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Evaluation of water erosion at Mghaira area (Kaza of Jbeil – Lebanon)

Joseph Nakhoul

Abstract: *Water erosion leads generally to a high soil degradation, and thus excessive loss of its value. The evaluation of this process in the region of Mghaira (Lebanon - Caza of Jbeil) is realized through a model, designed by the PAP/RAC and FAO, which present two approaches : predictive and descriptive.*
The predictive phase which was previously prepared in 2009, determine the degree of sensitivity to natural erosion ; the descriptive phase is based on the observed physical factors that determine the degree of stability of each space. These field observations are combined with socio-economic characteristics of the region to determine the degrees of priority development in this area.
The descriptive erosion map shows that 88.46% of the study area is stable, while only 10.38% is unstable. The remaining space (1.15%) represents irrelevant areas.
According to the consolidated erosion map, we note that the majority of the unstable areas show high sensitivity to erosion, while the stable areas have different degrees of sensitivity. These disparities are due to the difference in the methodology of each phase of erosion evaluation and on the nature of the considered factors as well as their weighting
The map of priority development reveals that 26.1% of the study area is of low-priority, while 66.1% present medium priority and 6.7% are considered high-priority areas. Corrective measures and management guidelines are suggested at the end as a support for decision makers and stakeholders of similar projects.
Keywords: *water erosion, descriptive phase, predictive phase, priority development.*

I. Introduction

The soil is considered one of the most valuable natural resources of our planet, following its various functions and its main role in the cycle of life. The deterioration of these functions can cause major irreversible damage to nature and human life, which has generated global strategies focused on preservation and conservation. Lebanon is considered one of the countries suffering from symptoms of desertification and human involvement contributed in a significant way to land degradation (Bou Kheir et al., 2001a). Water erosion of soil is a main factor leading to such deterioration in Lebanon (Darwish et al., 2003) which can reach 70 ton per hectare in a single year at Lebanese mountains (FAO, 1986 In Bou Kheir et al., 2001b).

Mghaira area (15.63 km²) in Kaza of Jbeil constitutes the framework of this study where a big part is threatened by a moderate erosion risk and a high erosion risk (Darwish et al., 2004).

Objective of this work is to contribute to a descriptive qualitative assessment in the area of study in order to identify degrees of priorities for future planning and management plan, using a method developed by PAP/RAC (Priority Actions Program/Regional Activity Centre) and FAO (Food and Agriculture Organization) which integrates physical and socio-economical factors when describing erosion.

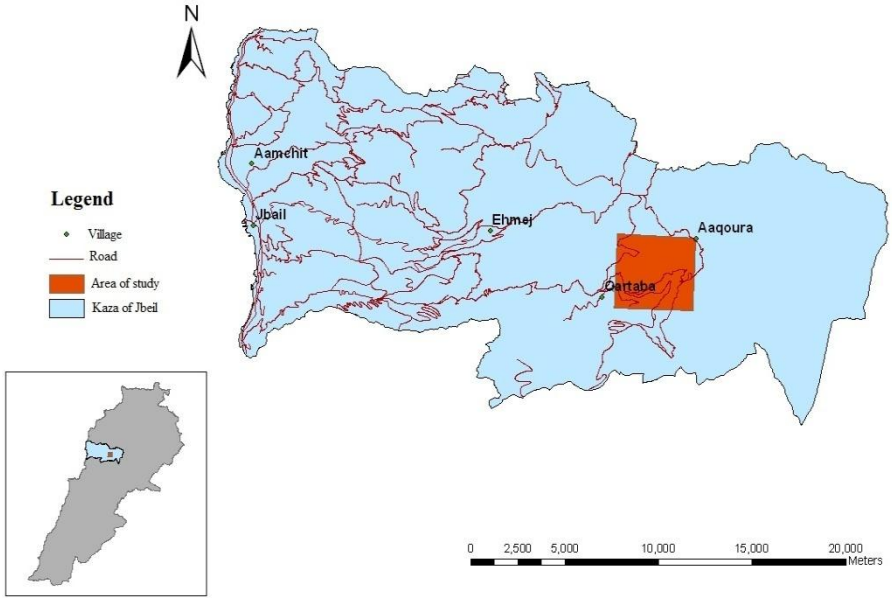

Figure 1: a map representing the area of study

II. Materials and methods

In order to determine planning priorities, the methodological approach consists of three phases: predictive phase, descriptive phase and integration phase.

The predictive phase was elaborated in 2009, in collaboration with the Cedars project (Darwish et al., 2009) and leaded to a map, describing potential erosion or erosion risks by degrees of sensitivity to this process according to physical factors like topography, land occupation and soil characteristics.

The descriptive phase offers a qualitative evaluation of actual state of erosion by determining different degrees of stability in the area after observations done in the field with Dr. Talal Darwish between April 2011 and May 2011. Delimitation of different zones was realized manually on the satellite image of the study area using a GPS to ensure from our identified zones, than digitalization of the map was made by GIS software. The area of study was divided into stable zones that don't show any actual form of erosion in relation to their dominant land occupation unit, degree of land instability, and probable factors of instability, and unstable zones where one or more erosion processes are taking place in relation to the form of erosion, erosion expansion trend and factors of erosion.

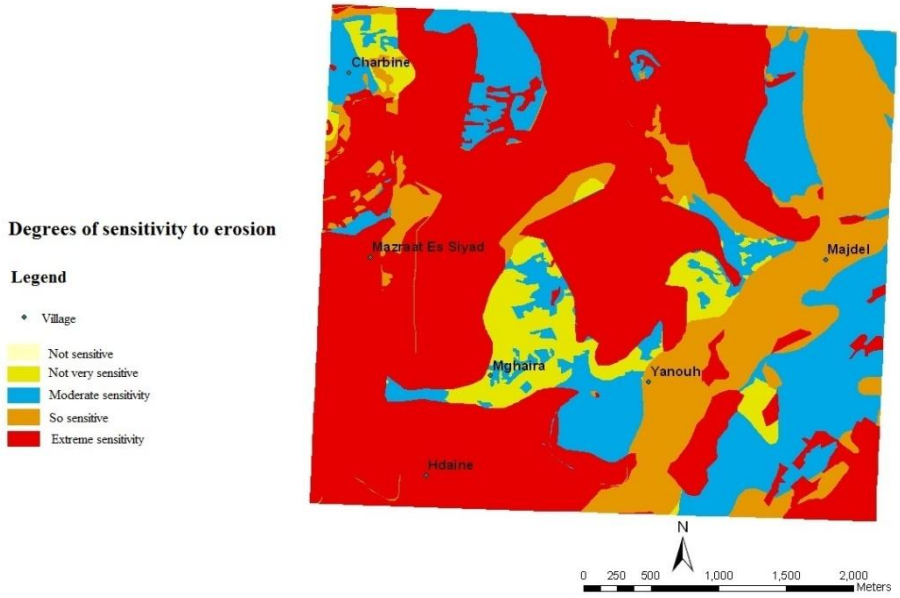

Figure 2: Potential erosion map prepared in the predictive phase (Darwish et al., 2009)

Integration phase consists of combining descriptive and predictive data in order to obtain a map containing different aspects of erosion. I used symbols to characterize stable and unstable zone (032g: area used for forestry purposes, stable with high erosion risk due to geological factors).

Identification of planning priorities was based on a method developed by experts from PAP/RAC (Khawlie et al., 2004) and on results of physical erosion evaluation and socio-economic conditions affecting erosion listed in the descriptive phase. In addition, values of the current and potential land use were considered according to different points of view, particularly, perception of the local population, introduction of national policies, evaluation of forestry potential, and forms of land use (agricultural and others).

III. Results and discussion

III. 1. a. Descriptive phase

Identified zone	Space (km^2)	Percentage from total area (%)
Stable	13.8	88.46
Unstable	1.62	10.38
Non relevant area (water basin, urban area)	0.18	1.15

Table 1: Results of descriptive phase showing space and percentage of identified zones

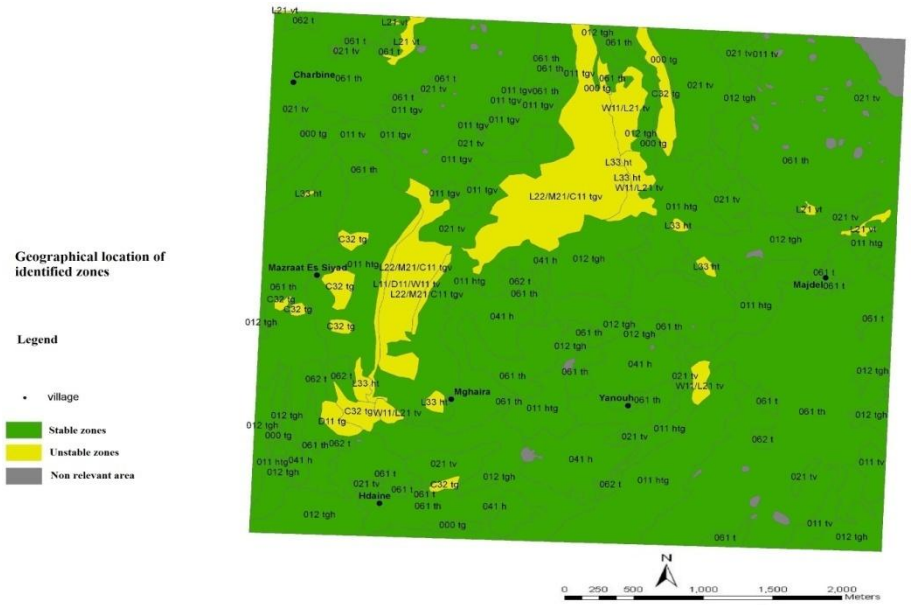

Figure 3: Map showing geographical location of identified areas

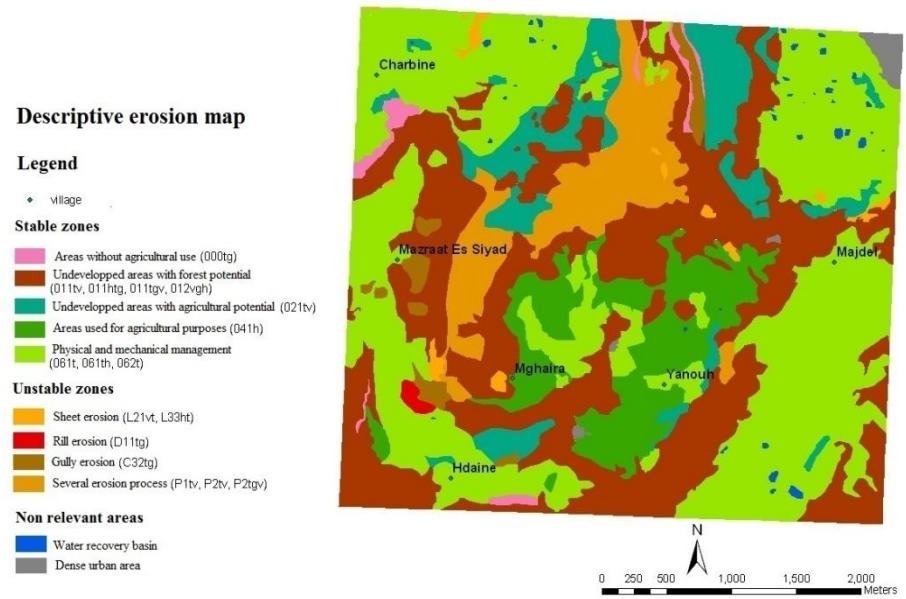

Figure 4: Descriptive erosion map

III. 1. b. Integration phase

By combining and comparing results from predictive and descriptive phase, we can say that significant portions of areas classified as highly susceptible to erosion or extreme sensitivity to the potential erosion map showed no active erosion processes in reality, given the vegetation cover and human activities. Furthermore, for unstable areas, there was a large discrepancy between the descriptive and potential mapping (94.5% of unstable areas are extremely sensitive or very sensitive to erosion). So the predictive method seems insufficient for a proper assessment of the risks of existing erosion, hence the importance of descriptive assessment of erosion that will lead to determine the degree of development priority in the area of study.

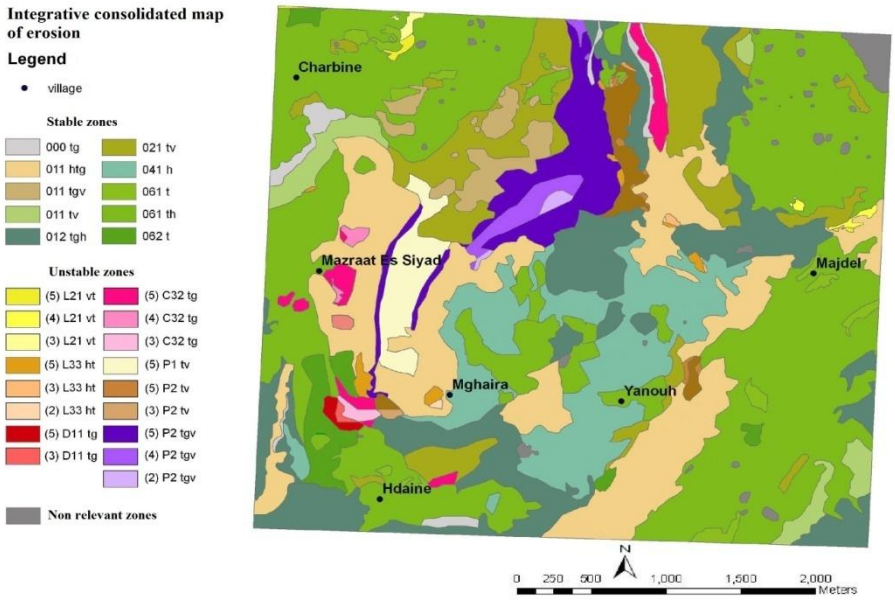

Figure 5: Integrative consolidated map of erosion

Degree of erosion sensitivity	Space (km²)	Percentage from total unstable areas (%)
Extreme sensitivity (5)	1.37	83.53
So sensitive (4)	0.18	10.97
Moderate sensitivity (3)	0.06	3.65
Not very sensitive (2)	0.03	1.82

Table 2: Table showing degrees of erosion sensitivity in unstable areas

III. 2. Priority planning

Unstable zones are distributed between moderate and high priority for planning according to intensity of existent erosion; these forms of degradation are due to direct human involvement and the absence of any preventive measure. On the other side, stable zones are distributed between moderate and low priority where natural conditions helped to keep some stability form.

Priority degree	Space (km²)	Percentage from total area (%)
Low	4.08	26.1
Moderate	10.34	66.1
High	1.0473	6.7

Table 3: Table showing degrees of planning priority in the study area

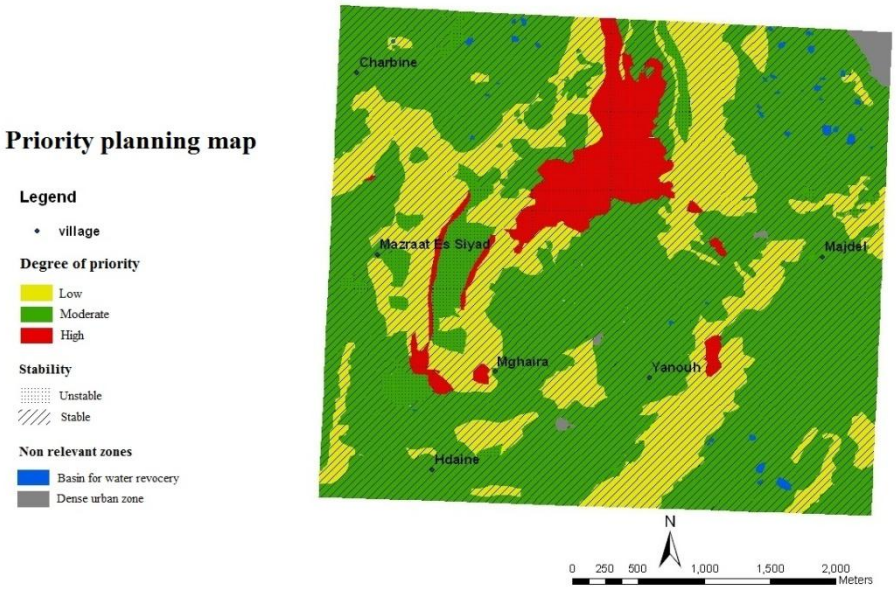

Figure 6: Priority planning map

III. 3. Corrective measures

Corrective measures must ensure sustainable management and conservation of the state of stability in a preventive way in stable areas; while in unstable zones, they must ensure a correction of the present state of degradation and be focused on correcting the degradation to achieve a minimization of damage and a greater appreciation of possible resources. Responsibilities must be distributed to Ministry of Agriculture (MoA), Ministry of Environment (MoE), Ministry of Public Works (MoPW), and Ministry of Tourism (MoT), while the private sector also can have a role by intervention of NGOs. For every identified zone in the integration phase, I proposed preventive or corrective measures with the corresponding responsible sector and the appropriate monitoring indicator that will occur after realizing proposed measures.

Code of polygon	Priority	Preventive proposed measures	Responsible sectors	Monitoring indicators
000tg	Low	- Apiculture - Ecotourism	MoE ; MoA ; MoT ; media ; local population ; municipality	- Diminution of rural migration - Increasing of rehabilitated spaces - Increasing of tourists number

Table 4: Table showing an example of corrective measures in one polygon or identified area

IV. Conclusion

During this study, erosion in the region of Mghaira was evaluated by a descriptive method that offered a qualitative approach to the current state of the erosion in the study area. According to this estimate based on fieldwork, 88.46% of the study area was considered stable lands where no existing forms of erosion are present, while unstable lands are suffering from current forms of erosion and cover 10.38 % of the total area of the region.

Existing socio-economic factors in the study area added to the various physical factors were used to determine the priority levels of development which have divided the area according to the need for implementing corrective measures.

It is obvious that the natural conditions of a region may increase erosion probability but human responsibility in using the land remains a major factor in the conversion of land that can cause subversive or ameliorative effect. Thus, I emphasize on the importance of human mentality in the perception of natural resources that must be very responsible and conscious.

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