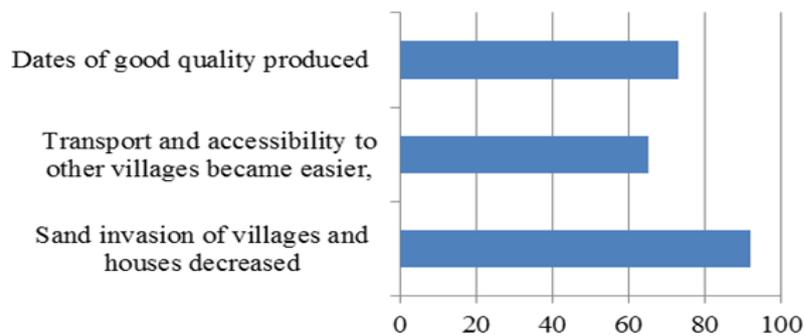


Figure-6. Improvements subsequent to anti silting managements as stated by population.

Nonetheless, we noticed that, the behavior of the local population towards these amenities against silting differs from one area to another; it is positive for some areas and negative for others. In fact, some amenities works have been damaged by some inhabitants, such as the uncontrolled sand withdrawal from Tabias. Besides, we noticed the existence of uncontrolled dumping of waste within reforestation sites.

Beyond everything, we noted the anarchic extension of the buildings to the detriment of the works amenities already established. Moreover, we noted that Tabias endorsement, located nearby buildings and houses, have generated sources of silting in about 46 % of "Sabria" zone. Furthermore, the rooting of ancient Tamarix plantations caused damages to 57% of inhabitants' houses at "Bchelli" zone [\[7\]](#).



Figure-7. Damages caused by some management as claimed by population.

Thus, some reluctance of some inhabitants towards these amenities was perceived through the destruction of some dune structures and water conflict with reforestation sites. Conversely some other inhabitants maintain these structures and manifest their willingness and awareness to protect the situation.

In fact, 91% of population thinks that a special attention should be paid to the training of stakeholders from extension services and the valorization of research achievements in order to improve techniques particularly for reforestation work and the use of other local species such as *Calligonum azel*, *Retama raetam*, *Lycium arabicum* for reforestation. Thus, the survey results provided that the awareness of the local population with respect to the importance of silting control structures is not quite widespread over all areas of the governorate of Kebili.

This is due to the fact that the integration and participation of the local population is not likewise adopted in all areas of the governorate. Therefore, it is obvious that all the interventions will not give the expected outcome only if the participatory approach is adopted in a more effective way by integrating all the local population into the choice, planning and execution process and thus establishing a close relationship and a better communication between administration and population and enhancing the sense of “bottom-up” process in order to achieve the goal of good and effective governance. [Biancalani \[8\]](#) announce that the inclusion of stakeholders in “participatory assessments” in each administrative region being assessed (district, province etc.) was an important innovation for national and for local land resources assessments. It required a range of experts and land users to arrive at a consensus assessment of the situation for a given area at a specific point in time through the use of standardized tools.

#### 4. CONCLUSION

In addition to its adverse environmental effects, the deposits of sand dunes are a serious threat to the entire infrastructure of development as well as for several oases, agglomerations, and irrigated perimeters, thus affecting roads, railways, agriculture, and socioeconomic welfare of population. The necessary intervention to mitigate this scourge generally requires huge financial means. Even though these strategies for combating silting have begun from several decades in southern Tunisia, they deserve additional efforts to mitigate the consequences of this phenomenon. In our case study, contribution of local people to conservation strategies and their behaviour towards these silting countermeasures differs from one zone to another. We can conclude that consciousness of the local population towards the importance of anti-silting structures is not widespread and even through the governorate zones. Most of rural population in Kebili governorate had low approval for improved management practices.

The results emphasize the effect of extension services and population's participation in the strategies' process on farmers' perception of anti-silting amenities. The farmers' awareness of improved management practices was found to be related to whether they had participated in the policies process or not. Also, according to rural population, specific extension activities of the type of cultivation are important. Thus, it is required to uphold farmers' awareness about environment problem and to strengthen the most suitable guidelines to improve environmental management in the region. It is obvious that the interventions as a whole will reach the desired effects only if the participatory approach is adopted and the local population is integrated into the planning and implementation process and thus establish a close relationship and efficient communication between the administration and the population. In fact, according to [Nedjraoui and Bedrani \[9\]](#) the irrational management of rangelands, the introduction of means and techniques of development unsuited to the environment, the lack of consultation between the different actors of the development contributed to environment and natural resources degradation and ecological and socio-economic unbalances.

Also, this research allowed us to identify several other points that deserve to be made in-depth such as the need for increased involvement of the private sector and international organizations and non-governmental organizations to progress and execute the sustainable work of combating silting. Indeed, the mobilization of fund is also a matter to be considered in order to improve the governmental intervention.

We would like to cite the example of the project of "Forum on Environmental Governance", initiated by the association: "Friends of the Environment" at Souk Lahad in Kebili, in partnership with the European Fund for Democracy (FEDEM), started in 2017 where field visits were organized to survey citizens of different delegations on the weekly market day. The objective is to identify the environmental problems of uncontrolled waste, the absence of a landfill, the mismanagement of green spaces, the bad management of household and building waste and the abusive exploitation of natural resources. After the data collection, a project team in collaboration with environmental experts offers training sessions on the environmental issue for 20 associative activists in the region.

**Funding:** This study received no specific financial support.

**Competing Interests:** The authors declare that they have no competing interests.

**Acknowledgement:** All authors contributed equally to the conception and design of the study.

## REFERENCES

- [1] E. Lambin, "Coupled human-environment system approaches to desertification," presented at the International Conference Desertification: Migration, Health, Remediation and Local Governance Royal Academy for Overseas Sciences United Nations Brussels, 22 September, 2006, 2006.
- [2] United Nations, *United Nations convention to combat desertification in those countries experiencing serious drought, particularly in Africa*. Geneva: UNEP/CCD, 1995.
- [3] Y. Masmoudi, *Multidisciplinary study of the dynamics of desertification in the South Tunisian*. Sfax: F.L.S.H, 2009.
- [4] J. Kailene, "Intervention on the fight against sand. Management day pastoral systems and the fight against desertification and climate change in Tunisia," presented at the Department of Forests, Ministry of Agriculture et Water Resources and Fisheries. Sidi Thabet Conference, Tunisia. April 17 - 18, 2012, 2012.
- [5] H. Khatteli, "Inventory and technical evaluation of actions to combat silting up in the six governorates of Southern Tunisia," *Arid Regions Review*, vol. 5, pp. 59-60, 1993.
- [6] L. Chakroun, "Contribution of forest policy to the fight against desertification," *Review of Arid Regions Medenine, Tunisia*, vol. 4, pp. 15-18, 1991.
- [7] Kebili Regional Office, "Ministry of Agriculture, water resources and fisheries," ed Tunisia: National Report of Agricultural Activities, 2017, p. 319.
- [8] R. Biancalani, "Land degradation assessment in dry lands projects," ed Rome, Italy: FAO, 2013, p. 10.
- [9] D. Nedjraoui and S. Bedrani, "Desertification in the Algerian steppes: Causes, impacts and control actions," *Vertigo - The Electronic Journal in Environmental Sciences*, vol. 8, pp. 18-19, 2008.

*Views and opinions expressed in this article are the views and opinions of the author(s), Current Research in Agricultural Sciences shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.*