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ASSESSMENT OF THE STATE OF SOME ANTI-EROSION INSTALLATIONS IN THE DAIRA OF HONAINE (WILAYA OF TLEMCCEN – ALGERIA)

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ABSTRACT

Water erosion is responsible for the degradation of more than half of the world's soils. In northern Algeria, it is widespread, particularly in the western region, which requires mechanical and biological developments to control it. The objective of this work is to evaluate the state and effectiveness of some anti-erosion developments, carried out in a coastal region: that of the Daira de Honaine (wilaya of Tlemcen). The methodology adopted was based on direct field observations, photo taking and data collection at the Forest Conservation in the wilaya of Tlemcen and the district of Remchi. The results obtained showed that most of the anti-erosion installations, carried out in 5 stations in the study region, are in very good condition. This demonstrates the perseverance of foresters, particularly in the creation of gabion thresholds and ridges, as well as the will of farmers in the good management and conservation of agricultural lands.

KEYWORDS

Water Erosion, Anti-Erosion Developments, Evaluation, Daira of Honaine, Wilaya of Tlemcen, Algeria

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1. Introduction

Water erosion is a complex phenomenon due to several natural factors and it is often accelerated by appalling human practices. It is one of the main causes of land degradation worldwide (Beatriz et al, 2002). It is responsible for the degradation of 56% of land, followed by wind erosion with 28%, chemical degradation (acidification, salinization) with 12% and physical degradation (compaction) with 4% (Roose et al. 2010).

Algeria, like the other countries of North Africa (Arab Maghreb), is among the most erodible regions in the world (Probest and Suchet, 1992). A multitude of anti-erosion methods have been applied around the world and in Algeria to slow down erosion processes (Zekri and Sid, 2023). To combat this phenomenon, the Algerian state has mobilized significant resources: reforestation, green barriers, torrential correction, fixing of banks and ridges. Particularly in so-called “priority intervention” areas: upstream of large hydraulic dams, towns and villages, agricultural land and ports.

The objective of this work is to evaluate the state of the anti-erosion developments carried out in a coastal region of the wilaya of Tlemcen: that of the Daira of Honaine (Northwest Algeria). This region is very popular with tourists in the summer season because of the many beautiful beaches it has and even in other

seasons because of the presence of forests and mountains with magnificent sea views. More than the existence of a port for fishing and leisure. These characteristics require that this region be protected against water erosion, especially with the existence of frequent mountainous reliefs.

2. Materials and Method

2.1 Study Area

The Daira de Honaine is part of the wilaya of Tlemcen. It is located on the northwest coast of Algeria and is made up of two municipality: Honaine and Beni Khellad (Fig.1). The town of Honaine presents remarkable tourist activity in summer. It extends over a total area of 6,385 hectares and is geographically located at different key distances: 70 km from the city of Tlemcen, 150 km from the city of Oran and 40 km from the Moroccan border (FCWT, 2024).

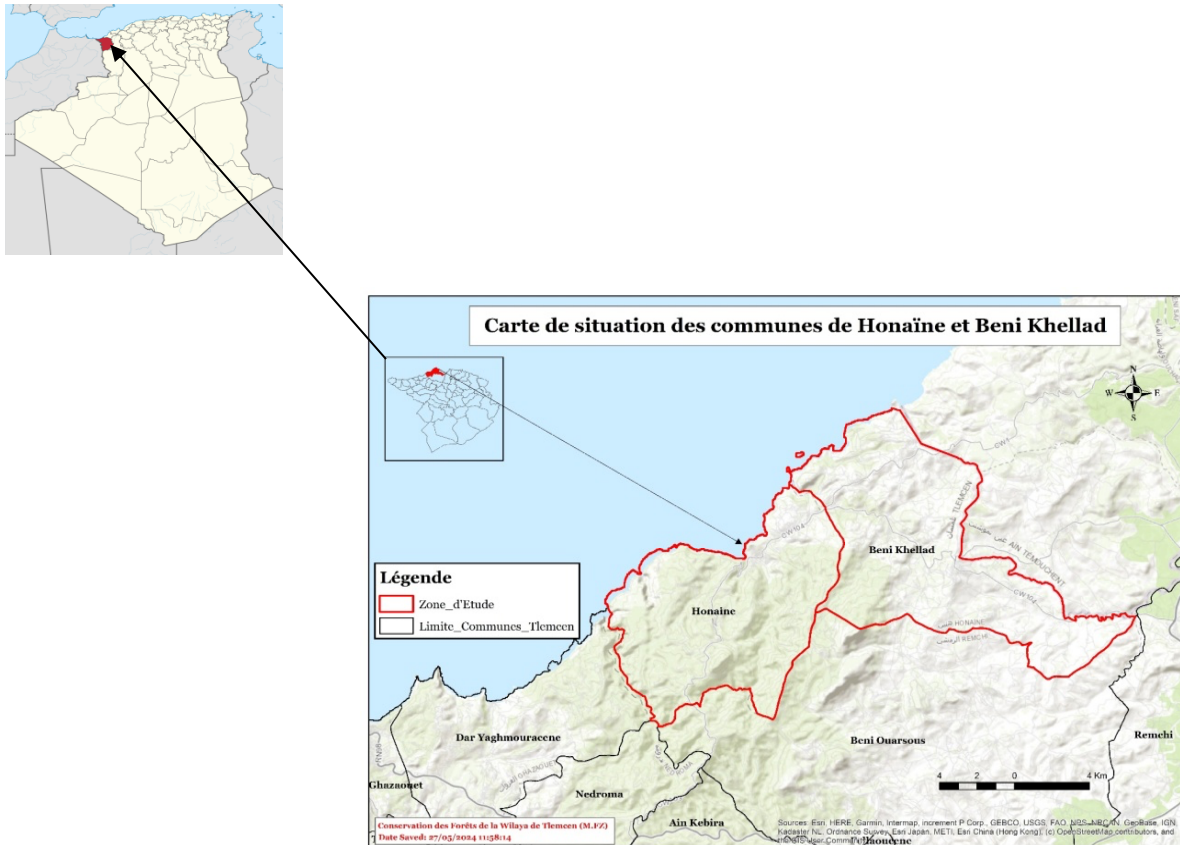


Fig. 1. Situation of the Daira of Honaine (FCWT, 2024)

The study area is an integral part of the Eastern Traras Mountains. The highest point is at Djebel Tadjra at 845 m. The slopes are very variable and range from 10 to 45%, they are gentler in the North than in the South. It is also characterized by the dominance of marls (substrate known for its vulnerability to water erosion) and particularly in the municipality of Beni Khellad. Limestones and hard dolomites as well as shales are also quite present. The latter are more resistant to erosion.

The climate prevailing in the studied area is typically Mediterranean. Currently the most responsive bioclimatic stage is the hot arid sowing, characterized by two seasons: a semi-humid season from October to May with irregular precipitation and a dry season from June to September. The driest and hottest months are July and August.

The forest cover occupies approximately 5700 hectares and presents a remarkable diversity of forest formations, including several key species including the Aleppo Pine and the Sandarac Gum tree. Agriculture is traditional, the useful agricultural area represents 1959 hectares or 34.36% (MWT, 2008).

The importance of the vegetation cover rate in the study area does not exclude the presence of the danger of erosion with its different forms and confirms the fragility of the environment to this phenomenon due to

either an accentuated topography or a composition fragile lithology. Figure 2 shows that the majority of land is either sensitive or very sensitive to water erosion in the Daira of Honaïne.

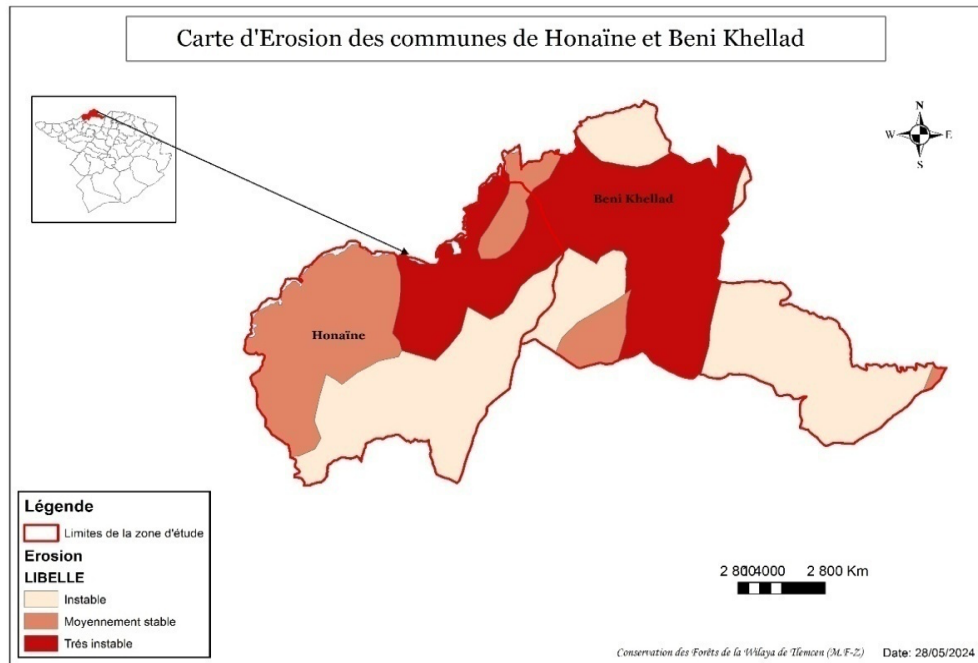


Fig. 2. map of sensitivity to water erosion in the Daira of Honaine (FCWT, 2024)

2.2 Methodological Approach

To achieve the objective of this study, the methodology adopted was based on direct field observations, photo taking and data collection at the Forest Conservation in the wilaya of Tlemcen and the district of Remchi. The field trips carried out between the month of February and the month of March (2024) allowed us to visualize the state of the anti-erosion installations present in some stations in the study area and to photograph them. The data collection focused on the anti-erosion developments carried out: their types, their volumes and areas as well as the date of their implementation. A more detailed analysis was conducted for the torrential correction thresholds by examining their current general state.

2.3 Study Stations

In the study area we have chosen 5 stations which contain anti-erosion facilities: the first station is located at the beach of Sidi Driss (municipality of Beni Khellad), the second next to the village of Ain Merika (municipality of Beni Khellad), the third station next to the village of Oueld Ben Ayad (municipality of Beni Khellad), the fourth station is located in the locality of Oueld Sid Chikh (municipality of Honaïne) and the fifth station is located upstream of the town of Honaïne (municipality of Honaïne).

2.3.1. Station 1

In the first station, gabions formed walls were built along the contour lines in 2003 and 2004 to protect the beach of Sidi Driss against the consequences of erosion (Photos 1 and 2). It is an unsupervised beach but it is very popular with summer visitors.



Photo 1 and 2: Station 1 of Sidi Driss beach protected against water erosion by gabions built in the form of walls

This station belongs to the locality of Ouled Amar, the latter is located 8 km north of the capital of the municipality of Beni Khellad. The physical environment of this area is characterized by gentle relief, with a modest maximum altitude of 150 meters, offering a relatively flat or slightly undulating topography. The degree of erosion is described as medium, suggesting a moderate vulnerability of soils to this phenomenon. The dominant soils are clay-loamy in nature, which gives them interesting fertility and good water retention capacity, while exposing them to the risk of erosion and compaction if they are not managed appropriately. The locality is located in a semi-arid climate, marking climatic conditions with moderate to low precipitation (MDP, 2009). This combination of physical characteristics combines assets such as the flatness of the terrain and the quality of the soil, but also challenges linked to erosion and aridity. The vegetation is diverse and typical of semi-arid areas. There are mainly Aleppo Pine and Sandarac Gum tree forests, which dominate the forest landscape. The plant cover also includes Doum palm, Butterbush and Diss grass, which are adapted to the climatic conditions of the region.

2.3.1. Station 2

In the second station, gabion thresholds were built in steps in the ravines in 2011, to protect agricultural land and the village of Ain Merika against linear erosion. This torrential correction action as a mechanical anti-erosion action as well as fruit plantations as a biological anti-erosion action were carried out within the framework of the Rural Renewal programs. The physical environment in the locality of Ain Merika is characterized by gentle relief. The dominant soil is clay-loam, which promotes the retention of water and essential nutrients for the vegetation. The climate is cool semi-arid, with an average annual rainfall of 350 mm. The local vegetation is composed of Thuya forests and rangelands where species such as Spiny Calycotome, Opuntia, Doum palm, Agave, Maritime Lavender and Rosemary grow. This plant diversity is well adapted to the semi-arid conditions of the region (MDP, 2011).



Photo 3: Station 2 of Ain Merika

2.3. Station 3

In the third station, the opening of ridges, torrential correction and fruit planting were carried out for erosion control. As part of the rural development program for the locality of Ouled Ben Ayad in 2009. The latter is located 9 km west of the capital of the commune of Beni khallad. The area of the locality covers 80 ha. It is a plain surrounded by mountains to the east and subject to a Mediterranean climate with a cool semi-arid bioclimatic floor. Annual precipitation is between 300 and 400 mm/year and the vegetation cover rate is 31% (MDP, 2008).



Photo 4: Station 3 of Ouled Ben Ayad

2.4. Station 4

In the fourth station there are ridges made as part of the DSR (Defence and Soil Restoration) in 1979 and planted by the Aleppo pine. It belongs to the locality of Ouled Sid Chikh. The latter is located 3 km west of the capital of the municipality of Honaine. Its altitude varies between 150 and 250 meters. It covers an area of 1200 hectares. Its relief is rugged, with slopes exceeding 25%, and the water crossing the mountain ranges is discharged into the Mediterranean Sea. The soils are clayey-loamy, made up of sandstone, sandy or non-karst carbonate formations. The region is subject to a semi-arid Mediterranean climate, with annual precipitation varying between 300 and 350 mm. This area is marked by a remarkable floristic richness with a coverage rate of 84% composed of: Forests (Aleppo pine and Sandarac Gum tree), forage plants (Opuntia, Lentisque, Pistachio and the Spiny Calycotome), honey plants (the wild lavender) and medicinal plants (Nerum oleander, Lentisque, Morus alba and Rosemary) (MDP, 2008).

2.5. Station 5

In the fifth station, sloping land was allocated to a farmer by the regional forestry administration. The latter, with a desire worthy of honor, arranged the space provided by terraces supported by low walls and planted with fruit trees (photo 5). These developments help protect the town and port of Honaine against flooding.



Photo 5: Station 5 located upstream of the town of Honaine

3. Analysis of Anti-Erosion Developments

3.1. Mechanical Processes

3.1.1 Torrential Fix

This action to combat linear erosion was observed in 3 stations in the studied area: the beach of Sidi Driss, the locality of Ain Merika and the locality of Ouled Ben Ayad.

In the beach of Sidi Driss (station 1), 4500 m³ of gabions were built in the form of walls according to contour lines between 2003 and 2004 (Tab.1):

Table 5. volumes of gabion thresholds, made in the Sidi Driss beach (municipality of Beni Khellad) between 2003 and 2004

Threshold number	Volume (m ³)	Year of production	Threshold number	Volume (m ³)	Year of production
1	227,38	2003	1	856	2004
2	188,03		2	228	
3	16,80		3	396	
4	12,48		4	10	
5	1125,24		5	10	
6	870,01		Total	1500	
7	158,00				
8	404,50				
Total	3002,44				

Source: (FCWT, 2024)

In the locality of Ain Merika (station 2), 1000 m³ of torrential correction, in the form of gabion thresholds, were created to protect agricultural land located downstream. This action was part of the collective actions of the Integrated Rural Development Project "IRDP" in 2011. In the same context, the locality of Ouled Ben Ayad (station 3), benefited from 800 m³ of torrential correction, in the form of gabion thresholds. in 2009.

3.1.2 Ridges

The ridges technique which allows the fight against sheet erosion and the control of other types of water erosion, was observed in two stations in the region studied:

- in station 3, three (3) hectares of terraces were opened to protect agricultural land located downstream as part of the IRDP in the locality of Ouled Ben Ayad in 2009;
- and in station 4 in the locality of Ouled Sid Chikh, ridges were opened in 1979 as part of the DRS. The latter are planted by the Aleppo Pine (Photo 6).



Photo 6: Ridges planted by the Aleppo Pine in station 4 of Ouled Sid Chikh

3.2.3 Terraces

This technique was observed at station 5, upstream of the town of Honaine. Where a farmer, encouraged and supported by forestry agents from the Honaine district, was able to develop sloping land with terraces reinforced by low walls and fruit plantations (photo 7). This makes it possible to minimize solid and liquid transport resulting from the phenomenon of erosion which threatens the town of Honaine located downstream, by flooding and the port by siltation.



Photo 7: Terraces supported by low walls and planted with fruit trees in station 5 upstream of the town and port of Honaine

3.2 Biological Processes

3.2.1 Fruit Plantation

This biological action is quite present in the area studied. One hundred (100) hectares of fruit plantation were carried out as part of the Rural Employment Project “REP” in 2004. And it was also greatly favored in rural development projects from 2009, notably olive growing. As part of the IRDP, 22 hectares were planted with olive trees in the locality of Ain Merika (station 2) in 2011 and 16 hectares in the locality of Ouled Ben Ayad (station 3, photo8) in 2009.



Photo 8: Olive growing in the Ouled Ben Ayad station



Photo 9: Fruit growing in station 5

3.2.2 Reforestation

This action is very effective against the phenomenon of erosion, where it allows lasting protection of the soil. The forest cover is quite present in the study area, which has allowed some control of the harmful consequences of erosion on land, infrastructure and the population.

4. Results and Discussion

The evaluation of anti-erosion developments in the Honaine region allowed us to identify the following main results:

- the current state of the gabions in station 1, observed during field surveys, showed that the weirs were built according to standards. They are most stable and in good condition despite having been built 20 years ago and they have minimized the effect of erosion on the beach of Sidi Driss. But bad habits carried out by summer visitors and the neighboring population who frequent this unsupervised beach have been observed, in particular the cutting of the wire of the metal mesh for resale (photos 10 and 11). This offense leads to instability of the weirs following the movement of the stones which fill the gabion cages. Erosion is therefore accelerated (photo 12).



Photo 10 and 11: Cutting of the metal mesh leads to movement of stones and instability of the gabion threshold



Photo 12: Acceleration of the erosion phenomenon following the instability of gabion sills

- the gabion thresholds observed in station 2 (photo 13) and station 3 (photo 14) are in very good condition, their stability is remarkable despite more than 10 years of their installation. This stability testifies to the perseverance of foresters in the stages of achieving these weirs. The latter protected agricultural land located downstream against flooding. Their stability can also be justified by the presence of a fairly dense plant cover next to other weirs. And unlike station 1, we did not observe the cutting of the metal fence in these stations, which affirms the awareness of the local population regarding the importance of these structures.



Photo 13: Stable gabion threshold with two cages and a rectangular spillway in the Ain Merika station



Photo 14: Stable gabion threshold in the Ouled Ben Ayed station

- The ridges observed in station 4 of Ouled Sid Chikh are also in very good condition despite already 45 years of their installation. This is justified by their planting with the Aleppo Pine, which protected them and their undergrowth against the effects of runoff, particularly during exceptional heavy and/or long-lasting downpours.

- The terraces supported by low walls and planted with fruit trees in the fifth station are also generally in good condition. Some low walls are poorly constructed (photo 15), this is justified by the lack of labor because the land is managed and operated by a single farmer.



Photo 15: Low walls built in station 5

5. Conclusions

The anti-erosion measures evaluated by this study represent the main mechanical and biological processes often used in Algeria and which belong either to traditional or modern techniques of water and soil conservation. Ridges and reforestation, carried out within the framework of the DSR, torrential correction and fruit planting carried out within the framework of the REP or IRDP as modern technology as well as terraces supported by low walls as traditional techniques were all observed.

The results obtained showed that most of the anti-erosion installations analyzed in the 5 stations in the study region are in very good condition. This demonstrates the perseverance of foresters, particularly in the creation of gabion thresholds and ridges. A remarkable and honorable desire of the region's farmers was also noted, by protecting the soil with fruit plantations and the opening of terraces. Only a few rehabilitations, notably in station 1 of Sidi Driss beach, are necessary for greater efficiency.

Challenges must also be overcome to optimize the effectiveness of anti-erosion actions and guarantee their long-term sustainability where it is recommended:

- To encourage research and innovation to develop anti-erosion techniques to local specificities;
- Strengthen financial and technical support policies for anti-erosion initiatives and continue to raise awareness and train local communities to ensure the sustainable adoption and implementation of water and soil conservation practices.

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