COASTAL LAND DEGRADATION MONITORING

IMPROVING COASTAL LAND DEGRADATION MONITORING IN LEBANON AND SYRIA

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- "Reconnaissance Survey"
- "Detailed Analysis"
- "Strategy and Recommendations"
- "Interactive Participatory Programme (IPP)"
- "Geographic Information System (GIS)".

The report integrates all project components into a comprehensive document.

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EXECUTIVE SUMMARY

This report describes the development in Syria of PAP/RAC-MAP-UNEP Erosion Mapping and Management Programme of the pilot project "Improving Coastal Land Degradation Monitoring in Lebanon and Syria". The report was prepared by **Dr. Mohammad Al-Abed** based on field work activities implemented by the project team and under supervision of Gunter Englisch as PAP/RAC expert.

The coastal landscape in Syria is the result of interactions between human activities and natural environment. The soil is the essential component interfacing these relationships, and consequently has become deeply affected. Among the natural factors which influence this phenomenon, precipitation, land relief, and vegetation cover offer conditions which are particularly unfavourable. However, in last decades, more favourable socio-economic circumstances have led to substantial decrease in the traditional erosive agents, and the Government has paid considerable attention to the problem, resulting in the restoration of a considerable number of forests.

The Kurdaha and Sheikh Bader areas were selected as the pilot areas for the application in Syria of the common consolidate methodology of Mapping of Rainfall-Induced Erosion Processes in the Mediterranean Coastal Area. Consequently, this will form Syria contribution to the overall PAP/RAC-MAP-UNEP Erosion Mapping and Management Programme. Kurdaha area is located in the middle to northern part of the coastal mountains, about 30 km south-east of Latakia. It is bordered by the Ghab-rift in the east and the Syrian coastal plain in the west, and extends over 40,040 hectares. Sheikh Bader area extends over 20,279 hectare, lies in the Tartous district, 35 Km to the north-east of Tartous city. Relevant features of these pilot areas are: great variety of ecosystems, great human pressure, land abandonment, large areas affected by soil erosion processes, and socio-economic condition of the region in economic recession, except for the partially flat and gently sloping lands where agriculture is developed. Unfortunately, due to the lack of time and funds all the detailed analysis activities were implemented up to 800 meters. Thus, the generated maps are up to this altitude only and don't cover the entire areas of Kurdaha and Sheikh Bader. Consequently, the field investigation has been done on 235 Km^2 in Kurdaha area instead of 400.4 Km^2 (the total area), and on 188 Km^2 in Sheikh Bader area instead of 200.79 Km^2 (the total area).

Topographic maps at 1:50000 scale, and Landsat7-ETM image taken in March 2001, were used for the executing of the project. The project activities, which have been completed in about 30 months, consist of image interpretation, land surveys and field work, as well as office work. The investigations of soil erosion in the pilot areas were carried out using modern remote sensing techniques and modern methods of mapping of erosion processes with the aid of Geographic Information System, GIS, modified to suit the conditions in the Mediterranean zone.

As a result, 1:50000 scale basic erosion status map and descriptive erosion maps for the two pilot areas were finalised. In addition, various thematic maps were also finalised, like the contour, roads network, drainage, settlements, and administrative boundaries maps. Besides, land use and land cover map, land systems and, land forms map, and land unit map which combined these three maps together. The final soil erosion maps provide useful tools for the knowledge and interpretation of the erosion processes that are present in the pilot areas. They are also a planning tool for the erosion control.

According to the erosion mapping methodology, the stable or stabilised areas account for 42% and unstable areas account for 16% of Kurdaha total area. In Sheikh Bader, the stable or stabilised areas account for 54% and unstable areas account for 38% of the total area. Successful land degradation control is based on the efficient use of available resources and therefore needs the establishment of clear priorities for both identification and planning of future interventions in the framework of control programmes. In total for Kurdaha area, about 8.49% of the assessed area falls into the high priority class, 29.53% were classified as medium priority areas, and 61.03% as low priority areas. The high priority areas in Kurdaha area were identified as unstable areas showing active erosion processes, such as dominant multiple processes due to bad land management, dominant gully network, and dominant sheet erosion. For Sheikh Bader area, about 16.17% of the assessed area falls into the high priority class, 39.88% were classified as medium priority areas, and 42.53% as low priority areas. In the high priority classes in Sheikh Bader area, the unstable areas are dominant, showing two unstable conditions: dominant multiple processes due to bad land management and dominant sheet erosion. Based on the priority procedure the hot spots in Kurdaha mainly occur in southern parts of Kurdaha city as well as in the south-eastern parts. As for the area of Sheikh Bader, the hot spots largely occur to the north western and southern parts of Sheikh Bader city.

General recommendations for the preparation of management plans of areas affected by degradation cannot disregard the guiding principles of sustainable development, in terms of management and conservation of the resources base, and of orientation of technological and institutional progress so to ensure a continuous satisfaction of human needs for present and future generations. The application of the principles of sustainable development makes it possible to preserve natural and genetic resources, while promoting a development which is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. The application of sustainable development principles to fragile ecosystems such as arid and semiarid zones, very common in Mediterranean areas, must cope with the issues of land degradation and desertification. The success of land degradation control programmes depends on favourable framework conditions. These framework conditions comprise appropriate organisational, institutional, legal and political structures and processes as a basis for the programme planning and implementation. The management efficiency of the institutions involved is crucial in this respect. If the framework conditions are found to be insufficient, appropriate steps, such as capacity building efforts, have to be initiated in order to ensure sustainable programme implementation. Furthermore, financial considerations have been taken into account from the very beginning of the initial phase of programme formulation, and the funding sources carefully analysed. Finally, monitoring of erosion is essential and should be considered in any erosion control programme because it provides regular assessment of activities, recording of impact, and periodical analysis of relevant information.

1. INTRODUCTION

The issue of land resources conservation is strongly felt in Syria like in most other Mediterranean Countries. The main environmental concerns of the coastal zones in Syria mostly arise from the high concentration of people (high natural growth and migration) and related activities (intensive agriculture, heavy industry, transportation).

Degradation processes are further accelerated by the natural characteristics of the landscape, such as relief, geomorphology, geology and soil characteristics, as well as by the climate type of the concerned zone in terms of rain intensity, drought and climate change.

In this connection, the General Organisation of Remote Sensing (GORS) joined its efforts with a Lebanese partner organisation and International Centres working in the field of environmental observation and monitoring in order to implement a methodological approach and a capacity-building programme for supporting plans for the control/management of land degradation in Syrian coastal areas.

GORS was established in 1986 and replaced the national Centre of Remote Sensing which was already established in 1980. The organisation became responsible for aerospace and land survey using remote sensing techniques, as well as for analysing remotely sensed data in order to utilise them in exploring and exploiting natural resources, and environmental studies in the Syrian Arab Republic. The headquarters of GORS are located in the Saboura area about 10 km west of Damascus. The site was selected to meet the demands for acquisition of space data from satellites.

GORS has carried out numerous projects and studies since its establishment in a variety of fields, such as hydrology, geology, agriculture, environment, urban and regional planning, archaeology, meteorology, cartography and different general studies of space and remote sensing.

These projects and studies involve for example:

- geological studies for the Syrian coastal area as well as studies on volcanism in the southern part of the coastal series;
- projects on landuse/landcover mapping, crop monitoring, soil classification, land degradation and reforestation;
- environment studies on air and water pollution such as the thermal pollution in Banias area as a result of phosphate loading in Tartous port, or the determination of landfill sites for different regions in the country;
- projects on wells detection and monitoring of large and small lakes in Syria as well as snow cover monitoring on Haramon mountain in the south-west of Syria;
- contributions to urban and regional planning, such as production of thematic maps and monitoring of the urban expansion;
- production of digital maps for some parts of Syria based on space images at scale of 1:50,000; and
- collection of meteorological data by means of a meteorological receiving station in order to collect and analyse meteorological data for weather forecasting in Syria.

Through this experience and expertise, GORS was highly qualified to execute the work on land degradation monitoring presented in this report. Furthermore, since its establishment

in 1986, GORS has been developing co-operation at three levels: local, regional and international.

At the local level, GORS has carried out numerous studies and projects with several national ministries and institutions. Meanwhile, at the regional level, GORS has developed co-operation with Arabic states and the Arab League. This co-operation involved the exchange of experience and information with Arabic states such as the organisation of the First Arabian Conference on Remote Sensing and Space Research in 1995. Besides, GORS continues its efforts towards the establishment of an Arabic space agency in order to promote remote sensing techniques and space science in Arabic and regional studies. As for the international co-operation, GORS is co-operating with several foreign countries and international bodies.

The present report is part of the documentation of the regional project “Improving Coastal Land Degradation Monitoring in Lebanon and Syria”, co-funded by the European Commission. The background information for this project will be provided in the following chapter (Chapter 2), followed by a summary of the results of the reconnaissance survey (which is documented in detail in a separate report) and related diagnostic analysis for the entire coastal area under investigation (Chapter 3). In Chapter 4, the pilot areas selected for in-depth analysis are described and in Chapter 5, the results of this detailed analysis are presented. The detailed analysis was based on a descriptive mapping approach recommended in the UNEP/MAP/PAP “Guidelines for erosion and desertification control management with particular reference to Mediterranean coastal areas, 2000”. In compliance with the methodological procedure recommended in the Guidelines, recommendations for remedial measures have been developed (Chapter 6) and consolidated in the form of draft management plans for the selected pilot areas (Chapter 7). This is complemented by the description of prerequisites for implementation of draft management plans (Chapter 8), also in accordance with the above Guidelines. At the end of the report, the resulting conclusions are given in Chapter 9. A Bibliography and several Annexes complement the report.

2. PROJECT BACKGROUND INFORMATION

The EU LIFE Third Countries project "Improving Coastal Land Degradation Monitoring in Lebanon and Syria" (hereinafter referred to as the CoLD Project) was implemented to improve Lebanese and Syrian national capacities of relying on advanced tools for environmental management and planning of coastal zones, according to the principles of sustainable development.

The main objective of the project was to provide a clear reference framework for approaching the issue of land resources degradation in coastal areas and for implementing sound conservation and sustainable development measures. As identified in the initial project proposal, the CoLD Project focussed on the main components of land degradation and desertification in the area under investigation, namely the deterioration of the permanent natural and semi-natural vegetation cover and resulting erosion processes including the loss of intrinsic properties of soils.

In this context, the General Organisation of Remote Sensing (GORS) directly carried out project activities for Syria, in close co-operation with the involved Lebanese partner, the National Centre for Remote Sensing (NCRS) and with the support of the MAP/UNEP Centres through the implementation of a capacity building programme relevant to both technical requirements and management aspects.

GORS co-operated with the following project partners in the framework of the CoLD project:

- UNEP/MAP Environment Remote Sensing Regional Activity Centre (CTM - ERS/RAC): Since 1993 CTM (Mediterranean Remote Sensing Centre) has been playing the role of the Regional Activity Centre for Environment Remote Sensing (ERS/RAC) of the Mediterranean Action Plan (MAP), under the aegis of United Nations Environment Programme (UNEP). ERS/RAC is hosted at CTM premises in Palermo, Italy. ERS/RAC's role is to contribute to the best use of space techniques (especially, remote sensing) by Mediterranean countries in the field of environmental observation and monitoring, in view of the sustainable development of the Region and in the framework of the Barcelona Convention.
- UNEP/MAP Priority Actions Programme Regional Activity Centre (PAP/RAC): PAP/RAC, established in 1978, is a key component of the Mediterranean Action Plan (MAP). As one of six Regional Activity Centres within MAP, PAP/RAC has built up a global reputation owing to its expertise in Integrated Coastal Area Management (ICAM). The multidisciplinary nature of ICAM is realised through Coastal Areas Management Programmes (CAMPs) and other projects dealing with individual natural resources, including nature protection, water resources and soil erosion, as well as with management of activities such as tourism, urban development, aquaculture and waste.
- Lebanese National Council for Scientific Research - National Centre for Remote Sensing (NCSR/NCRS): The National Council for Scientific Research (NCRS) has been established in Lebanon in 1962 as a result of joint efforts of public authorities and the scientific community and their determination to integrate science and research strategy into national policy. The NCRS is a public institution assigned with the task of formulating national science and technology policy, initiating, guiding, supporting and conducting scientific research programmes and activities in Lebanon. It advises the Government on all science and technology issues.

The project partners of the CoLD Project relied on an overall budget of 503,000 Euro, 70% of which funded by the EC. The Project was launched in February 2002. Its total duration was initially 30 months but a project extension of 4 months was granted by the EC and therefore the final project termination was set for December 2004.

The CoLD Project is based on a multi-scale approach which allows to tackle the phenomenon of land degradation according to a diagnostic analysis of the whole coastal area of the two concerned Countries (scale 1:100,000) and a detailed analysis carried out in four selected pilot areas (scale 1:50,000) in order to make possible the provision of Guidelines and Recommendations to local stakeholders as a support to planning and decision making processes.

The CoLD project was implemented in three main phases, hereinafter referred to as "components" which represent specific aspects of land resources evaluation and management.

The first component was devoted to the diagnostic analysis of the human impact on the territory and of the causes of land degradation. The second component was devoted to the detailed analysis of four selected areas in order to evaluate the effects of such an impact on economic activities, that is, the consequences of the induced degradation. Finally the third component was addressed to consolidate the outputs of the previous two phases in order to produce guidelines and recommendations in support of land planning and environmental management, in compliance with the principles of sustainable development.

Within the project phases, three main operational activities were implemented, namely the "Reconnaissance Survey", the "Detailed Analysis" and the "Strategy and Recommendations" Activity.

The first two, based on a multiscale approach, were addressed to provide the physical characterisation of the study area by identifying two main broad categories of landscape units, stable non-erosion affected areas, and unstable erosion-affected areas. For those belonging to the first category, the extent of erosion risk was defined, while for the other ones the type of dominant erosion processes and their relative intensity and expansion trend were identified.

The Strategy and Recommendations activity was based on the integration of mapping outputs of the Detailed Analysis, with socio-economic/land use features and national or local policy priorities, in order to identify, as for homogeneous areas, options for preventive, curative and protective remedial measures to be applied. The project activities were based upon the scheme recommended in the UNEP/MAP/PAP “Guidelines for erosion and desertification control management with particular reference to Mediterranean coastal areas, 2000” and the related procedural steps.

These activities were supported by the setting-up of a proper Geographic Information System (GIS) which includes all produced data, made available both in paper and in a digital format.

Another activity, transversal to the overall project implementation, was the Public Participation Programme. The implementation of the participatory programme was made through meetings, workshops and outline and technical documents, in order to:

- introduce the relevant participatory techniques in the planning/management process;
- upgrade national institutional capacities for application of the participatory process;
- strengthen the commitment by involved authorities and stakeholders;
- contribute to the quality, effectiveness and sustainability of the project; and
- raise awareness on the benefits of the project and create support for its implementation and follow-ups.

More information on the CoLD Project can be obtained from the project website: www.coldproject.net

3. SUMMARY OF DIAGNOSTIC ANALYSIS RESULTS AND RESULTING GENERAL RECOMMENDATIONS FOR MANAGEMENT OF THE WHOLE STUDY AREA

3.1 INTRODUCTION

General recommendations for the preparation of management plans of areas affected by degradation cannot disregard the guiding principles of sustainable development, in terms of management and conservation of the resources base, and of orientation of technological and institutional progress so to ensure a continuous satisfaction of human needs for present and future generations. The application of the principles of sustainable development makes it possible to preserve natural and genetic resources, while promoting a development which is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

The application of sustainable development principles to fragile ecosystems such as arid and semiarid zones, very common in Mediterranean areas, must cope with the issues of land degradation and desertification.

This is why it is essential to combat desertification through the application of at least three main measures:

- preventive measures, in order to prevent the occurrence of degradation phenomena in lands which are not yet degraded, or which are only slightly degraded;
- mitigation measures, in order to rehabilitate the productivity of moderately-degraded lands;
- restoration measures, for soil recovery and land reclamation in seriously degraded areas.

A sound knowledge of causes of land degradation and of desertification processes is needed in order to select, for each management area, the most appropriate actions for natural resources conservation.

In this connection, the benefits of thematic mapping at reconnaissance scale – such as erosion risk mapping – should be considered mainly in terms of possibilities of selecting areas for priority interventions, where more detailed studies can be carried out, as well as field inquires aimed at determining the type and intensity of active erosion processes. Generally speaking, areas characterised by slightly or not yet degraded land, or moderately degraded one, are often the most widespread and should be devoted special attention and priority.

Actions to restore seriously degraded land should be limited to specific cases in which land degradation is clearly identified and recovery measures are deemed suitable, effective and sustainable.

In the field of rural sustainable development, policies should aim at operating so that agricultural and rural sectors could meet the basic nutritional needs of present and future generations and supply rural people with long-term employment, decent living and working conditions, while preserving the productive capacity of natural resources.

Therefore, the main objectives to be taken into account in the development of land management plans should be:

- on the technical side, the application of preventive, mitigation and restoration measures to relevant areas;
- on the political side, the development of policies aimed at promoting sustainable development and at reducing the impact of human pressure on land resources.

If these objectives can be considered universal, their practical application requires their translation into strategies and concrete actions, both at national and international levels.

At a national level, land management and planning policies should be implemented so to develop global outlines that embody vulnerability and risk as essential components of planning decisions.

At an international level, the scientific community could play an important role in keeping on studying desertification processes and in improving techniques to combat these processes.

The reconnaissance survey carried out over the coastal areas of Syria was aimed at facing the need of a comprehensive, uniform data set at a small scale for the whole coastal area. Even though it was performed following slightly different approaches, it allowed to classify each homogeneous unit of the study-areas relying on its overall erosion risk.

Obviously, the scale used for such a study does not allow a detailed analysis of causes of land degradation with relevant preventive or corrective measures, although it provides the opportunity to assess priority areas for more detailed studies and to get an overview of the main causes of land degradation processes in these areas.

The torrential rains which are responsible for severe water erosion processes act over an environment where certain morphological characteristics (mainly slope) and land use/land cover patterns – as described by the reconnaissance survey – represent the two key factors to assess land degradation and to be taken into account for devising land management programmes.

Among other factors which play an equally important role, some soil features – such as soil texture – can be mentioned as affecting in turn water infiltration rate and, as a consequence, the infiltration/runoff ratio.

For scale reasons, considerations about recommendations coming from factors like the latter are remitted to the Detailed Analysis.

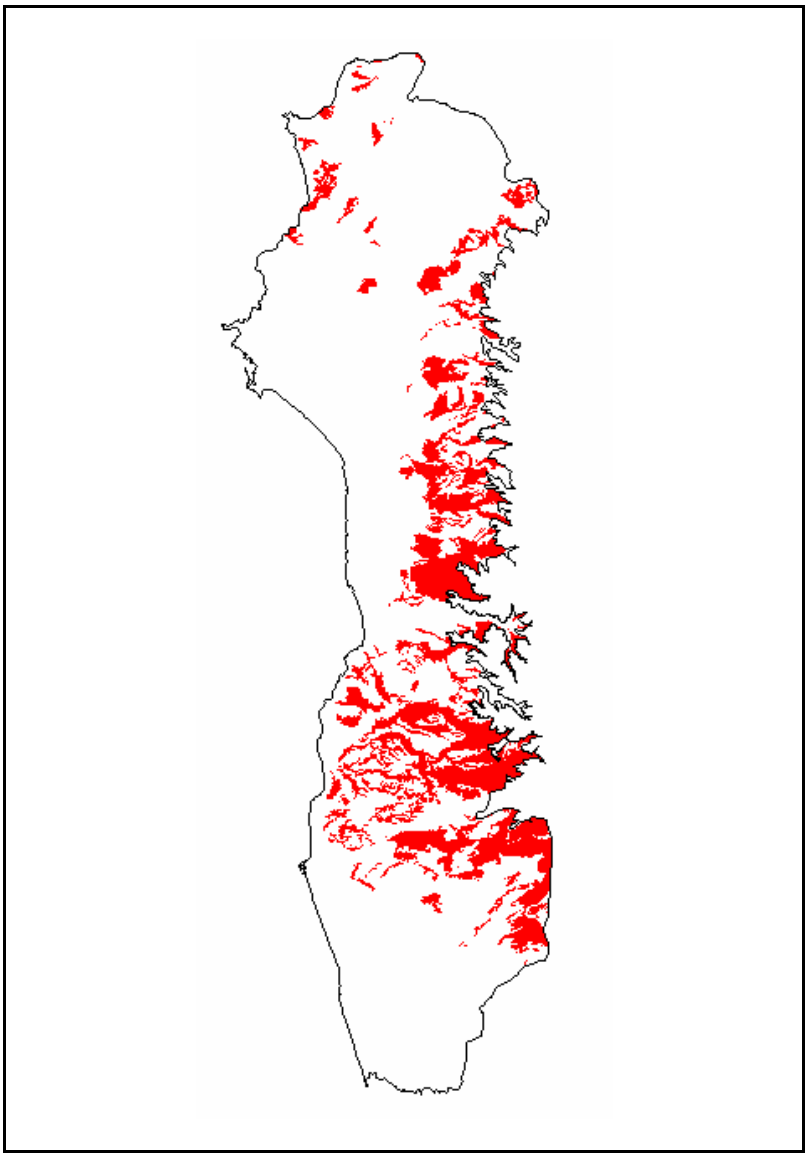
3.2 MORPHOLOGY

The morphological asset of Syria plays a key role in characterising erosion-prone areas and in defining management plans aimed at facing similar phenomena. In particular, two main factors have to be considered, namely, the slope gradient and the slope length.

The slope gradient is undoubtedly the most important factor in assessing erosion risk: the slope value weights half or more the total erosion risk value of morphological units classified as highly, very highly or extremely highly susceptible to erosion. Such units represent about 48% of the considered Syrian territory.

Map 3.1 displays the extent and the spread of these morphological units in red. Shown are the land units selected according to both of the following criteria:

- land units with more dissected morphologies and steepest slopes;
- land units classified as falling into the three highest erosion risk classes.



Map 3.1: Areas with steep slopes falling in higher erosion risk classes (classes 4, 5, and 6) are shown in red

The slope length becomes a critical factor – though only locally – in the land system of Lower Coastal Plain, where it plays a quite important role on more gentle slopes in which the presence of long slopes with quite uniform slope gradient contributes to the increase in runoff speed and in the erosive power of water. In such situations, the effect of this factor is highly dependent upon the type of land use/land cover and, for agricultural areas, upon agricultural practices for water control.

3.3 LAND USE/LAND COVER PATTERNS

According to evidence coming from field survey, from previously existing thematic maps and from satellite data interpretation, it can be stated that the coastal areas of Syria show, besides a quite high variety of morphological characteristics, some dominant patterns of land use types characterised by specific erosion risk classes.

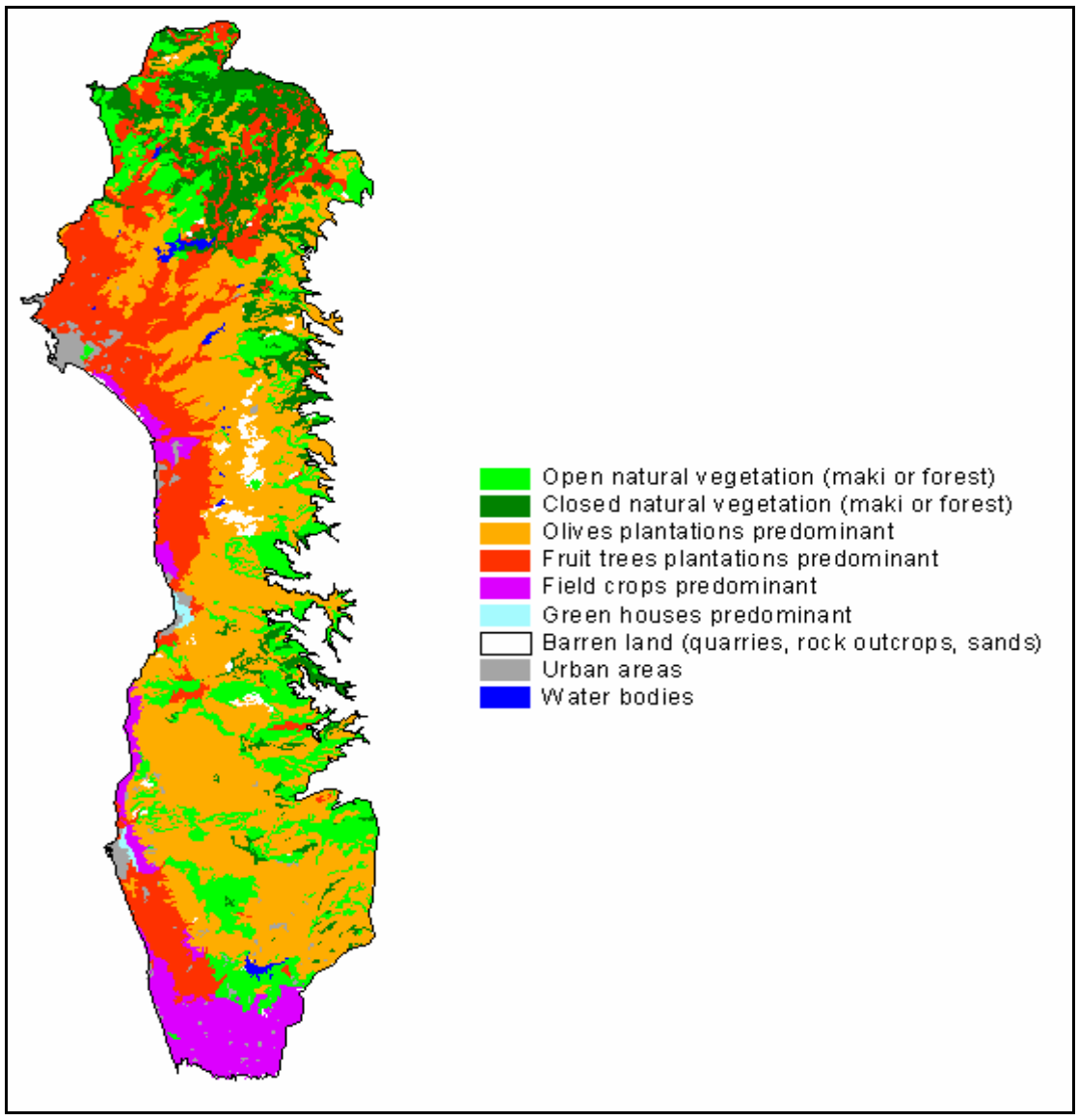
Map 3.2 shows the land use/land cover map (the relevant legend has been simplified, with respect to the original data set, for a better small-scale thematic representation).

About 40% of the Syrian study-area is marked by olive plantations. They are characterised by a plant spacing which usually leaves more than a half of the soil surface unprotected from erosive action of raindrops. Most of those plantations are located on hilly areas, with morphologies varying from gently undulating to steep slopes and calcareous soils particularly rich in gravel and stones.

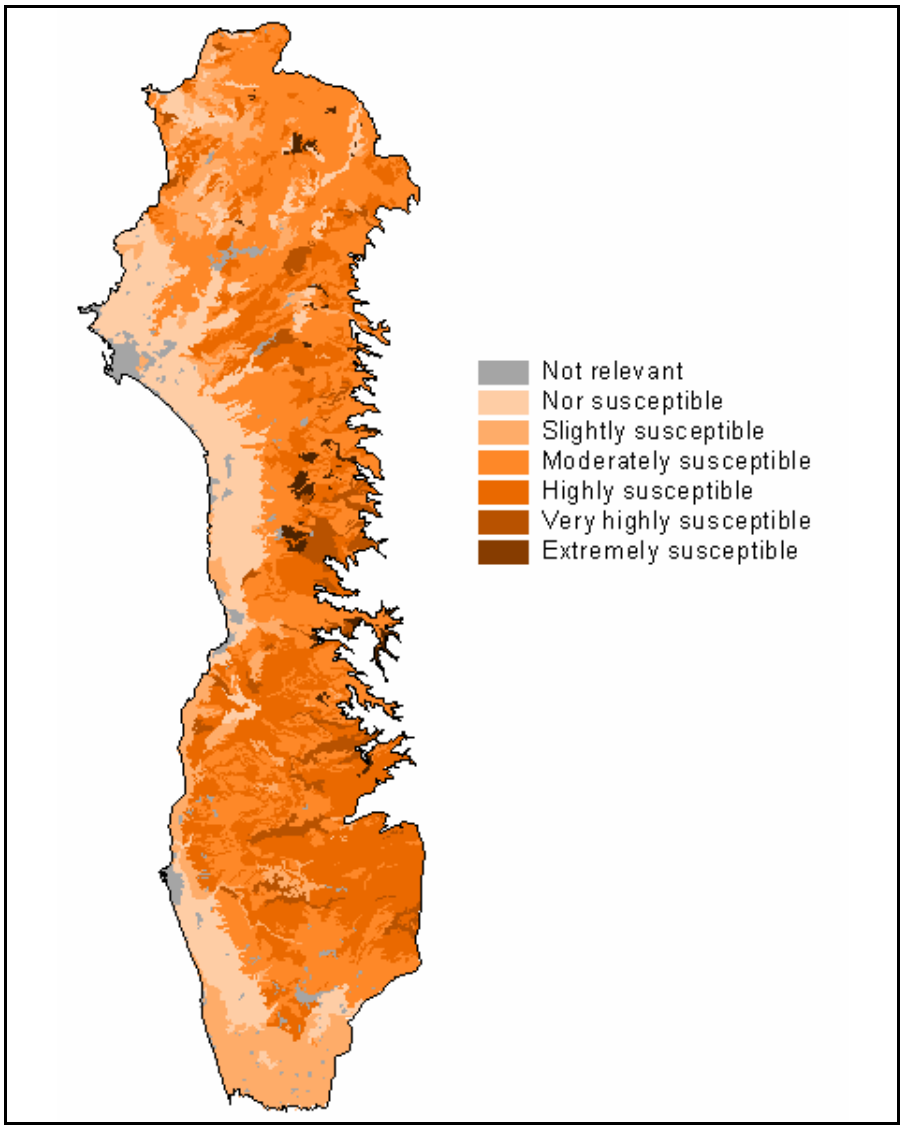
Olive plantations are very often irregularly mixed with natural vegetation formations such as open maki, open shrubs and, locally, smaller reforested surfaces. These natural formations have various degrees of degradation and show percentages of vegetation cover ranging from 10% to 70%.

The pattern drawn by the mix of this land cover with olive plantations is, in most cases, below the minimum mapping unit size and therefore it is not mappable at the reconnaissance scale.

At lower altitudes, on the coastal plain, land use is characterised by tree plantations (especially citrus), intensive farming and field crops.



Map 3.2: Land use/land cover map (simplified legend) of the coastal areas of Syria



Map 3.3: Erosion risk map of the Syrian coastal areas

3.4 RECOMMENDATIONS FOR THE MOST CRITICAL AREAS

Relying on the various combinations of the two above reported factors mostly affecting erosion risk, three main scenarios were highlighted for which some general management recommendations are hereinafter provided.

3.4.1 Olive plantations on steep slopes

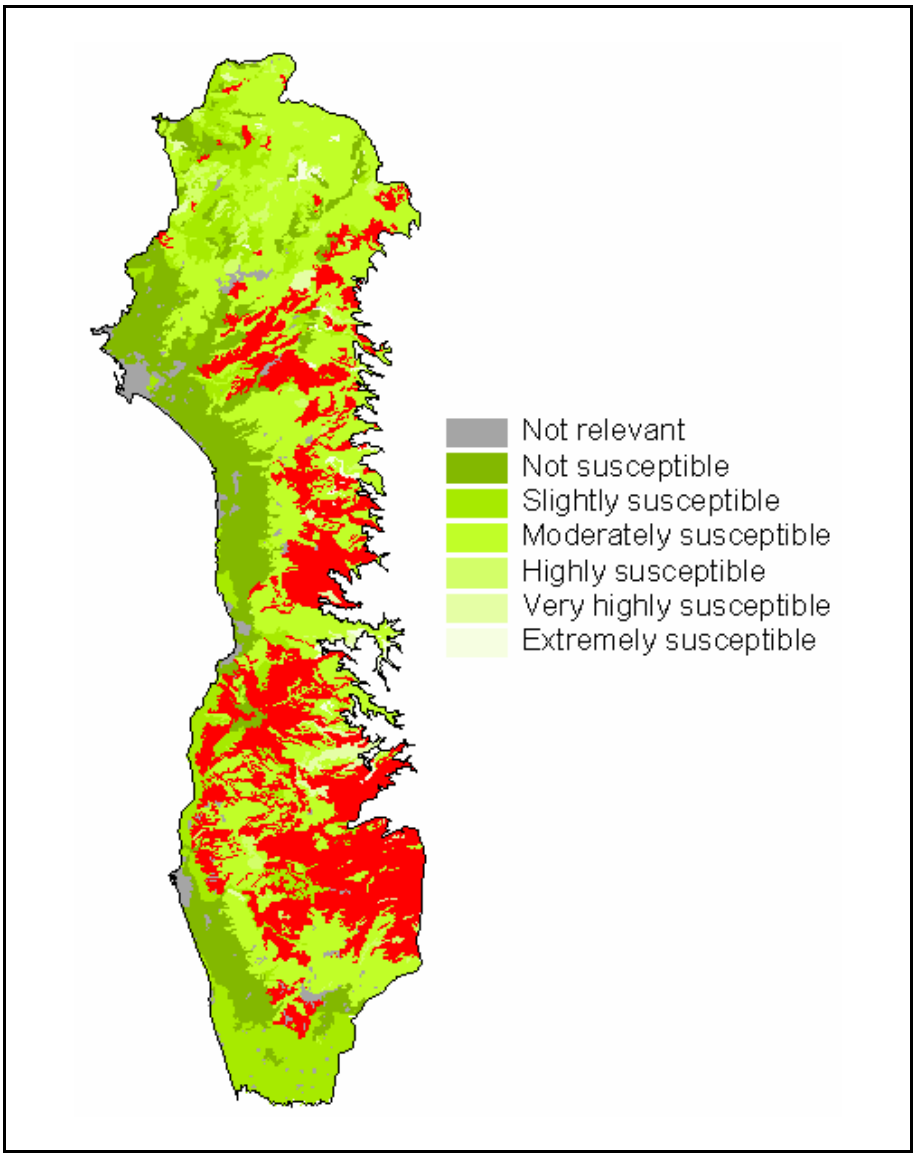
Steep slope gradient and olive plantations characterise a great part of the study-areas. For those areas, field evidence clearly shows the extremely high weight of conservation practices in facing erosion risk.

Table 3.1 shows the distribution of olive plantations areas in the various erosion risk classes. As estimated relying on field survey data, in Syria about 70% of slopes covered with olive plantations are managed through some kind of conservation practices (mainly contour stones terracing, but also bench terracing and contour ploughing). Such practices play a key role in decreasing the surface water runoff and, as a consequence, in reducing erosion risk. Obviously, the effectiveness of such measures depends on slope steepness.

Table 3.1: Distribution of olive plantations in erosion risk classes

Erosion risk classes	Area (ha)
Not or insignificantly susceptible	2,454
Slightly susceptible	10,638
Moderately susceptible	77,929
Highly susceptible	53,758
Very highly susceptible	5,921
Extremely susceptible	0

As shown in Map 3.4, areas including olive plantations and falling into higher erosion risk classes (classes 4, 5 and 6) are mainly located in the eastern part of the study-area, where morphology is dominated by the more dissected landforms (erosion slopes, fluvial scarps, fault scarps, dissected sloping areas), i.e. where average slope values are higher, regardless of the Land System those areas belong to.



Map 3.4: Erosion risk map: areas with olive plantations falling into higher erosion risk classes (classes 4, 5, and 6) are shown in red

Field data show that, for all those areas, erosion processes are much more active not only where no conservation practices are applied but also where such practices are not maintained.

A degraded or partly destroyed terrace may cause or even accelerate intensive erosion processes, therefore, maintenance interventions such as repairing partially-collapsed terraces seem to have the same importance as the application of new land management measures.

3.4.2 Naturally-vegetated steep slopes

Areas covered with natural vegetation (open or closed maki, herbaceous or forest) on steep and very steep slopes are zones highly susceptible to erosion and the presence of vegetation cover becomes the only protection against the rainfall impact.

In these areas the conservation of a good vegetation cover and the increase in vegetation density are fundamental and all actions aimed at increasing water infiltration and at reducing surface runoff should be encouraged.

In naturally vegetated areas, it becomes clearly important to devote particular attention to soil protective factors: vegetation cover must be preserved or increased as much as possible, uncontrolled fuelwood collection and excessive grazing need to be always monitored and reduced.

Another very important factor to be kept under control in these areas are man-induced forest fires which lead soil surface to a total exposure to erosive agents. Especially in open and closed maki and under the climatic conditions, fire can easily expand over large areas and completely destroy these natural formations.

In forested areas, the creation and maintenance of fire break lines can be a very effective measure for reducing damages caused by forest fires.

Furthermore, particular attention should be devoted to the following measures:

- Land use changes, such as forest cutting for agricultural purposes, must be totally prohibited.
- Establishing natural reserves should be encouraged in order to minimise the soil erosion rates and simultaneously protect the endangered plant species, as well as to keep the forestland productivity and biodiversity.
- In areas neighbouring forestlands, agriculture residues should be processed applying the principle of prescribed burning in order to minimise the risk of uncontrolled fires.

Map 3.5 shows the distribution of naturally vegetated areas on steep slopes, while Table 3.2 reports the distribution of such areas in erosion risk classes.

3.4.3 Agricultural areas on moderate slopes

A third critical area is highlighted in the coastal plain, where high slope length - even if with a moderate slope gradient – combined with agricultural activities (in particular, citrus and other fruit trees plantations and field crops) may induce erosion phenomena. Generally speaking, in these areas suitable procedures should be taken to distribute and direct the agricultural activities according to the characteristics of soil and land morphology.

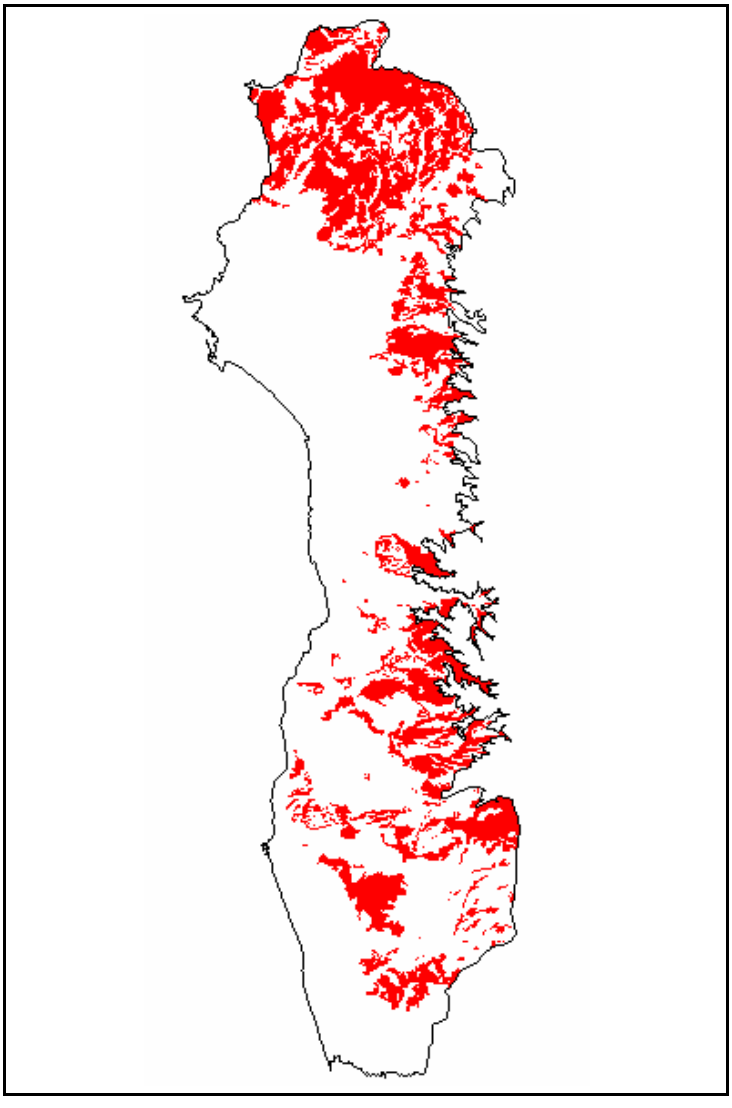
Furthermore, the already existing agricultural practices for water management should be integrated, where necessary, with actions aimed at catching up surface water and at reducing sheet and rill erosion.

Table 3.2: Distribution of naturally-vegetated areas on steep slopes in erosion risk classes

Erosion risk classes	Area (ha)
Not or insignificantly susceptible	8,814
Slightly susceptible	7,656
Moderately susceptible	39,081
Highly susceptible	32,414
Very highly susceptible	4,175
Extremely susceptible	2,391

In this connection, the importance should not be underestimated of preserving the traditional means of management of agricultural lands, both in terms of materials and techniques used. As a matter of fact, such techniques are very often the result of the adaptation of human activities to the environment over a very long time and are more likely able to ensure the stability of agricultural lands with respect to erosion processes.

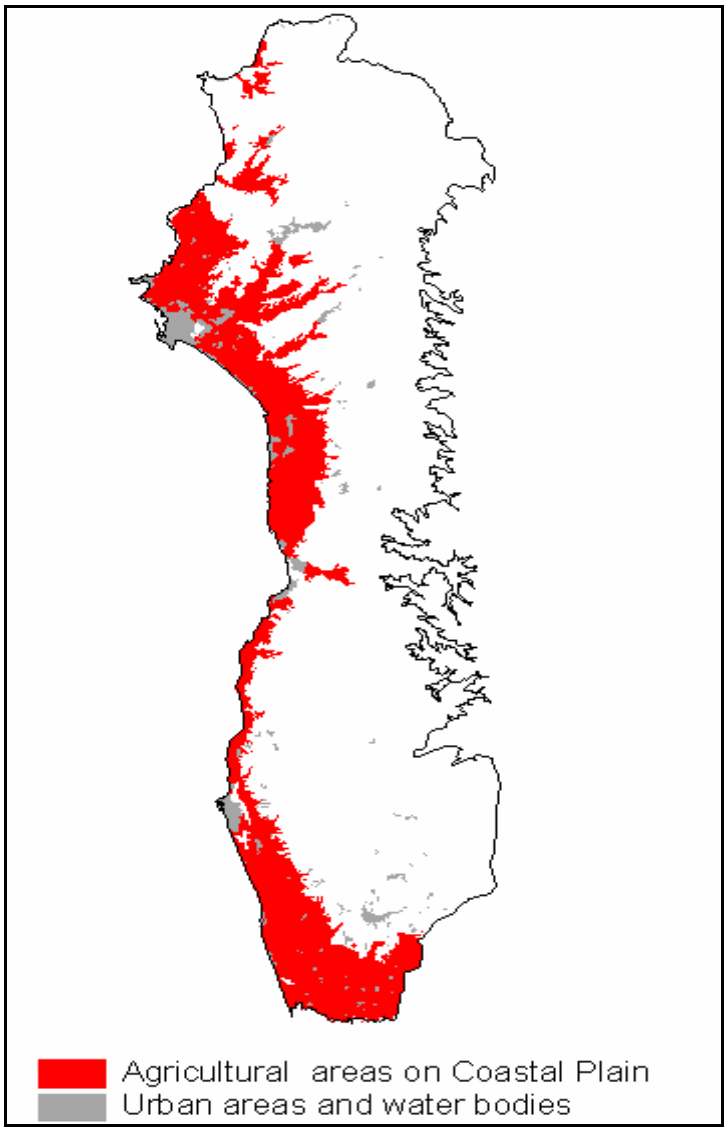
Table 3.3 shows the distribution of agricultural areas in the erosion risk class, while Map 3.6 shows their location.



Map 3.5: Naturally-vegetated areas on steep slopes

Table 3.3: Distribution of agricultural areas on Coastal plain in erosion risk classes

Erosion risk classes	Area (ha)
Not or insignificantly susceptible	50,604
Slightly susceptible	31,155
Moderately susceptible	2,196
Highly susceptible	1,802
Very highly susceptible	0
Extremely susceptible	0



Map 3.6: Agricultural areas on Coastal Plain

3.4.4 Urban areas

Apart from the three above-mentioned scenarios, the effects of urban areas have to be considered as well, where some areas seem to be affected by the problem of uncontrolled urban growth. As a general recommendation, restrictions should be imposed in order to avoid urban expansion at the expenses of areas with natural vegetation cover and of fertile agricultural lands.

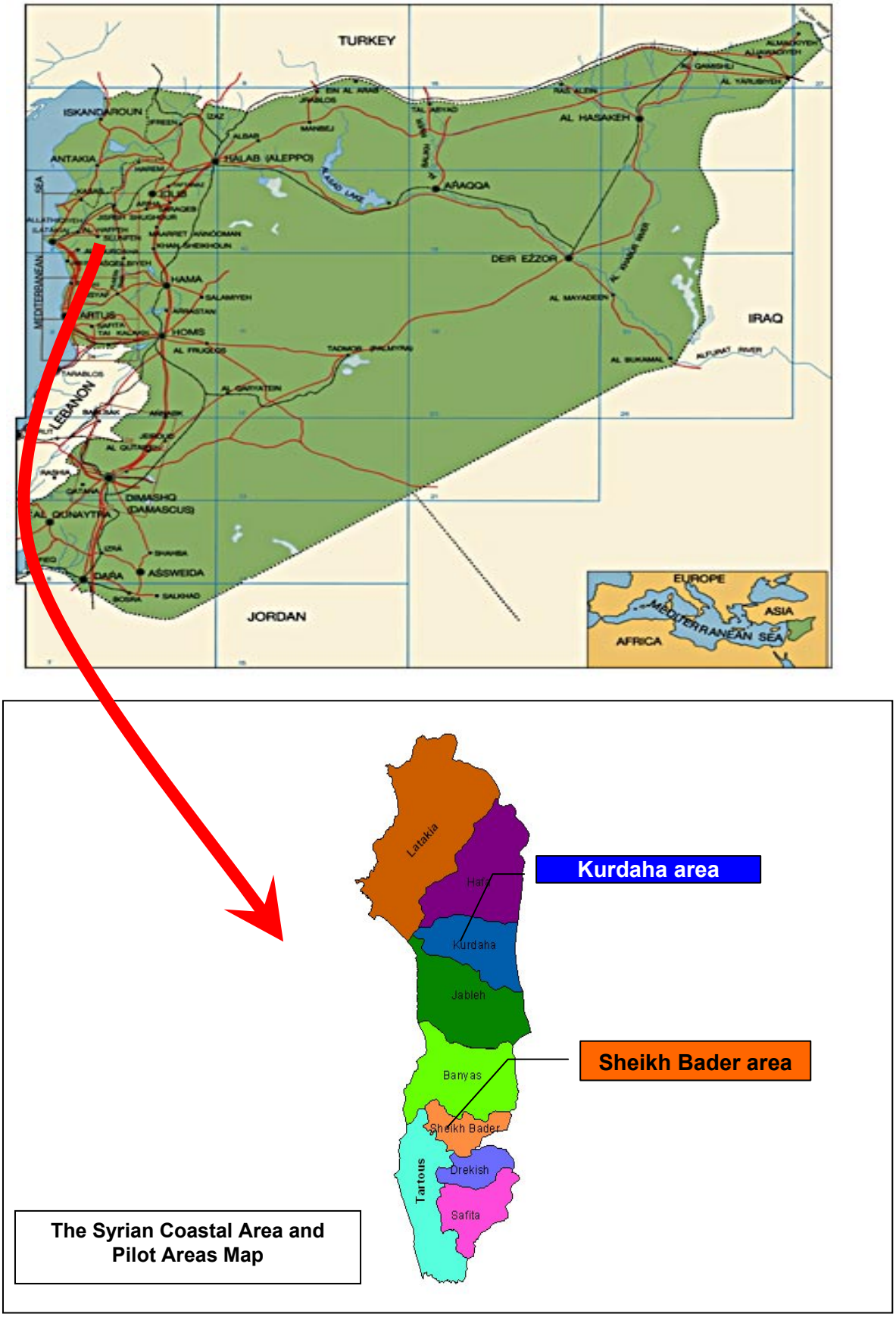
4. DESCRIPTION OF PILOT AREAS

4.1 LOCATION OF THE STUDY AREA

The coastal region is located in the north-western part of Syria bordered in the west by the Mediterranean Sea with the coastline of about 220 km. The region can be viewed as a major natural resource and “transitional” in character, linking the Mediterranean Sea with arid zones of the interior Syria and the Arab world.

The coastal region of Syria covers about 4,190 km^2 (2% of the national territory). The region is divided into two main districts; Latakia district in the north with 2,300 km^2 total area and Tartous district in the south with 1,900 km^2 area. Unfortunately, due to lack of time and fund, all the detailed analysis activities will be implemented up to 800 meters.

Two pilot areas were identified in the coastal region of Syria; the first pilot area is Kurdaha and the other is Sheikh Bader (Map 4.1). The Kurdaha area is located in the central to northern part of the coastal mountains, about 30 km south-east of Latakia with a total area of 40040 hectare. It is bordered by the Ghab-rift in the east and the Syrian coastal plain in the west, it lies between 35° 54′ 58″and 36° 14′ 35″ east, and between 35° 20′ 15″ and 35° 32′ 39″ north (Image 4.1). The second pilot area is Sheikh Bader with a total area of 20279 hectare. It lies in Tartous district between 35° 57′ 40″ and 36° 15′ 55″ east, and 34° 59′ 55″ and 35° 5′ 39″ north (Image 4.2). The detailed analysis activities will be executed in these two pilot areas up to 800 meters only due to the project limitations.



Map 4.1: Syria and the Study Area Map

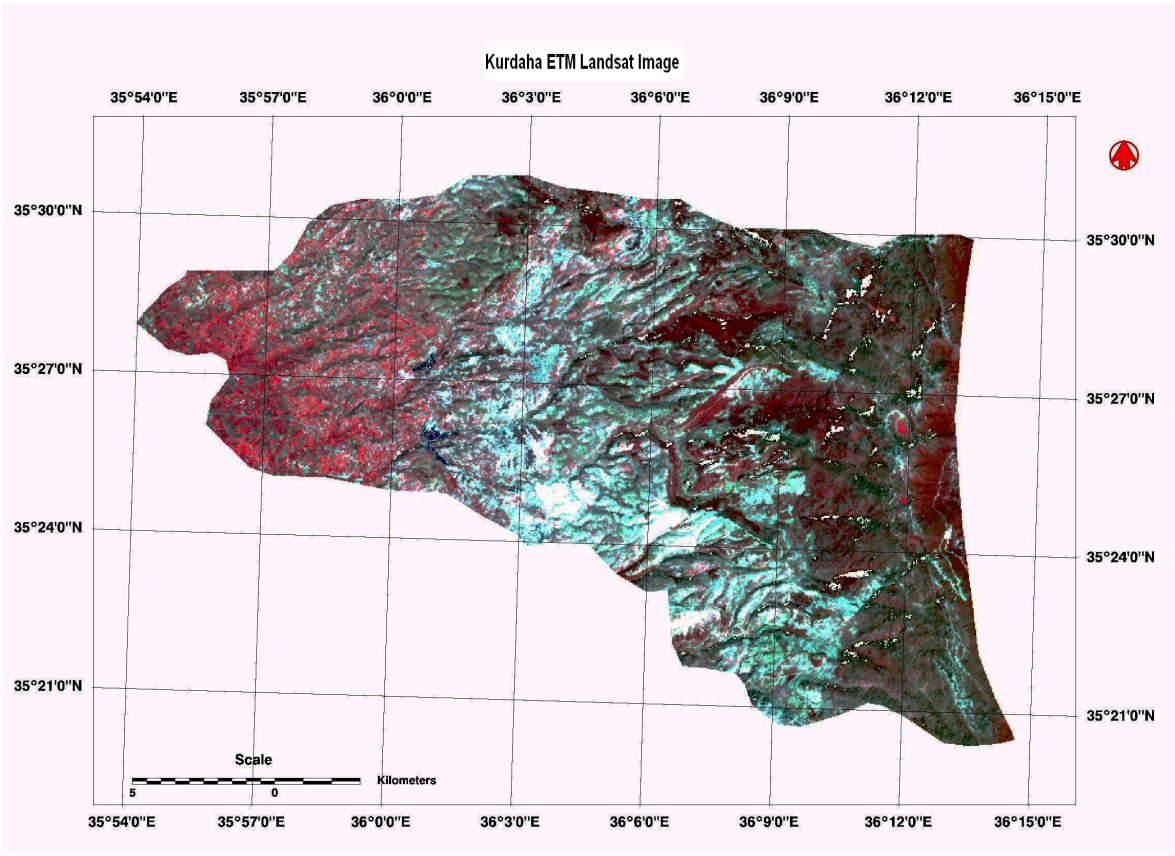


Image 4.1: Kurdaha ETM Landsat image, 2001

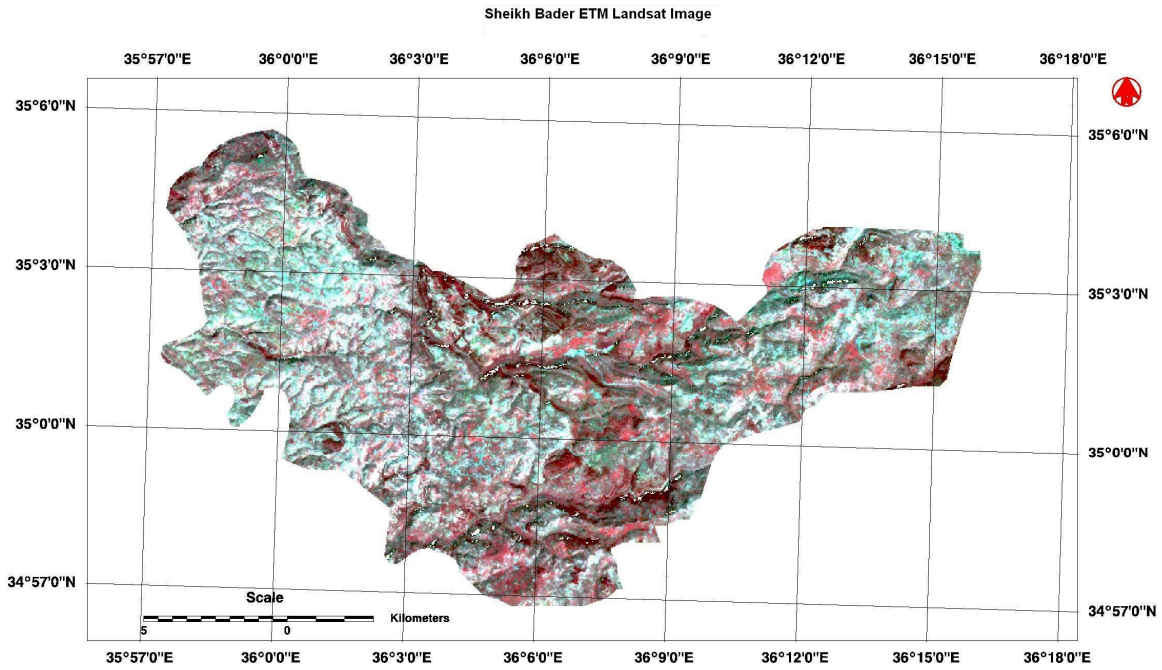


Image 4.2: Sheikh Bader ETM Landsat image, 2001

4.2 VERIFICATION OF SELECTION OF PILOT AREAS

The two pilot areas were selected based on a number of criteria chosen to allow the selection of the most representative areas for the whole Syrian coastal region. The criteria are listed and described in Table 4.1 which states the rating grade values rating from 1 (lowest possible rating) to 5 (highest possible rating). Through application of these criteria 4 possible pilot areas (Kassab, Kurdaha, Sheik Bader, Safeta), two pilot areas were identified as shown in Table 4.2.

Table 4.1: Rating grid showing the possible value for each criterion

Criterion	Rating				
	5	4	3	2	1
Intermediate zone	Fully in the intermediate zone				Only coastal strip or high mountain chain
Watershed	Complete coverage				Not fully situated in the study area (<50%)
Size & Form	8 to 12% of study area/ typical form				Considerably bigger or smaller/ non-typical form
Slope, relief, hydrology, fluvial dynamics	Slopes between 8 and 25%				Less representative for selected range
Vegetation cover, pedology, geology	Typical mixture				Non-typical representation
Erosion processes, erosion risk	High occurrence of sheet erosion associated with occasional occurrence of mass movements				Non-occurrence of erosion process
Landuse	Typical mixture				Only one Landuse type represented
Population	High population growth				No population dynamics
Practices	Typical representation of conservation practices				Non typical representation of conservation practices
Availability of data	All necessary data available				No data available
Logistics	Favourable logistical conditions				Non- favourable logistical conditions

Table 4.2: Rating grid applied to select the two pilot areas

Criterion	Kassab	Kurdaha	Sheikh Bader	Safeta
Intermediate zone	5	5	5	4
Watershed	5	5	5	4
Size & Form	3	3	3	3
Slope, relief, hydrology, fluvial dynamics	4	3	2	3
Vegetation cover, pedology, geology	5	4	4	2
Erosion processes	3	4	5	4
Landuse	3	2	3	3
Population	2	4	3	4
Practices	3	2	2	4
Availability of data	2	4	4	1
Logistics	4	4	3	3
Total	**39**	**40**	**39**	**35**
Strategic priority	-	+	+	-
Selected	No	Yes	Yes	No

Kassab area and Sheikh Bader area have the same total score. Kassab is located in the northern part of Latakia while the Sheikh Bader area is located in middle of Tartous district. However, for strategic reasons there was the need to select one pilot area from each district, so preference was given to the Sheikh Bader area because Kurdaha has already been chosen to be representative for Latakia district due to its higher rating score.

4.3 PHYSICAL AND MORPH-DYNAMIC CHARACTERISTICS

4.3.1 Geology

The entire coastal region of Syria represents the north-western edge of the Arabian platform, formed during the Mesozoic, over the secondary and tertiary periods, under influence of the formation of Tethys, the Arabian-African shield and the Mediterranean Sea (Geological map of Syria, 1978).

The area is a "coastal area mountains arch-block uplift bordered by the north-west Syrian block and the Lebanon-Syria fault in the east, the river of Kabir Alshamali basin in the north and the Mediterranean Sea in the west (geological map of Syria, 1978). Faulting follows the S-N direction characteristics of the entire rift system of the Middle East.

The mountains area is mostly composed of Jurassic and Cretaceous dolomite, limestone and marl, and the Bassit Block (north of Latakia) is of volcanic origin (ophiolitic rocks), the coastal zone itself is mostly covered by Quaternary sediments, appearing in the form of sands, gravels, sandstones, conglomerates, pebbles and clay. Exception to this is the area in the very north, from Ras –Al Fassouri to the state border, and the area in the middle-south, from Banias to Tartous. The area in the north is made of Paleogene-Neogene sediments, and serpentinites and gabroides (north of Wadi Qandeel), while the area in the south is composed of Neogene basalt and Cretaceous limestone.

However, virtually the entire coastal strip (coastal strip: 1 to 2 km inland from the sea) is covered by marine, fluvial and eolian sediments of recent origin.

4.3.1.1 Kurdaha Geology

The description of geology, geomorphology, and hydrology in Kurdaha area is based on the Geological Map of Syria, Qerdaha sheet, 1980.

Kurdaha area is located on the marginal part of the Arabic platform bordered by the Syrian- Lebanon rift in the east (Ghab-rift) and the Mediterranean Sea in the west. It may be divided into two blocks separated by an east-west running fault. The first one is the northern block which may be defined as a half-sited horst, dipping gentle to steep to west and south-west. While the second, the southern block determined as an oblique horst dipping to the west in general. Similarities in the tectonic pattern of both blocks conclude a common origin. They were uplifted during the origin of the Ghab- rift. In a later stage the northern block was turned, whereas the southern one remained in its position.

In the eastern parts of Kurdaha area, we find hard Jurassic limestone and dolomite, more than 1000 meters thick; the bedrocks are partly covered by large boulders and the rocks are predominately bare due to intensive karstification. Furthermore, there is a westward alternation of limestone, dolomite and marl of Cretaceous and Paleogene time, 600 to 800 meters thick also with Karstification of hard limestones. Ferruginous soils and terra fusca are present on flat areas and marls. Further to the west, we find chalky marl, chalk and limestone of upper Cretaceous time, up to 600 meters thick. Still going westward, soft marly siltstone, marl and medium-hard sandstone of Neogene time occur, up to 300 meters thick, followed by hard and soft fine grained marine sandstone of Pleistocene time, 1 to 4 meters thick, intercalated by gravels and covered by a well-developed soil. Further westward fluviatile sand, silt gravel, pebble, and boulder beds of Holocene time occur, deposited in wadis and alluvial fans, up to 10 meters thick.

4.3.1.2 Sheikh Bader Geology

The description of geology, geomorphology, and hydrology in Sheikh Bader area is based on the Geological Map of Syria, Qadmous and Banyas sheets, 1980.

The area is located on the marginal part of the Arabic platform. This area is a part of the coastal mountain ridge bordered by the Syrian-Lebanon-rift (Ghab-rift) in the east and the Mediterranean Sea in the west. The area may be determined as an oblique horst dipping to west and south-west. This area can be considered as the extension of the southern block that exists in the southern part of Kurdaha area.

Jurassic sediments occur as a narrow band in deep valleys in the north (wadi al Ouyoun and Mashta al Helou). They are composed of limestone, partly dolomitic and in some parts of marly or dolomitic layers. Cretaceous sediments are widespread in the area. They are limited by the crest of the mountains in the east and the Mediterranean Sea in the west. They are represented by limestone, dolomite, marl and chalky marl. The rocks overlay more or less conformably Jurassic beds. Due to similarities in the lithology and missing of an angular unconformity the contact to the underlying Upper Jurassic beds is not well distinguishable, The Paleogene does not occur in the area. Neogene sediments occur strip-like above lower to Upper Cenonian and are overlain by basalt. Also, they occur below a thin cover of Pleistocene deposits in the west, Pliocene rocks are composed of marl, limestone, conglomerate and basalt. In general, the basalt beds are either coarse-grained calcareous sandstone with pebbles of Cenomanian limestones and flint, or brown soft calcareous clay, or organogenous detrital limestone. The thickness of the basalt beds is 1-2m. Quaternary sediments form terraces along large rivers. Holocene terraces were noticed in recent river beds, westward they are exposed along the shore-line, and the width of them reaches 6 km. The Quaternary sediments are represented by marine and fluviatile terraces and dunes.

4.3.2 Geomorphology

Geo-morphologically, the coastal zone is a flat area, compared to the rest of the region. Generally speaking, the coastal region can be divided into 6 main geomorphologic areas: shoreline, coastal plain, hilly country, river valleys, foothills, coastal range (PAP/RAC, 1990). The second and the third category cover most of the coastal zone in Syria. More precisely, about 60% of the total coastal zone areas belong to the category “coastal plain” and about 30% to the category “hilly country”, and the remaining less than 10% is covered by the other 4 geomorphologic units, respectively the shoreline (beaches, dunes), the river valleys and wadis, the foothills, and the coastal range."

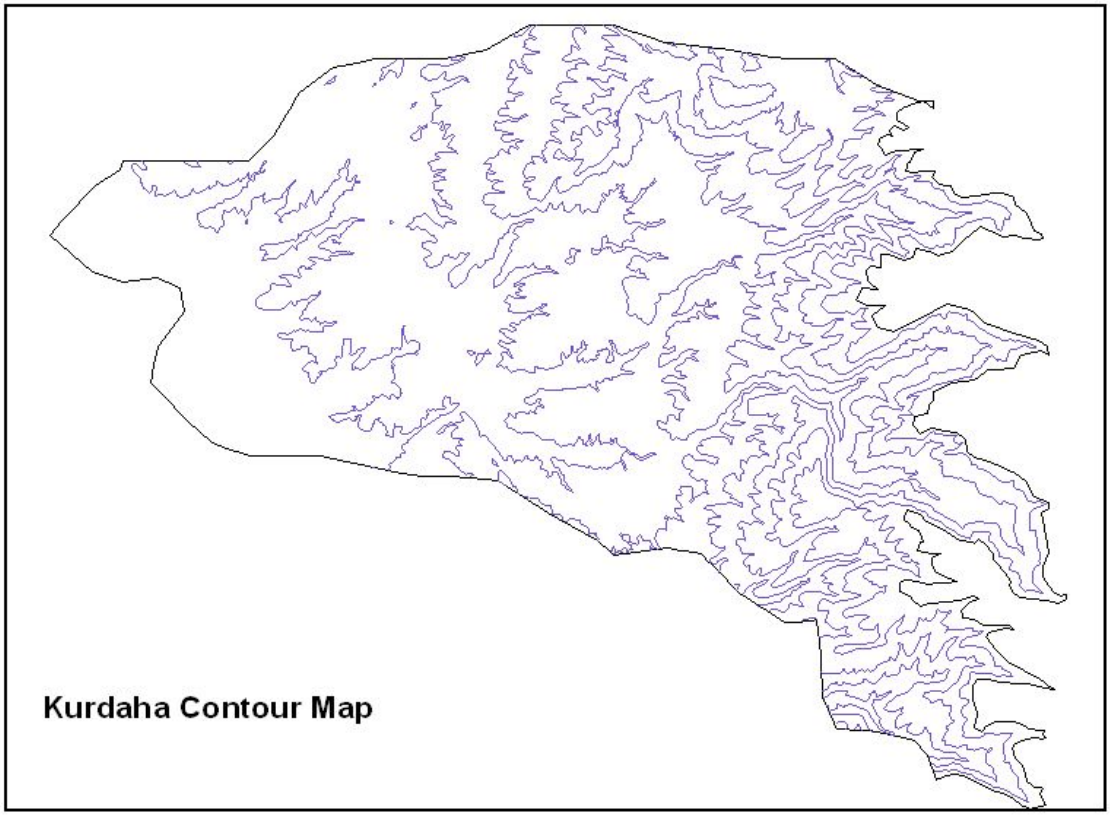
There are 2 major plains in the zone, Jableh-Latakia plain in the north (approximately 50 x 10 km) and Akkari plain in the south (very narrow near Tartous, more than 10 km wide toward the border with Lebanon). Both plains gently slope toward the sea. Thus, most rivers and wadis run towards the west or south-west carrying fluviatile deposits. Millennia of combined effort of the forces of sea and wind have produced very long and broad beaches along the coastline. They run all the way from Latakia to the Lebanese border, with relatively short interruptions south of Jableh and south of Banias. The longest beaches, the one south of Latakia and the other one south of Tartous, are almost 1 km deep (wide), more than 15 km long, and combined with impressive belts of sand-dunes in the background.

4.3.2.1 Kurdaha Geomorphology

The mountain ridge of the coastal mountains, located east of Kurdaha and rising up to 1435 meters above sea level, slopes, in general, gently westwards to the Mediterranean Sea but steeply to the Ghab-rift in the east (see Map 4.2). Many perennial streams cut farther and farther eastwards into the ridge of the mountains.
Kurdaha district is separated into four geomorphologic areas:

- The coastal mountain in the east;
- The foothills of the mountains in the middle (300-500m);

- The hill country in the west sloping gently to the coastal plain; and
- The Ghab-plain, located east of the mountains.



Map 4.2: Kurdaha Contour Map

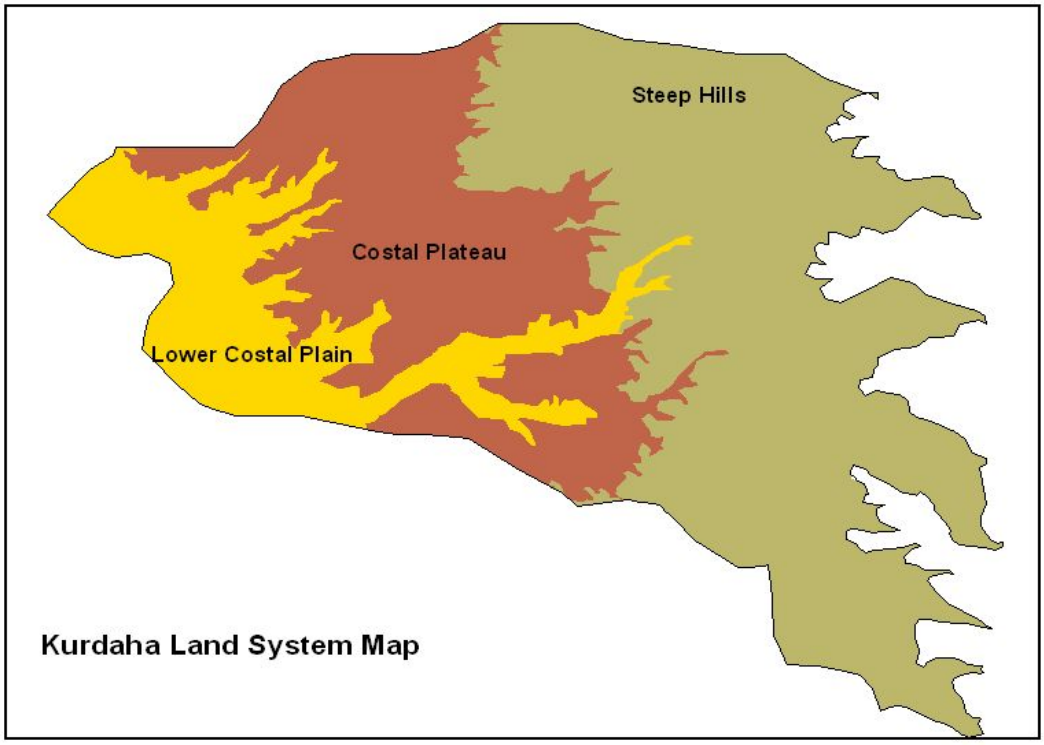
The coastal mountains consist of two geomorphologic units. The middle and northern part belong to a *deeply dissected carbonate terrain*. It includes mostly limestone and dolomite in high relief areas and sometimes interbedded marly limestones along with dolomite and limestone on lower valley slopes.

Maximum relief is as much as 450 m. Most slopes are convex and represent high run-off areas. Due to steep slopes bare rock ledges are common. On the crest of the Coastal Mountains large circle-like deep funnels of volcanoes occur, exceeding partly 300 meters in the depth and 1 km in diameter. Most of them are not touched by valleys.

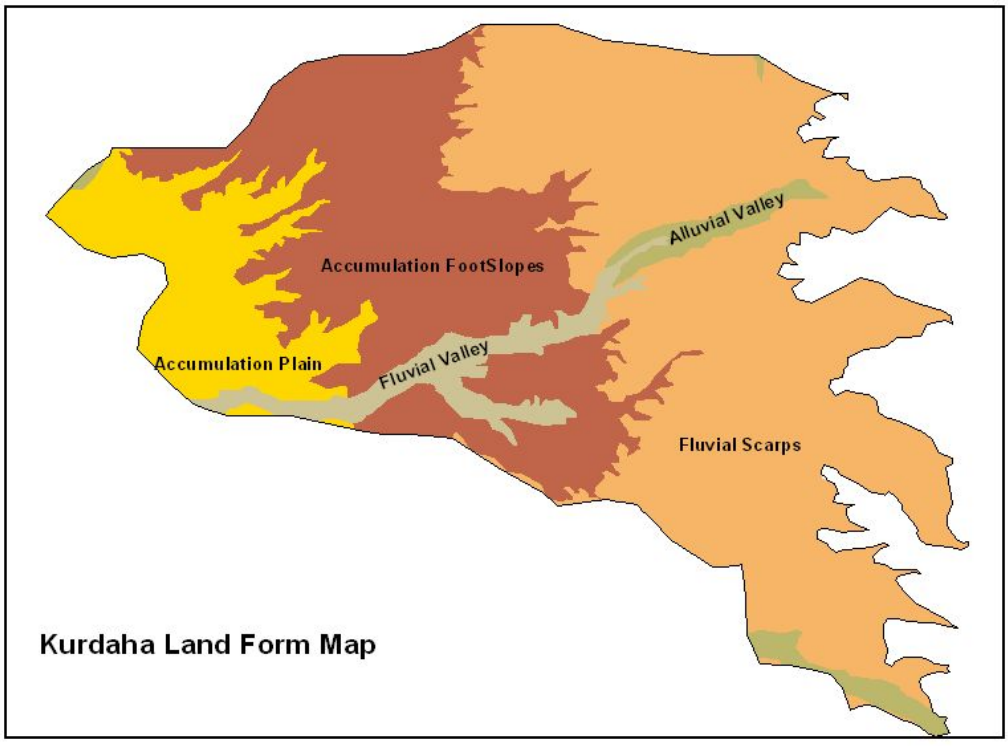
The southern part of the coastal mountains belongs to a *moderate dissected karstic Tableland* surrounded by deeply dissected terrain. The karstic Tableland includes thick fractured, karstified carbonate rocks consisting of limestone and dolomite. Maximum relief is as much as 80 m. The surface slopes gently to the west. Sinkholes, collapse sinks, karst fissures and joints are common. The drainage is predominantly subterranean. At the contact to deeply terrain the morphological features change suddenly.

The *foothills* are located on the western slope of the coastal mountains. They consist mainly of moderate inclining slopes built up of marls, dolomites, marl-limestones and limestones, cut by many latitudinal valleys or canyons. Large-scale karstification is missing; many slopes are covered by talus. The *hill country* rises gently from 100-250 m above sea level. The hill country is modified by valleys, partly flat terraces occur.

The *Ghab-Plain* is a terrace-like area surrounded by steep mountainous slopes. The land system map (Map 4.3) and land form map (Map 4.4) provide better understanding of Kurdaha geomorphology.



Map 4.3: Kurdaha Land system map



Map 4.4: Kurdaha Land form map

4.3.2.2 Sheikh Bader Geomorphology

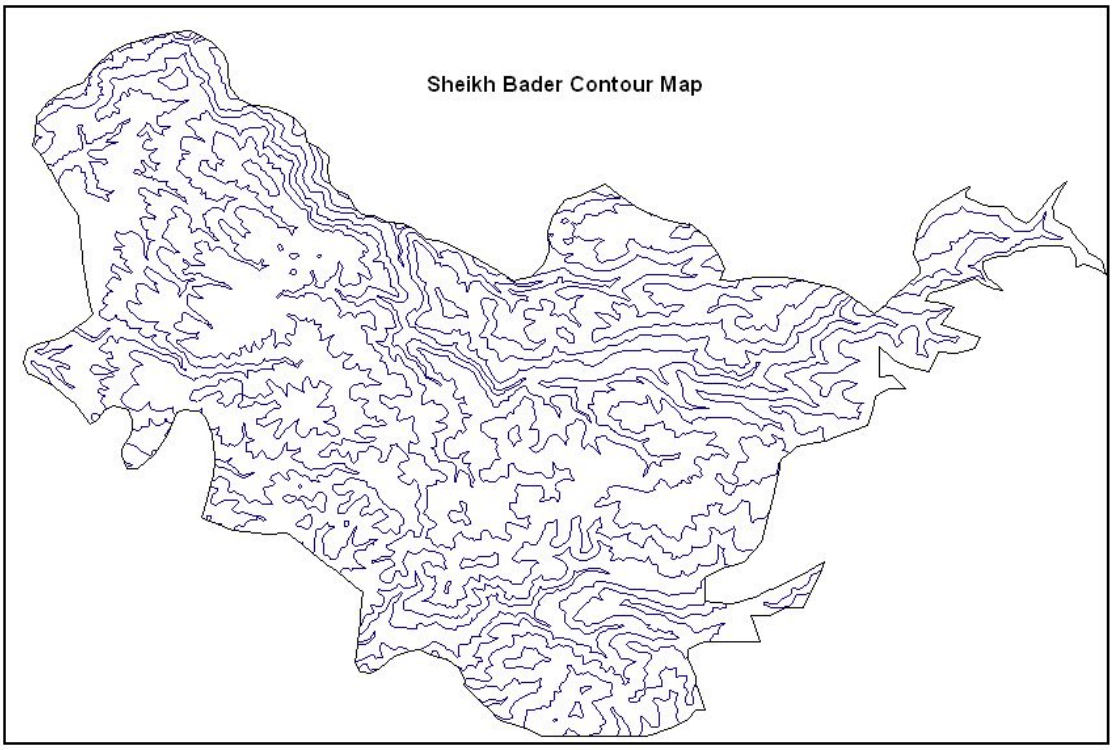
The coastal mountains ridge forms the eastern part of the area. It dips gently toward the Mediterranean Sea (see Map 4.5). Many perennial streams cut farther the ridge toward the east. In the east-northern parts of the area, it belongs to moderate dissected karstic Tableland. It is composed of karstic carbonate rocks surrounded by deeply dissected terrain formed of limestone and dolomite. Sinkholes, collapse sinks, karst fissures and joints are common. The drainage is predominantly subterranean. The morphological features change suddenly at the contact to deeply dissected terrain.

The deeply dissected terrain is located west of the karstic terrain and surrounds it. It is formed mostly of limestone and dolomite in high relief areas, sometimes interbeded with marly limestone on the lower slopes. Most slopes are convex and represent high run off areas. Due to steep slopes bare rock ledges are common. On the contrary to the deeply dissected terrain the moderate dissected terrains reach high relief difference and the top of the hills is flat. The land system map (Map 4.6) and land form map (Map 4.7) provide better understanding of Sheikh Bader geomorphology.

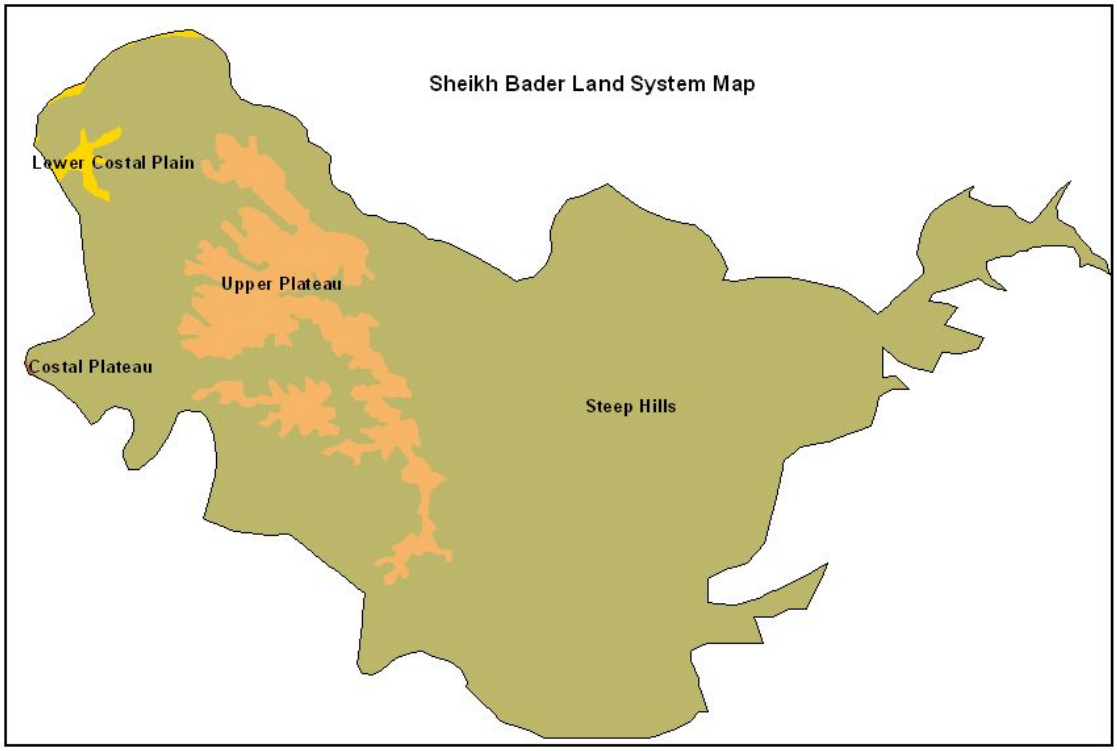
4.3.3 Hydrology

The climatic, geological, and geomorphologic conditions of the coastal region provide unusually fortunate combinations of forces which make the coastal zone the richest corner of Syria with regard to the availability of fresh water. The network of surface and underground water courses is well developed and the abundance of limestone helps in terms of retention, storage and annual distribution of water. The favourable rainfall regime and the abundance of limestone resulted in a well developed network of underground as well as surface water courses. The large groundwater table is comparatively shallow, so that there is plenty of wells, springs and other water resources in the coastal region.

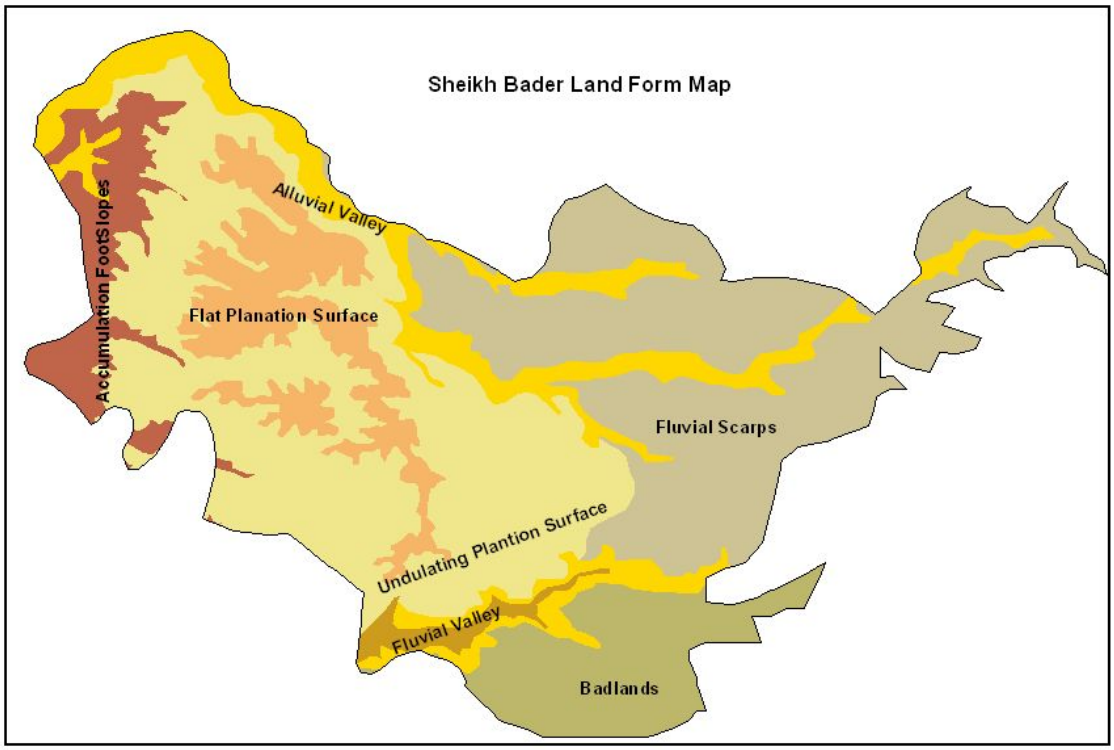
Clearly, fresh water, together with the fertile soil, is the most vital resources of the coastal zone. However, it also to be the most endangered one.



Map 4.5: Sheikh Bader Contour map



Map 4.6: Sheikh Bader Land system map



Map 4.7: Sheikh Bader Land form map

4.3.3.1 Kurdaha Hydrogeology

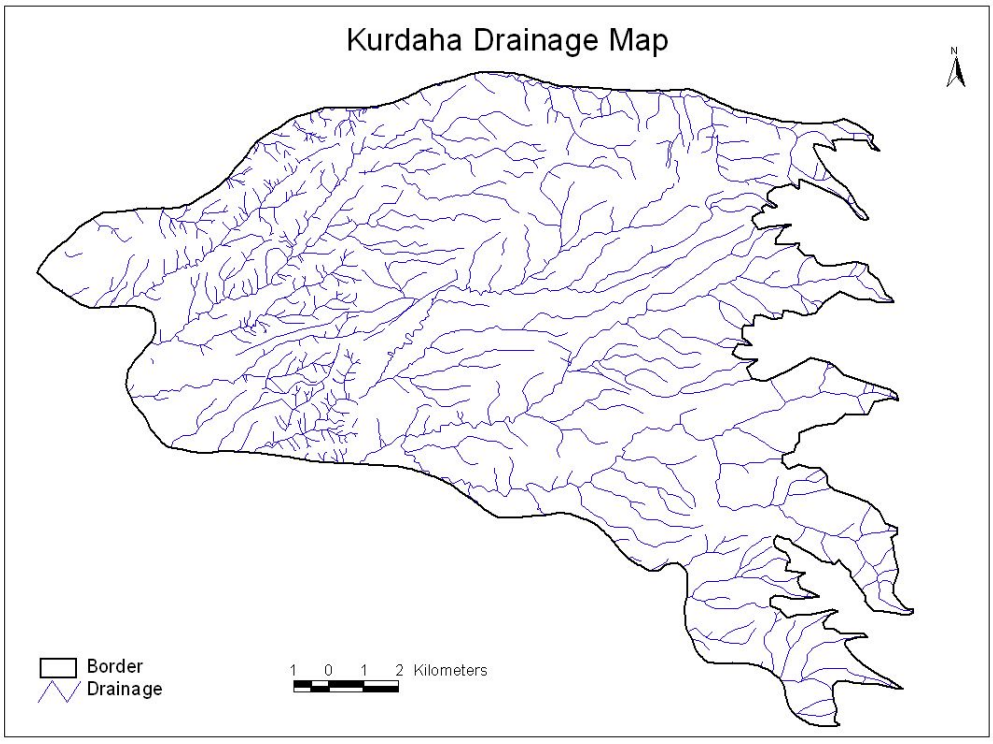
Surface run-off is limited in Kurdaha area. Due to the karstification of carbonate rocks the water disappears in joints, fissures, and sinkholes. Important sources of ground water are located in the areas of Jiboul, Jdaedh and the foot of the slope to the Ghab. Generally, the Jurassic limestones and dolomites form an important karst aquifer. Minor aquifers of the same type occur in Cretaceous and Paleogene beds. Jurassic rocks are considered as recharge areas of the karst aquifer. Springs are related to impermeable marl layers (Jiboul and Jdaedeh). Westwards partly an aquifer is developed, but discharge of springs is low. At the coastal strip the aquifer becomes contaminated and not potable. The drainage network of Kurdaha area was derived from topographic maps of scale 1:50,000, (Map 4.8).

4.3.3.2 Sheikh Bader Hydrogeology

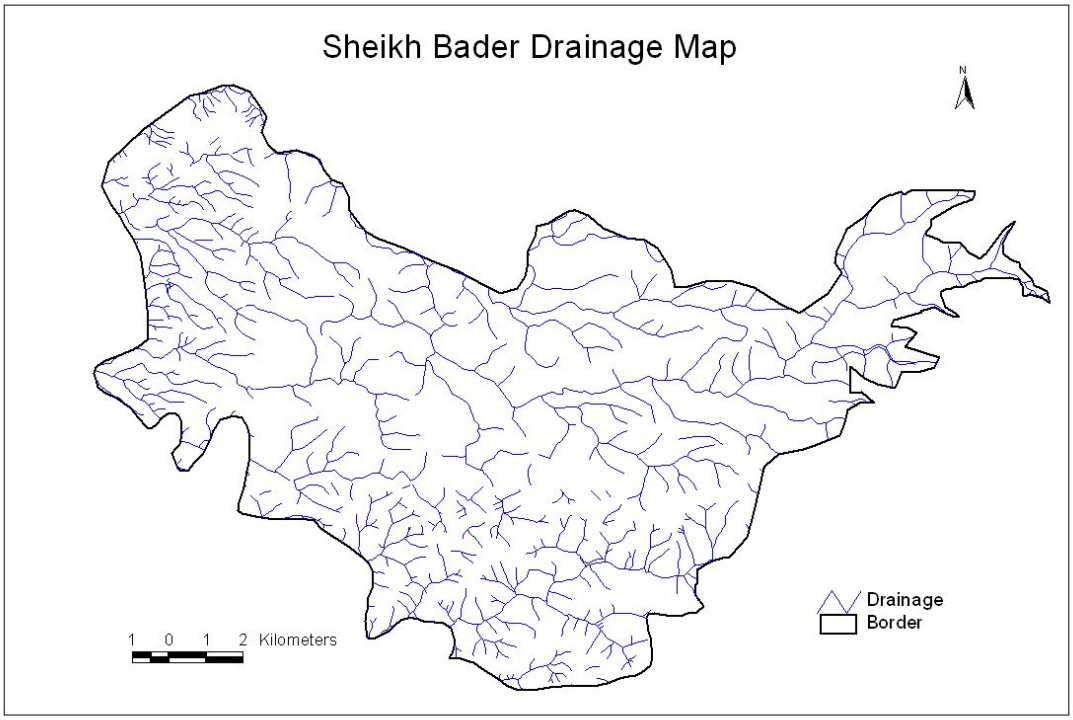
Run-off of water is limited in the northern part of the area. Due to the karstification of carbonate rocks the water disappears in the joints, sinkholes and fissures. Small rivers exist flowing toward the Mediterranean Sea. Generally, the Jurassic limestones and dolomites form an important karst aquifer. Minor aquifers of the same type occur in cretaceous and Paleogene sediments. The Ain al Beida (Blaatah) formation is considered as a low discharge aquifer. Basalt lava is an aquifer but storage capacity and discharge are low. The drainage network of Sheikh Bader area was derived from topographic maps of scale 1:50000, (Map 4.9).

4.3.4 Pedology

The red Mediterranean soils prevail in the coastal region with an addition of vertisol and alluvial soils patches (PAP/RAC, 1990). Predominance of the red soils is overwhelming in both coastal plains (Jableh and Akkari). These soils contain clay and loam, and vary in depth. However, the coastal zone, i.e. in the two plains, their depth usually goes to 1 m or more. The soils of highest quality can be found in the western parts of the Jableh and Akkari agricultural plains which have largely benefited from the combinations of factors such as favourable climate, abundance of groundwater, easy access to agricultural mechanisation, easy transport and the existing infrastructure network.



Map 4.8: Kurdaha Drainage map



Map 4.9: Sheikh Bader Drainage map

Table 4.3: Major soil types for Latakia district (*Source: GORS, 1991*).

Unit name	Sub-Unit name	Dominant soils			Main associated soils
		U.S.A taxonomy	FAO	French Classification	
Coastal plain soils		Typical Calcixerolls	Chernozems	Chernozems	Calcixerollic Xerochrepts Lithic Xerochrepts
Piedmont soils	Gently sloping soils	Calcixerollic Xerochrepts	Cambisols	Sols bruns calcairs	Typic Xerorthents Typic Xerochrepts Typic Cacixerolls
	Moderately sloping soils	Lithic Xerochrepts Lithic Xerothents	Lithosols	Lithosols (Xero Rankers)	Typic Xerochrepts Typic Xerorthents Rock out crops
	Steeply sloping soils	Lithic Xerothents Lithic Xerochrepts	Lithosols	Lithosols (Xero Rankers)	Lithic Haploxerolls Typic Calcixerolls Rock out crops
Summit soils	--	Lithic Xerochrepts	Lithosols	Lithosols (Xero Rankers)	Rock out crops
River bed soils	--	Mollic Xerofluvents	Fluvisols	Sols d'apport alluvial	Typic Xerothents
Barren lands	Sandy land	--	--	--	--
	Rock out crops	--	--	--	--
Forest soils	--	Ultic Haploxerolls	Chernozems	Sols marrons	Calcixerollic Xerochrepts Typic Haploxerolls Entic

In general, Latakia soils can be divided into main five groups (GORS, 1991) coastal plain soils, piedmont soils, summit soils, river bed soils, and forest soils (see Table 4.3). Furthermore, the following soil types can be found in Kurdaha: mountainous soils, alluvial soils, colluvial soils, and coastal plain soils.

For soils in Sheikh Bader, there are seven soil types according to the land directorate in Tartous. These soil types are listed in Table 4.4 (Darwish *et al*., 1986).

Table 4.4: Soil types in Sheikh Bader (source: Land directorate in Tartous)

Soil type	Depth (cm)	Physical characteristics	Chemical Characteristics	Occurrence
Alluvial soils	50-100	Texture: clay Structure: blocky Infiltration: moderate Colour: brown	pH: weak alkali organic matter: poor content	occupy the foot of hills, found on calcareous rocks with gravel in their profile and on the surface
Hill soils	25-50	Texture: clay loam Structure: blocky Infiltration: good Colour: brown	pH: 7.3 organic matter: mild content	found on hills with gravels in their profile and exposed stones on the surface
Valley and Drainage Soils	> 100	texture: clay loam sandy to loamy Structure: granular Infiltration: good	pH: moderate organic matter: mild content	Found mixed with gravels, and coarse sand layers with certain thickness may found within the soil
Low Mountain Soils	50 – 100	texture: loam Structure: granular on surface and blocky with depth Infiltration: moderate	pH: moderate organic matter: poor content	Depth may decrease in some spots (25-50 cm), found mixed with gravels and stones, used mainly as olive terraces
High Mountain Soils	25-50	texture: clay loam colour: dark brown Infiltration: good	pH: moderate organic matter: poor content	Depth may found less than 25 cm where the basalt rocks with stones and gravels in different sizes ,used mainly as olive terraces
Steep Slope soils	20-40	texture: clay loam colour: brown to dark brown Infiltration: good	pH: moderate organic matter: poor content	Steepness 50-75%, found on calcareous rocks, erosion is very high
Summit Soils	< 20	texture: clay, clay loam Structure: granular colour: red brown Infiltration: good	pH: moderate organic matter: poor content	Very shallow soils with gravels on calcareous rocks

4.3.5 Land Use and Land Cover

Firstly, for the area of Kurdaha according to *Directorate of Agriculture in Kurdaha*, the total area covers about 40,040 hectare (400.4 km^2). The cultivable area is about 12794 ha, while the uncultivable about 3441 ha. See Table 4.5 and Table 4.6 and Figure 4.1 and Figure 4.2. The main crops are olive, citrus, grapes, greenhousing, apple, wheat, tobacco, wheat, and mixed crops. For the natural land cover types, one may find: Quercus L., Pinus L., Pistacia L., Abiesl, Cedrus L., Myrtus, Laurus nobilis L. For the shrubs, the dominant species are: Spartium junceum L., Poterium Spinosum L., Inula Viscosa, Calycotome Link, Thymus capitatus, Micromeria rupestris L., Sorghum halepense.

Principally the main landuse systems contain five basic classes which are natural vegetation cover, agricultural lands, bare land, water bodies and urban areas.

Table 4.5: **Landuse in Kurdaha for the year 2002 (area/hectare)**

Total area	Cultivable lands			Uncultivable lands				Steppe	Forest
	Total	Cultivated	Uncultivated	Total	Buildings & public roads	Marsh & Rivers	Rocky lands		
40,040	16,235	12,794	3,441	6,552	3,250	552	2,750	1,500	15,753

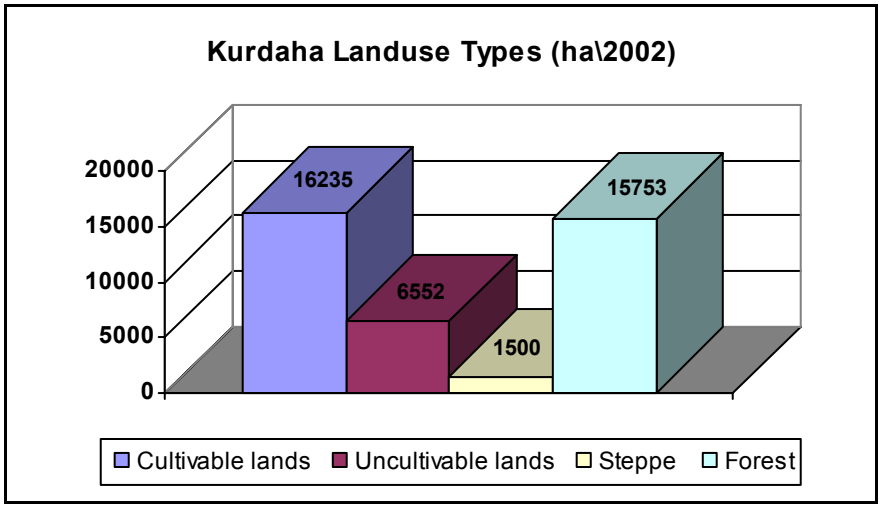


Figure 4.1: Major Landuse types in Kurdaha district
(***Source: Directorate of Agriculture in Kurdaha)***

Table 4.6: Cultivated lands in Kurdaha for the year 2002 (area/hectare)

Total cultivated lands	Fallow lands	Under crops lands							
		Total		Irrigated				Non-irrigated	
		Non irrigated	Irrigated	Crops	Planted with trees	Breeding	Green housing	Crops	Planted with trees
12,794	389	9,581	2,824	499	2,288	7	30	2,755	6,826

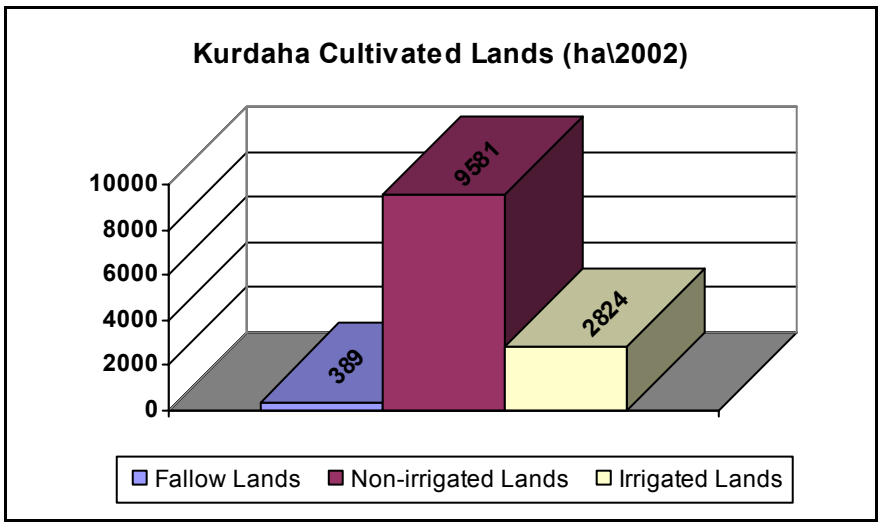


Figure 4.2: Cultivated lands in Kurdaha district
(Source: Directorate of Agriculture in Kurdaha)

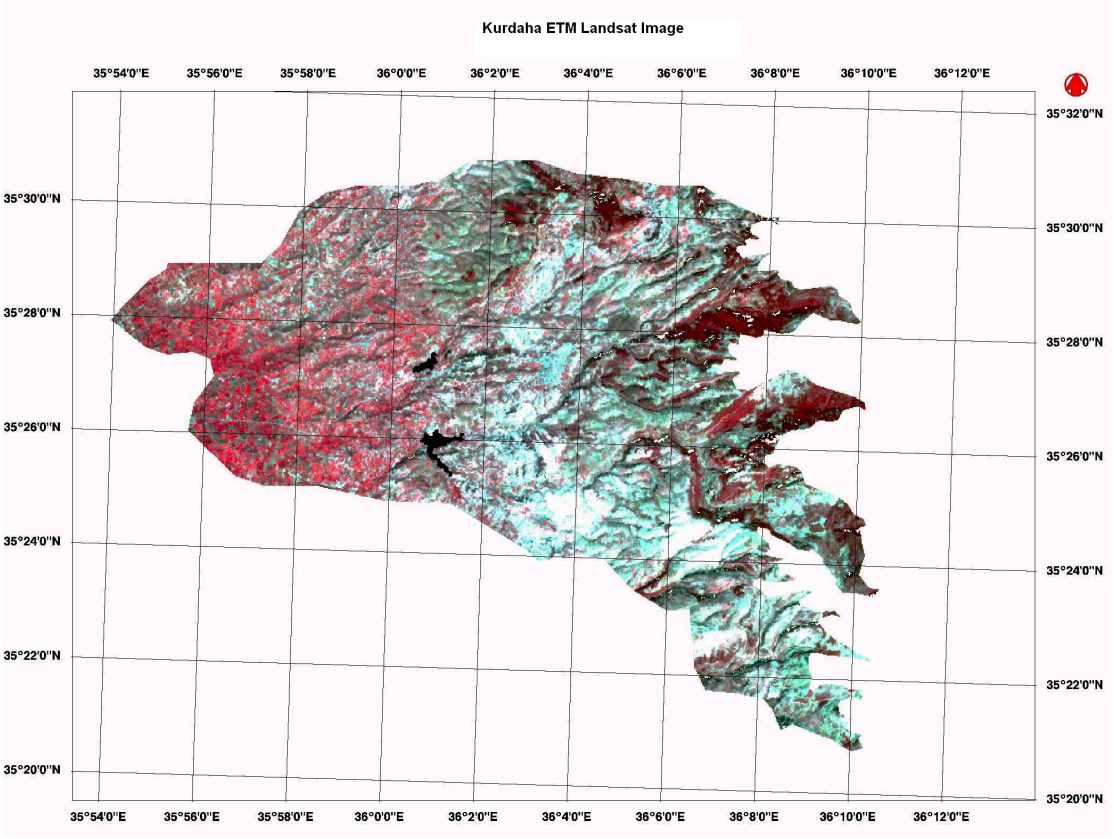


Image 4.3: Kurdaha ETM Landsat image, 2001, *(*up to 800 meters*)*

The landuse and land cover map of Kurdaha areas (Map 4.10) was extracted from Landsant7 ETM, 2001 (Image 4.3).

Secondly for the area of Sheikh Bader according to *Directorate of Agriculture in Sheikh Bader*, the total area of Sheikh Bader is about 20279 hectare (202.79 km^2). The cultivable area is about 13,250 ha, (Table 4.7 and Table 4.8). In this area, the main agricultural landuse include olive, grapes, greenhousing, apple, wheat, tobacco. The natural land cover consist mainly of different species such as Quercus L., Arbutus L., Pinus L., Pistacia L., Rhus cariaria, Prunus L., Ceratonia Siliqua L., Laurus Nobilis., Platanus L. Meanwhile, the main types of shrubs are Spartium junceum L., Micromeria rupestris, Thymus capitatus, Artemisia herba Alba, Myrtus Communis L., Poterium Spinosum L., Inula Viscosa, Calycotome Link, Sorghum halepense, Horolum vulgare, Cynodon dactylon, Juniperus oxycedrus. The main landuse types and cultivated lands in Sheikh Bader can be presented graphically in Figure 4.3 and Figure 4.4.

Landuse systems are similar to the ones in Kurdaha with the following 5 classes natural vegetation cover, agricultural lands, bare land, water bodies and urban areas.

Table 4.7: Landuse in Sheikh Bader for the year 2002 (area/hectare)

Total area (ha)	Cultivable lands	Uncultivable lands				Steppe	Forest
		Total	Buildings & public roads	Marsh & Rivers	Rocky lands		
20,279	13,250	1,961	1,300	229	432	50	5,018

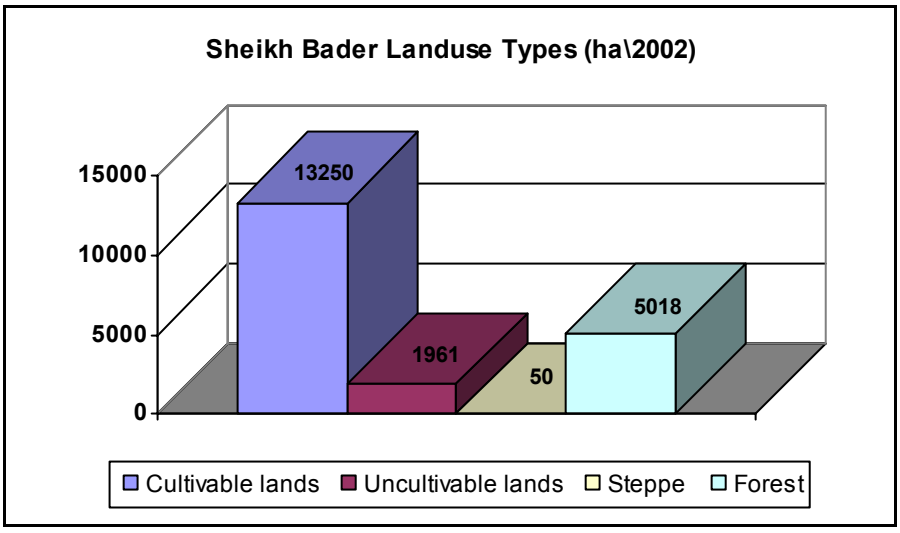


Figure 4.3: Major landuse types in Sheikh Bader district
(Source: Directorate of Agriculture in Sheikh Bader)

Table 4.8: Cultivated lands in Sheikh Bader for the year 2002 (area/hectare)

Total cultivated lands (ha)	Under crops lands							
	Total		Irrigated				Non-irrigated	
	Non irrigated	Irrigated	Crops	Planted with trees	Breeding	Green housing	Crops	Planted with trees
13,250	12,912	338	36	264	27	11	4,377	8,535

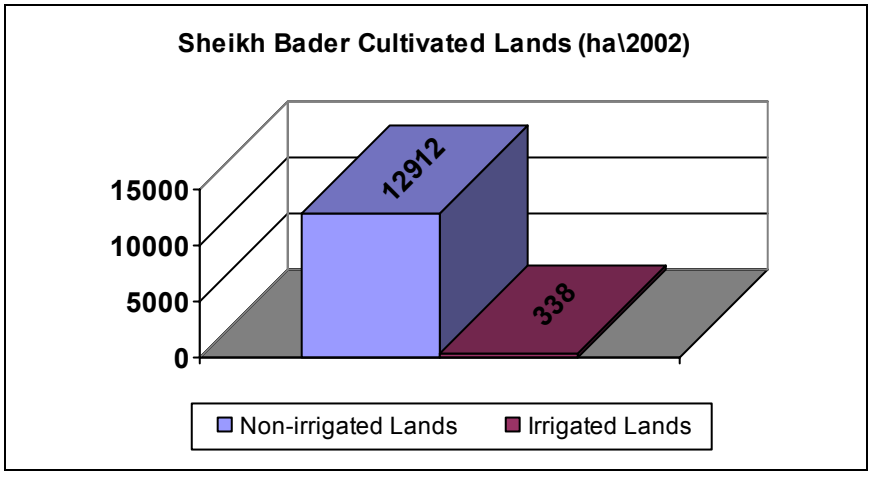
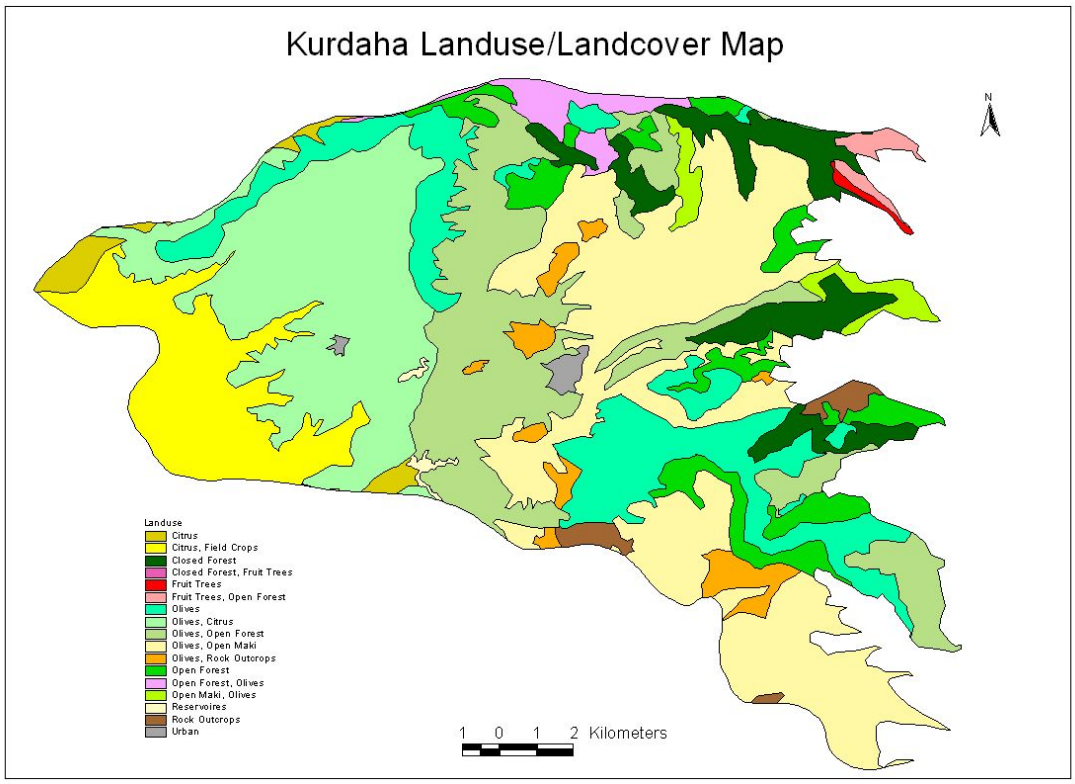
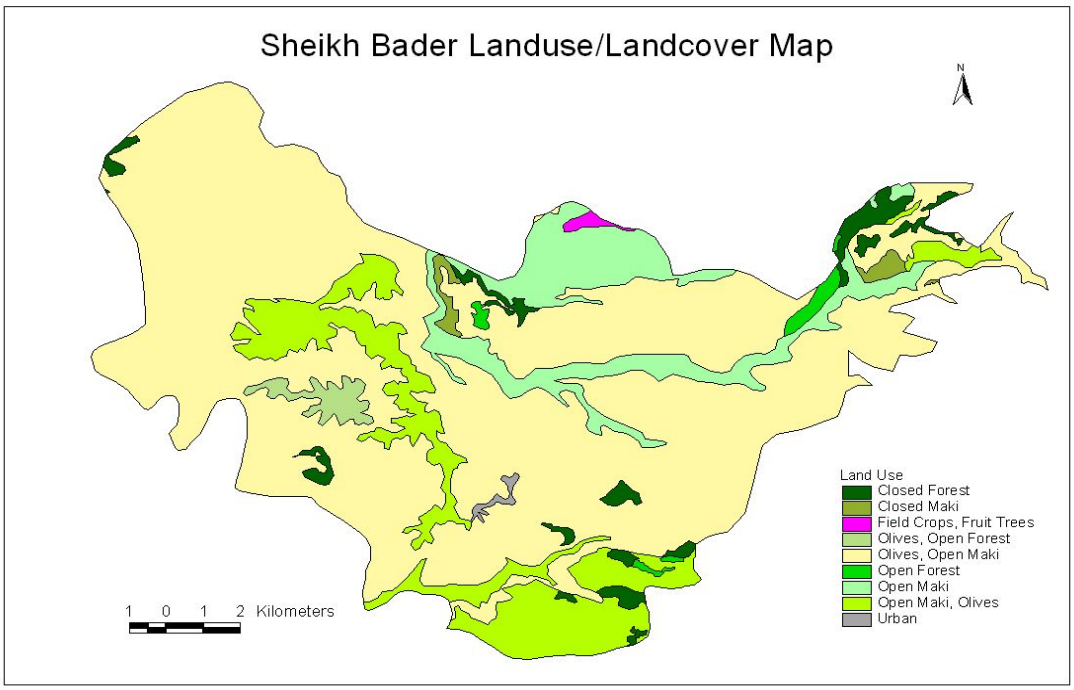


Figure 4.4: Cultivated lands in Sheikh Bader district
(Source: Directorate of Agriculture in Sheikh Bader)

The landuse and land cover map of Sheikh Bader area (Map 4.11) was extracted from Landsant7 ETM, 2001(Image 4.4).



Map 4.10: Kurdaha Landuse/Landcover map



Map 4.11: Sheikh Bader Landuse/Landcover map

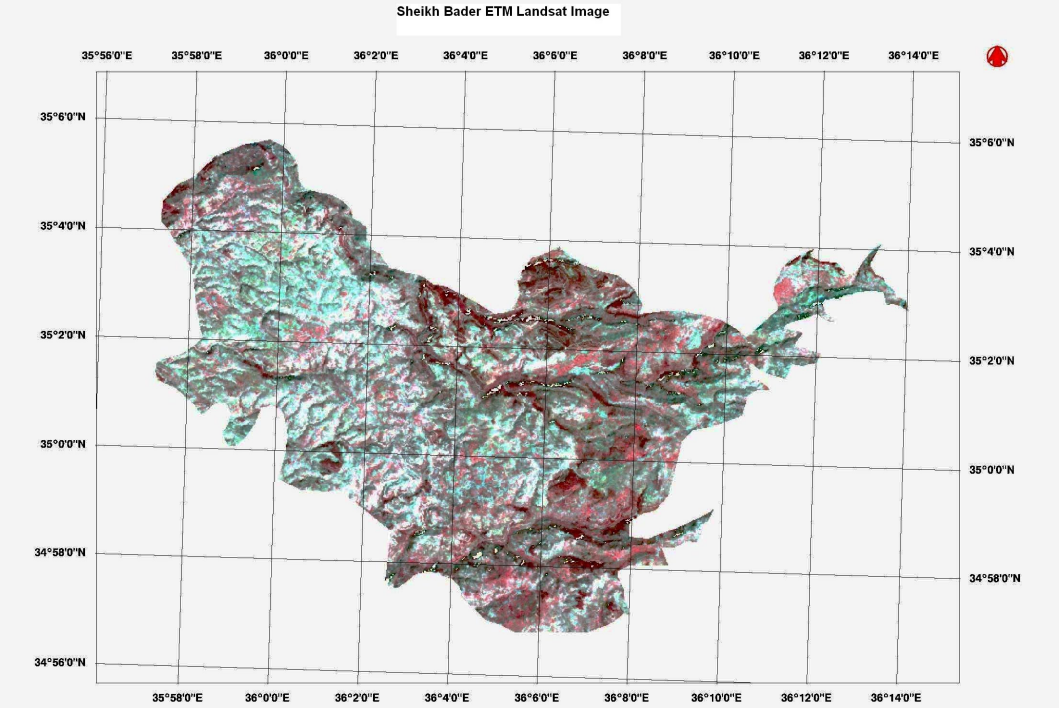


Image 4.4: Sheikh Bader ETM Landsat image, 2001, (up to 800 meters)

4.3.6 Climate

The entire coastal region belongs to the Mediterranean humid or subtropical types of climate, with the amount of rainfall and temperature gradually increasing from the west to the east and decreasing from the higher to the lower slopes of the coastal mountains and from north to south down the Bassit block (PAP/RAC, 1990). Thus, a general characteristic of the coastal zone is a combination of high temperature and medium amount of rainfall. The average annual temperature for Latakia and Tartous is almost 20º C, as compared to 12.5º C for Slenfeh, in the mountainous hinterland. The climatological data included in this report are obtained from the Climatic Atlas of Syria, 1977, and Eid 2004.

The climate of Syria is generally considered as modified Mediterranean. According to the agro-climatological reference book (1973), Syria can be roughly divided into three climatic regions:

- The coastal area with best humidity conditions, mild winter, and warm rainless summer.
- The desert area covering about 2/3 of the country with poorest humidity conditions, cool winter and very hot summer.
- The intermediate area with moderate humidity conditions. This area is found between the previously mentioned zones, as well as a strip of about 40-50 Km along the northern boundary.

4.3.6.1 Temperature

The coldest month in Syria is January, while the hottest month is August in the coastal area. The mean monthly temperature values increase continuously after January to reach their maximum during July. In the coastal area, the mean monthly temperatures range from 10 to 12º C in January and up to 26º C in July. In the mountainous regions these values drop to 4 to 6º C in January and to 20 to 22º C in July. The average maximum

temperature in the coastal area ranges from 15 to 17º C in January to 28 to 29º C in July. In the mountainous regions they vary from 6 to 8º C in January to 24 to 26º C during summer. The highest minimum temperatures are found in the coastal plain with 6 to 8º C in January, in the coastal mountains these values are 2 to 4º C.

Unfortunately, the available climate data are not sufficient for the two pilot areas. For the area of Kurdaha, the annual average maximum and minimum temperature during 1989 - 1998 are given in Table 4.9 (Eid 2004).

Table 4.9: Kurdaha annual average maximum and minimum temperature

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Maximum	22.6	22.3	21.6	19.8	23.1	22.8	22.8	23.4	23.8	24.8
Minimum	14.7	13.9	13.6	11.9	14.5	14.6	14.1	14.9	14.6	15.6

While for the area of Sheikh Bader, the annual average maximum and minimum temperature during 1989 -1998 are given in Table 4.10 (Eid 2004).

Table 4.10: Sheikh Bader annual average maximum and minimum temperature

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Maximum	22.6	22.0	21.4	20.2	21.7	22.6	22.0	22.1	21.6	23.4
Minimum	12.8	12.4	12.6	11.2	12.0	13.1	12.4	12.8	12.2	13.6

4.3.6.2 Rainfall

In Syria, rainfall distribution and reliability are mainly affected by the seasonal routes of the Atlantic cyclones passing eastwards along the Mediterranean.

The rainfall season usually begins in September over the coastal area and reaches the maximum in December and January. The season extends till June. The precipitation amount in the coastal area reaches values of 850-860 mm over the coastal low land. In the coastal mountains the annual average of the rainfall increases gradually with increasing elevation to reach a maximum of 1,500-1,600mm at the ridges of the mountains.

The measured annual average of rainfall in the area of Sheikh Bader is 1,213 mm for the last 10 years. Table 4.11 contains rainfall data received from the Sheikh Bader meteorological station. While the measured rainfall for Kurdaha is given in Table 4.12 (Eid, 2004).

Table 4.11: Measured rainfall in Sheikh Bader (1992-2002)

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1,022	1,098	1,187	1,242	1,026	1,091	1,153	1,295	897	1,577	1,764

Table 4.12: Kurdaha annual average precipitation

1989	1990	1991	1992	1993	1994	1995	1996	1997
74.7	15.5	400.3	148.5	73.0	159.0	56.5	252.1	152.3

4.3.6.3 Relative humidity

The main source for air humidity in Syria is the Mediterranean Sea. In summer there is significant decrease of relative humidity from west to east away from the effect of the sea. However, in winter humidity decreases slightly westwards over the coastal districts.

In the coastal region, the relative humidity values are slightly higher in summer than in winter, reaching 70-80% in July and 65-70% in January. The relative humidity annual average is 69% for Sheikh Bader and reaches 62% for Kurdaha. Table 4.13 shows the annual average relative humidity in Latakia and Tartous (Eid, 2004).

Table 4.13: Annual average relative humidity for Latakia and Tartous

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Latakia	66	64	68	65	65	68	68	68	66	68
Tartous	68	67	69	67	67	69	69	69	67	68

4.3.6.4 Wind

Generally wind speed increases in winter in the coastal region. Where north-eastern to eastern winds prevail over the coastline in winter while south-western to southern winds prevail during the rest of the year. The annual average wind speed in Kurdaha is about 1.7 m/s and 3.7 m/s in Safita near Sheikh Bader. The wind speed annual average in both Latakia and Tartous is shown in Table 4.14.

Table 4.14 Latakia and Tartous annual average wind speed (m/s)

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Latakia	3.7	3.8	3.3	3.4	3.8	3.9	3.4	3.1	3.9	3.7
Tartous	2.5	2.6	2.5	2.8	1.8	2.7	2.9	2.8	2.9	2.7

Unfortunately, the wind speed data is insufficient and gathered only for Kurdaha area during 1997 and 1998 as given in Table 4.15, (Eid, 2004).

Table 4.15: Kurdaha monthly average wind speed (m/s)

1997	2.9	1.6	3.3	2.6	1.3	1.1	1.2	1.6	1.2	0.9	2.4	2.2	1.9
1998	2.9	3.2	2.4	1.7	2.0	0.4	0.8	0.7	0.8	1.2	1.4	1.8	1.6

4.3.6.5 Evaporation

The average evaporation is related to the general meteorological configuration of the region, only the mountains have comparatively favourable evaporation/rainfall balance. Solar radiation is estimated at 2500-2800 hours of annual sunshine (PAP/RAC, 1992). The annual average evaporation in Latakia and Tartous are given in Table 4.16.

Table 4.16: Latakia and Tartous annual average evaporation

Year	1989	1990	1991	1992	1993	1994	1995	1996
Latakia	2.3	2.8	2.3	2.4	2.6	2.4	2.3	2.3
Tartous	2.7	2.4	2.1	2.1	2.1	2.8	2.1	2.0

4.4 SOCIO-ECONOMIC CHARACTERISTICS

4.4.1 Population

The main characteristics and problems related to the population of the coastal zone are the high population growth and the high population density in the coastal zone. Population growth rates are indeed very high. The distribution of population over the coastal region points at the significance of intra-regional migrations, from mountains and hilly areas towards the coastal plains, or in or around cities. Furthermore, with the exception of the area of Damascus, the coastal region is the most densely populated region in Syria, which is a direct consequence of the high population growth and migration dynamics. The highest population densities are in the coastal cities.

4.4.1.1 Kurdaha Population

The Kurdaha area comprises 95 villages and 14 extension units spread over those villages. The total population is about 82,000 for the year 2003 (table 4.17), distributed mainly in the cities and the rural areas mainly south of Kurdaha (table 4.18). The settlements map of Kurdaha area was extracted from topographic maps at scale 1:50,000. (Map 4.12).

Table 4.17: The population increase in centre of Kurdaha between 1995-2005 (Statistical abstracts, 1995)

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
70,576	72,203	73,862	75,554	77,281	79,042	80,838	82,669	82,000	86,442	88,384

Table 4.18: Population, density and area in Kurdaha district

Name of Area	Number of Following Villages	Population	Area (Hectare)	Density
Kurdaha Centre	15	21,049	18,171	1.16
Dier-hana	10	10,320	2,454	4.20
Kalhat AL Mahlba	9	7,757	3,741	2.10
Rwayaist AL-Bastina	7	5,207	1,844	2.80
Bakrama	6	5,684	4,513	1.20
Harf Mastiera	9	11,857	3,552	3.30
Astamo	4	4,000	2,079	1.90
Kamien	3	3,500	869	4.00
AL-Debieka	7	7,495	1,884	3.90
Bachlama	6	3,600	3,049	1.10
Marhj Maerban	3	3,900	856	4.50
Aien AL-Rous	4	3,400	1,642	2.00
Bastan AL-Barka	7	7,600	3,449	2.20
AL-khshakhsha	5	10,000	2,174	4.50
Kurdaha (total)	**95**	**82,000**	**40,201**	**2.00**

From the above-mentioned table, we can say that the population density in Kurdaha is low due to several factors such as:

1. relatively big area,
2. the immigration flow towards the coastal cities and other cities to search for jobs especially among younger persons,
3. the distribution of land use which depends on the human activities is distributed among :
   - arable land with a percentage of about 33%;
   - urban land with a percentage of about 3%;
   - natural land cover and forest with a percentage of about 35%;
   - badlands with a percentage of about 29%.

4.4.1.2 Sheikh Bader Population

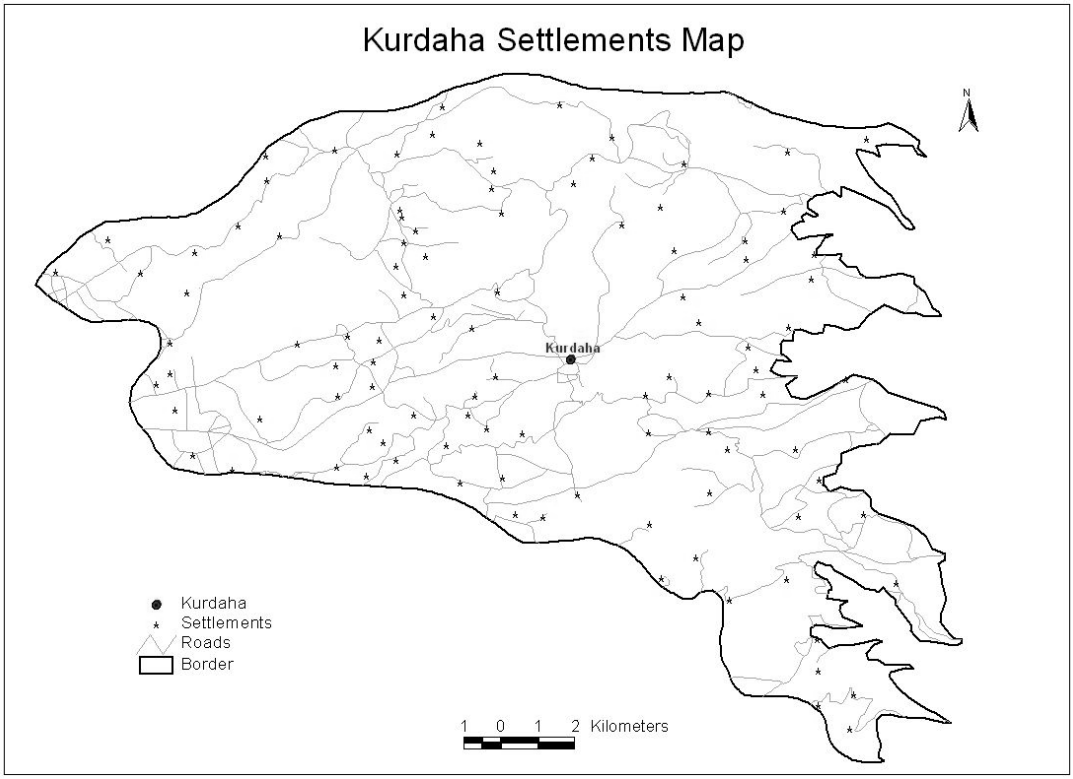
The district of Sheikh Bader comprises a 77 villages and 10 extension units spread over those villages. The settlements map of Sheikh Bader area was extracted from topographic maps at scale 1:50,000. (Map 4.13).

The population is about 150,706 distributed over organised and non-organised settlements (Table 4.19).

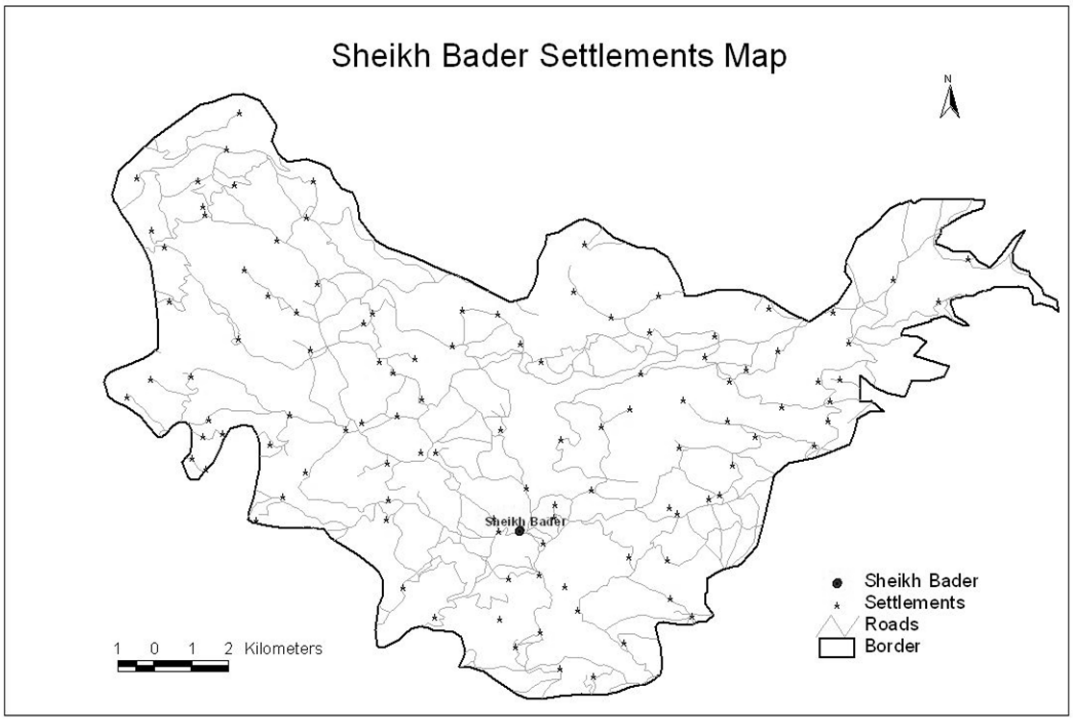
Table 4.19: Population, density and area in Sheikh Bader district

Name of Area	Number of Following Villages	Population	Area (Hectare)	Density
AL-Wardeai	6	3,115	9.634	0.3
AL-Mraiekb	6	6,190	25.638	0.2
AL-Nmriea	7	5,410	15.450	0.3
Breasieen	7	5,474	23.399	0.2
Sarejies	5	6,435	13.800	0.4
AL-Mjadiel	6	5,248	13.370	0.3
AL-Mosha	7	6,450	14.965	0.4
AL-Kamciea	10	11,634	28.895	0.4
Brmanat AL Mshaiekh	15	20,750	58.260	0.3
Sheikh Bader	8	80,000	20.279	3.9
Sheikh Bader (total)	**77**	**150,706**	**223.69**	**0.6**

Also here, the population density in Sheikh Bader is low due to the vast area and immigration flow dynamics.



Map 4.12: Kurdaha Settlements map



Map 4.13: Sheikh Bader Settlements map

4.4.2 Economic Activities

The present level of economy reveals that the coastal region has been one of the national development priorities, due to its favourable natural conditions. After 1963, the coastal region, particularly the coastal zone, has been receiving large investments of national significance and witness a remarkable growth in industrial activities resulted in a selective abandonment of traditional landuses. Although the coastal region is covering only 2% of the national territory and contributing with 11% to the total population of Syria, it brings in as much as 12% of the national wealth (PAP/RAC. 1992. vol. 2).

The high population growth and concentration in the coastal zone and its urban and rural areas have generated adverse environmental problems:

- The heavy pressures of population in the cities have caused housing deficiency, which in turn stimulated a sprawl of illegal housing in suburban areas and devastation of fertile land.
- Natural resources have been overexploited and destroyed.
- Over-pumping of water resources (particularly underground water) has caused intrusion of saline water into aquifers.
- In response to the increasing demands for jobs and employment, the newly opened enterprises and tourist accommodations tend to disregard the environment.
- In attempt to provide more food to sustain the rapidly growing population some forest areas have been cleared and turned into cultivated land causing accelerated soil erosion processes.

Adverse environmental effects, being an indirect result of the high and rapid population growth and concentration in the coastal zone, have become a heavy burden to the fragile coastal resources. Although it seems that migration flows from the hinterland towards the coast is slowing down, the needs of the growing population for employment, particularly in the manufacturing industry and tourism, urgently call for the protection and rational utilisation of the coastal resources.

4.4.2.1 Kurdaha Economic Activities

In general, Kurdaha area is very poor with manufacturing and industry facilities as well as tourism facilities in spite of its favourable natural conditions. Tourism in the area is relatively limited despite the beautiful scene (compared to other surrounding tourist areas like Slunfa, Hafa and Kasab). There are some tourist facilities in the area, like Kurdaha Hotel (state owned hotel) in the city of Kurdaha, and several restaurants (private owned) spread all over Kurdaha district. Tourism forms about 5% of the general income only. Agriculture is the dominant economic activity and consequently, most of the exported products rely on the following agricultural products:

1. Citrus: occupy about 50% of the agricultural area and form 50% of the agricultural products.
2. Tobacco: occupy 30% of the total agricultural area. It comprises 30% of the products. Production concentrated especially in some mountainous villages.
3. Olive trees: occupy 20% of the agricultural area and form 20% of the products too.
4. Vegetables (including greenhousing): occupy about 5% of the agricultural area. All these products are exported to Latakia city, besides, about 20% of citrus products export to the other parts of Syria.
5. Animal Products: about 70% of these products are consumed in the Kurdaha area itself and the rest is exported to Latakia city.

In addition to these exported agricultural products, some construction materials are also being exported to all over the country because there are several quarries in the region. As for the imported materials, they are mainly home appliances, garments, fuel, food, etc.

A very common phenomenon found in the area is that most of people have double careers. They have a job with the government and simultaneously working in agriculture. Consequently, although the family income has two sources, income is insufficient and this makes local people careless about their arable lands. Generally, the monthly average income of an employee is about 4,000 – 5,000 Syrian pounds.

The settlement types reflect urban patterns. The land tenure system is mixed and complex where private owned and state owned land alternates. The complexity of land tenure structures is due to particularisation of farm plots by inheritance. The predominant agricultural practices include olive plantation and cows breeding. Up till now there is no agricultural market in the area.

4.4.2.2 Sheikh Bader Economic activities

Agriculture is the backbone of the area economy. The exported products depend on agricultural products and particularly on:

1. Olive and olive oil: which come in the first category before all other exported agricultural products. Usually, the private sector (merchants) purchase it, and prices fall considerably in good harvest years;
2. Fruits and particularly apple, exported to the private sector;
3. Tobacco: purchased by the government;
4. Wheat, mostly consumed within the area, and the remaining parts exported to Tartous cereal office.;
5. Silkworm: the breeding of silkworm takes place in the area and then exported to silkworm products factory in Drikish area;
6. Animals products: about 80% of it consumed in Sheikh Bader area itself and the rest exported to the Tartous Mohafaza.

Beside these products, the area also exports the construction materials to private and state consumers within the coastal areas because there is one quarry in the region. Moreover, food, home appliances, and garments are the main imported products.

In spite of the spectacular nature of the area of Sheikh Bader, the tourism sector is still fragile and relies mainly on private contributions and not the state ones. The government has planed several tourist facilities but they are not realised. The area is rich with springs, hills, mountains, forest spots, and green cover in general. There are several restaurants in the area, and tourist season starts at the end of spring and lasts until autumn. Tourism only forms about 3% of the general income.

As in Kurdaha, most persons also have double careers. They have a job with the government and simultaneously working in agriculture. Consequently, although the family income has two sources, however, income is still insufficient and this makes local people careless about their arable lands. Generally, the monthly average of income of an employee is about 3,000 – 4,000 Syrian pounds.

The landuse system is managed according to a specific agricultural plan. Moreover, the land tenure system is private owned (75%) and government owned (25%) with complexity in its structure due to particularisation of farm plots by inheritance. The predominant

agricultural practices include olive plantation, fruit trees, crops, and cows breeding. Also here, there is no agricultural markets yet.

4.5 EROSION AND LAND DEGRADATION PROCESSES

The coastal area has excellent agricultural conditions. However, the region is being confronted with various types of land degradation, deforestation and improper utilisation, and leading to ecological and environmental problems which are becoming more and more serious. Moreover, as a result of various conditions such as agricultural development, urban expansion, deforestation, overgrazing, inappropriate agricultural practices, and forest fire soil erosion by water is becoming a major problem in several areas of Latakia. Furthermore, large areas of the rolling hills and gentle mountain slopes have been turned into bare land. If soils are not properly managed, soil erosion leads to decreasing soil productivity in the short term and to irreversible soil degradation in the long term (Abed, 2000).

Nahal 1984, mentioned that the amount of eroded soils exceed 200 tons per hectare per year in the coastal mountains when facing the combination of heavy rainfall, steep slope inclination and bare slope surface. This rate was also mentioned by the FAO report in 1980. The FAO cited that the soil loss rates range between 50-200 t/h/y in the coastal mountains with deteriorated natural vegetation cover, 10-50 t/h/y in coastal mountains with less deteriorated natural vegetation cover, 10-50 t/h/y in the coastal plains. The soil erosion risks mainly occur on the southern and northern parts around *Kurdaha* city, as well as in some eastern and northern mountain areas where the combination of heavy rainfall events, barren mountains and the steep slopes prevails. These regions have the greatest erosion rate of 275 tons per hectare per year.

According to Abed (2000), the soil erosion extent and severity mainly occur on the eastern and northern high mountains in Latakia, where the heavy rainfall, barren mountains and the steep slopes exist. These regions are mainly located near to the east of *Slunfa* city and in separate areas north to *Rabiha* city as well as in some northern parts of Latakia south-west of the *Kasab* area. These areas have the greatest erosion rate of 275 tons per hectare per year. The other sites that have serious erosion problem are those of barren lands which are located near to the north and south of *Kurdaha* city, with an erosion rate of 275 tons per hectare per year while the coastal plain region erode at a rate of 0 to 50 tons per hectare annually, and then northern mountains at 10 to 70 t/h/y.

Sheet erosion is the dominant erosion type in the region. Rill erosion and gullies spread over some spots, while mass movements may be found on steep slopes.

PAP/RAC (1992) reported that the rates of annual loss of soil per hectare have been the lowest throughout most of the coastal zone (under 30 tones/ha/year). Only areas north of Latakia and in the hinterland of Banias-Tartous coast have been categorised as exposed to "medium" or "strong erosion" (30-60, and 50-100 t/h/y, respectively)

Some projects were realised in the Sheikh Bader area such as a reforestation project, a fruit trees plantation project, and an agricultural development project. While for Kurdaha area the currently active projects are a reclamation of stony-lands project (Fruit trees plantation project), the martyr Ali Al-ali Project, and an agricultural development project. In order to combat soil degradation, local farmers usually apply terracing and land reclamation techniques.

5. DETAILED ANALYSIS RESULTS (FROM THE DESCRIPTIVE EROSION MAPPING)

This chapter explains only the criteria determined under the conditions of the survey area. These criteria are part of the criteria belonging to the descriptive approaches within the general methodology in the corresponding document of PAP/RAC guidelines (PAP/RAC, 1997).

5.1 MAPPING METHODOLOGY AND RELATED FIELD WORK

Erosion mapping is an essential tool for the knowledge of the distribution and geographic extent of the phenomenon, as well as for its qualitative characterisation. The erosion map provides information about nature, intensity and distribution of the relevant phenomena. On this basis it is possible to identify the most severely affected areas and the dominant types of erosion processes.

Mapping of water erosion in Kurdaha and Sheikh Bader areas was assessed according to the common consolidated methodology of Mapping of Rainfall-Induced Erosion Processes in the Mediterranean Coastal Area, (PAP/RAC, 1997). The method is based on elaboration of the Geographic Information System, GIS, in accordance with the criteria and standards for elaboration of Landsat image and maps with scale 1:50,000, using ArcGIS, Arcview, Spatial Analyst as well as ERDAS program packages. These programmes allow working out of numerous maps in digital form, and carrying out overlay and connection with databases.

Erosion processes description has been applied to the survey area according to the criteria and legend given in the Chapter 2.2 of the guidelines (see Annex 1). This original legend has then been modified to fit the various conditions of the survey areas in both Kurdaha and Sheikh Bader, see the *Modified Erosion Mapping Legend* which presented below in Box 5.1.

The erosion processes description identified two broad categories:

- Stable, none-erosion affected areas: areas of land with no evidence of any active erosion processes, because of the predominant stabilising effect of one or several landscape components thus generating a state of morphdynamic equilibrium, and
- Unstable, affected areas: areas of land where one or several active erosion processes occur.

The descriptive approach consists of the application of the above-mentioned legend to the polygons of the erosion status map resulting from the first phase (predictive approach). Two procedures are used for such application: image interpretation, and field observation. Easily identifiable by image interpretation are wastelands (rock outcrops, stony or sandy areas) and some types of aforestation and plantations. Furthermore, field observations and erosion process identification procedures consist of two steps: defining the grade of erosion risks and causative erosive agents for stable/ stabilised environments; and defining the type of dominant erosion process, its relative intensity and evolutive trend for unstable environments. These two procedures are mainly qualitative assessments and are to be considered as complementary to the predictive phase.

Step 1: Defining the grade of erosion risks/potentials

- The procedure only applies to stable, non erosion affected areas, which are defined as showing very few signs or no evidence of erosion, with well developed top soil and good soil structure; these areas are usually unused or very lightly/suitably used by man: either the present vegetation cover is adequate and/or topographic and soil conditions prevent erosion.
- Different types of stable and/or rehabilitated areas are identified according to their use, management and grade of erosion risk: the erosion risk ranges from 0 to 3.
- In most cases, the main erosion risk causative agents are easily identifiable; they might be indicated by extra codes (i.e., multiple process, P).

Step 2: Identifying and defining dominant erosion processes

All unstable areas are affected by one or several erosion processes ranging from slight to moderate and severe degradation which, for each specific process, can be assessed in relative terms of instability (depth of gullies, volume of removed soil), or extension of space affected (localised, dominant or generalised). Here, the "Multiple process due to bad land management" with the symbol "P", refers to terraces built by man, degraded or partly-destroyed terraces, collapsed terraces, or abandoned terraces.

These field observations were carried out in the field using erosion risk maps (from the predictive phase), topographic maps, ETM Landsat image dating back to March 2001, Photo library on soil erosion processes, two GPS devices, binocular, video and digital cameras, compass, and the questionnaire presented in Annex 2.

In total, about 391 sites (polygons) have been described using GPS devices, among them 210 sites in Kurdaha area (Map 5.1 GPS locations in Kurdaha) and the remaining 181 sites in Sheikh Bader area (Map 5.2 GPS locations in Sheikh Bader). For each site the geographical location as well as the erosion situation have been identified with the Grade of Risk and Causative Agents for the Stable Area, and with the Grade of Extent and Expansion Trend for Unstable Areas, as shown in Annex 2.

SITE-DESCRIPTIVE MAPPING: GRADE OF STABILITY/EROSION PROCESSES

I. Stable, non-erosion-affected areas (*)

- 00 **stable, non-used wasteland** (rock outcrops, cliffs, stony or sandy areas)
- 01 **stable, unmanaged areas with potential for forestry use only**
- 02 **stable, unmanaged areas with agricultural potential** (crops and pasture)
- 03 **stable, managed areas with forestry use only**
- 04 **stable, managed areas with agricultural use** (crops and pasture)

• **Rehabilitated areas by means of:**

- 05 **natural or artificial re-vegetation**
- 06 **physical infrastructures** (terraces, check dams, etc.)

***Grade of instability risk**

Assessment of **instability risk** for all **stable** environments (00 to 04) and of risk for **rehabilitated** environments, i.e. 05+06 (i.e. a risk in the first years of rehabilitation) to be expressed by a complementary digit (0 to 3) to the original **stable units'** code:

0: No risk (= highest grade of **stability**)
1: Low to moderate
2: High
3: Areas in hazardous/precarious/critical state (Stability threshold = highest grade of **instability risk**)

Example : 03 = **stable** managed areas with forestry use only
Example : 032 = **stable** managed areas with forestry use only with a high **erosion risk**

***Identification of main causative agents**

Instability risk assessment may be reinforced by the identification of its most probable/ prevailing **causative agents** inherent in the **landscapes'** main basic components, i.e.:
t: Topography
g: Geology
v: Vegetation
h: Human activities
Example: 023 **g** = stable unmanaged areas with agricultural potential with erosion risk mainly due to geologic factors.

II. Unstable areas (**)

• ***Sheet erosion***

- L1 **localised**
- L2 **dominant**
- L3 **generalised with soil profile removal**
- Lx **= unreclaimable areas due to total soil removal**

• ***Rill erosion***

- D1 **localised**
- D2 **dominant**
- D3 **generalised**

• ***Gully erosion***

- C1 **individual gullies**
- C2 **localised gully networks**
- C3 **dominant**
- C4 **generalised**
- Cx **= unreclaimable areas due to generalised bad lands**

• **Mass *earth movements***

- M1 **local gravitational soil creep/solifluction**
- M2 **localised land slides/mudflows**
- M3 **dominant**
- M4 **generalised**
- MX **= unreclaimable areas due to total slope slides**

• ***Water or sediment excess***

- W1 **areas periodically flooded and/or sediment buried**
- W2 **areas permanently flooded and/or sediment buried/waterlogged areas**

• ***Associated processes ("Bad land management.")***

- P1 **localised**
- P2 **dominant**
- P3 **generalised**
- Px **= unreclaimable areas**

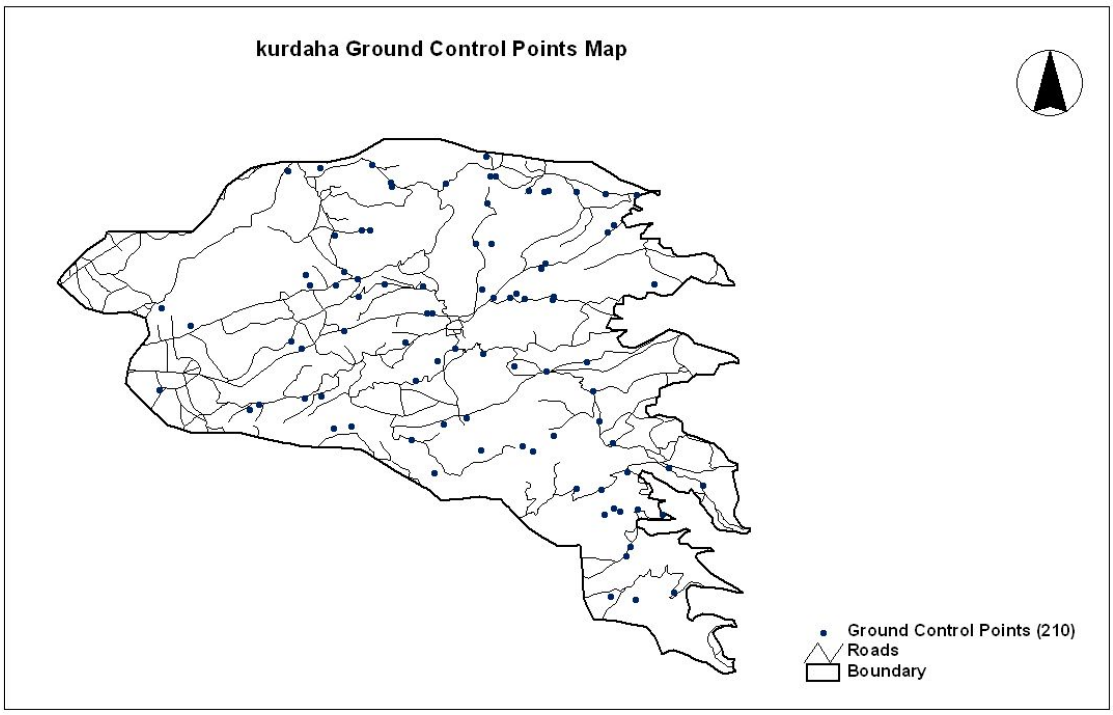
****Erosion expansion trend (rate)**

Assessment of erosion rate/trend for all **unstable** erosion-affected areas to be expressed by a complementary digit (0 to 3) to the original **unstable units'** code:

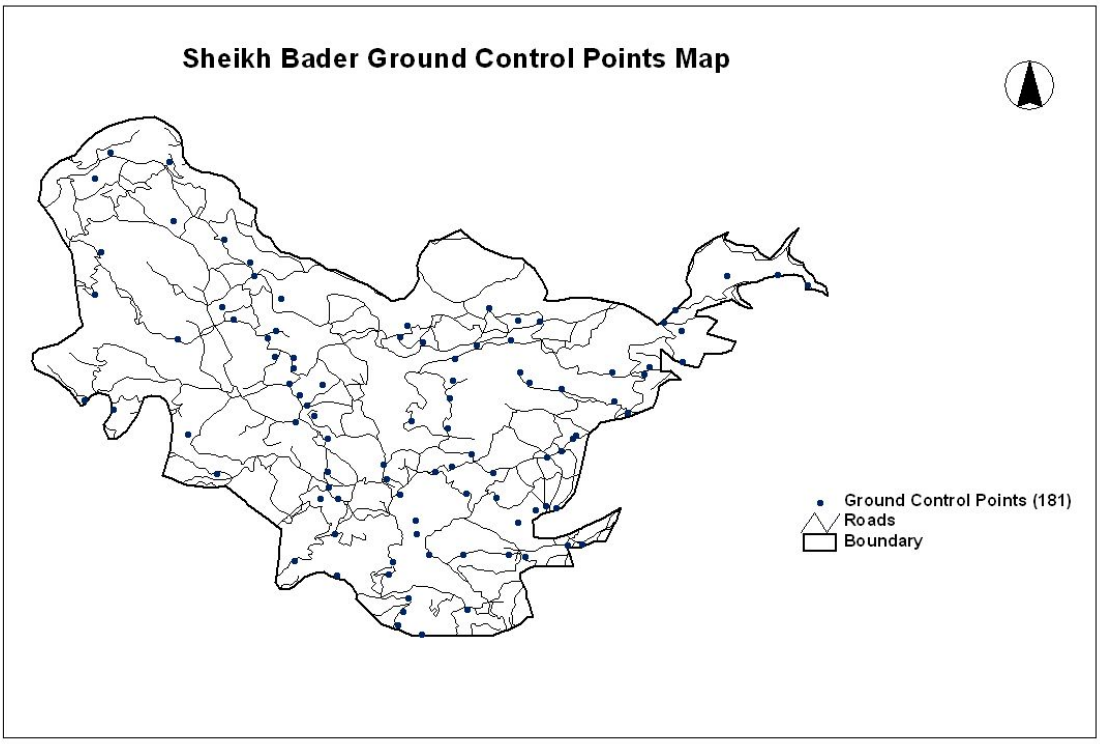
0: Trend to **stabilisation, recession** or limitation of spatial **expansion**
1: Trend to local **expansion** or **intensification**
2: Trend to widespread **expansion** or **intensification**
3: Trend to increase **generalised degradation** towards an **irreversible state**

Example:
L2 = dominant sheet erosion
L23 = dominant sheet erosion with a trend towards generalisation and an irreversible state (Lx type units)

Box 5.1: Modified Erosion Mapping Legend



Map 5.1: GPS locations in Kurdaha



Map 5.2: GPS locations in Sheikh Bader

5.2 DESCRIPTION OF DESCRIPTIVE EROSION MAP

Based on the field description and investigation the Descriptive Erosion Maps for Kurdaha area and Sheikh Bader area were finalised, as shown in Figure 5.1 and Figure 5.2. We have to mention that erosion mapping activities have been carried out in the pilot areas up to 800 meters above seal level, thus the generated maps are up to this altitude only and don't cover the entire real areas of Kurdaha and Sheikh Bader. Due to the project document limited the study area up to 800 meters above sea level in the Syrian coastal area. Thus, the filed investigation has been done on 235 Km^2 in Kurdaha area instead of 400.40 Km^2 (the total area), and on 188 Km^2 in Sheikh Bader area instead of 200.79 Km^2 (the total area).

Table 5.1: Erosion state of Kurdaha area according to the descriptive approach

Type	Erosion Situation (Kurdaha)	Erosion Risk/ Expansion Trend	Code	No. of Polygons	Area		
					Km^2	% (800m)	% (total area)
Stable Areas (72% 800m, 42% total)	Non-used wasteland	Low/moderate risk	001	4	4.60	1.96	1.15
		High risk	002	3	3.48	1.48	0.87
		Critical risk	003	1	0.28	0.12	0.07
	Unmanaged areas with potential for forestry use only	No risk	010	1	1.24	0.53	0.31
		Low/moderate risk	011	22	26.10	11.11	6.51
		High risk	012	11	7.18	3.06	1.78
		Critical risk	013	1	1.07	0.46	0.27
	Unmanaged areas with agriculture potential	Low/moderate risk	021	8	10.05	4.28	2.51
		High risk	022	11	9.65	4.11	2.41
	Managed areas with forestry use only	No risk	030	3	7.85	3.34	1.96
		Low/moderate risk	031	8	6.87	2.92	1.71
		High risk	032	2	1.35	0.57	0.33
	Managed areas with agricultural use	No risk	040	2	21.58	9.18	5.39
		Low/moderate risk	041	25	39.29	16.72	9.83
		High risk	042	10	14.45	6.15	3.62
	Natural or artificial re-vegetation	Low/moderate risk	051	2	1.07	0.45	0.27
		High risk	052	2	0.58	0.24	0.14
	Physical infrastructure	Low/moderate risk	061	3	3.84	1.63	0.96
		High risk	062	6	8.89	3.79	2.21
	Not Relevant	Not relevant	NR	6	2.26	0.96	0.57
Unstable Areas (27%, 16%total)	Gully erosion	Individual	C11	2	0.71	0.30	0.18
		Individual	C12	1	0.95	0.40	0.24
		Localised	C21	3	1.01	0.43	0.25
		Dominant	C32	3	3.71	1.58	0.93
	Rill erosion	Localised	D12	1	0.96	0.41	0.24
		Dominant	D22	1	0.65	0.27	0.16
	Sheet erosion	Localised	L11	6	5.77	2.45	1.45
		Localised	L12	9	9.52	4.05	2.38
		Dominant	L21	5	4.04	1.72	1.00
		Dominant	L22	4	2.36	1.00	0.59
	Mass earth movement	Localised	M21	2	0.35	0.15	0.09
		Dominant	M32	1	0.30	0.13	0.07
	Bad land management	Localised	P10	1	0.45	0.19	0.11
		Localised	P11	7	3.73	1.58	0.92
		Localised	P12	16	13.50	5.76	3.37
		Dominant	P21	1	0.63	0.27	0.16
		Dominant	P22	13	13.88	5.91	3.46
	Quarry	Individual	Q13	1	0.24	0.10	0.06
	Water or sediment excess	Periodical	W11	2	0.53	0.23	0.13
	Total			**210**	**235**	**100**	**60**

5.2.1 Kurdaha Descriptive Erosion Map

Most of the areas of Kurdaha include stable and stabilised zones which are not affected by active erosion. According to the Kurdaha descriptive erosion map, the total area of the lands having little to high erosion risk spread over 170 km^2 and account for 42% of Kurdaha total area and form 72% of the area up to 800m with the main causative agents belong to human activity and topography, as shown in Figure 5.1. While 16% of the total area (27% up to 800m) is covered by unstable zones in which bad land management, sheet and gully erosion are active, as shown in Figure 5.2. The final erosion diagnosis and assessments are showing in Table 5.1.

The stable areas with low to moderate erosion risk form about 23% of the total surface area, the stable areas with no erosion risk form about 8% of the total area, the stable areas with high erosion risk 12%, and the areas in critical state account for 0.3% of the total area.

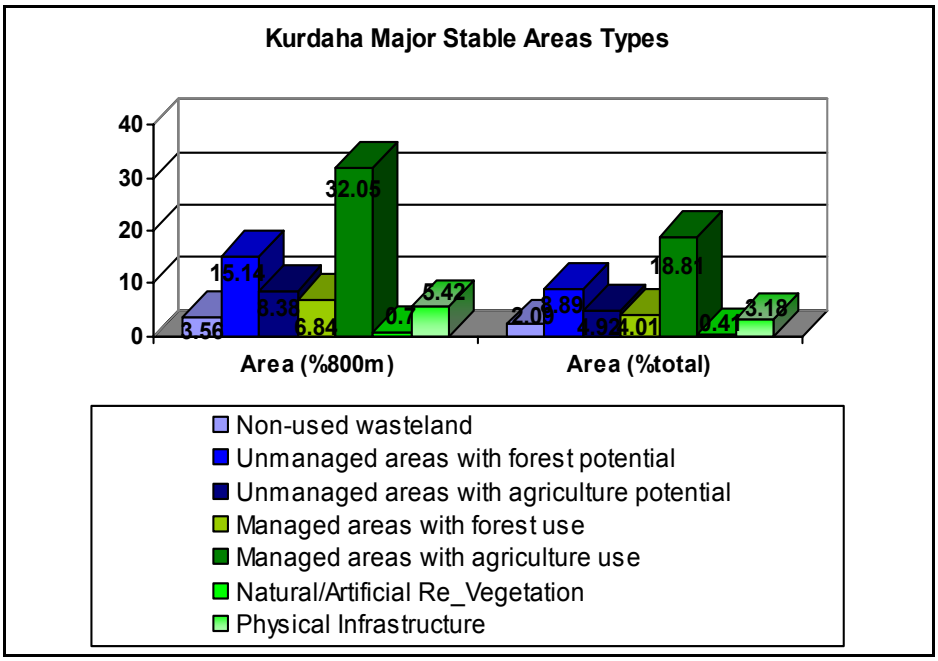


Figure 5.1: Kurdaha major stable areas types

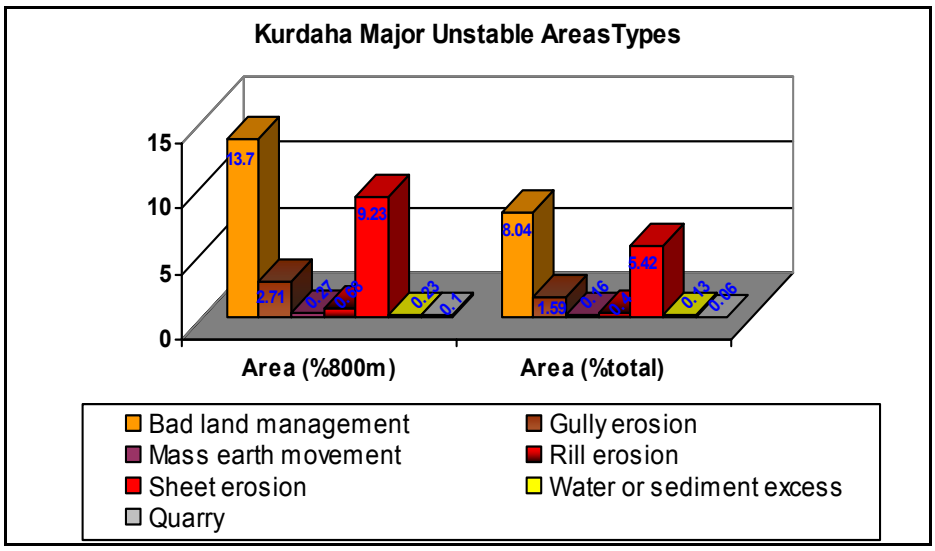


Figure 5.2: Kurdaha major unstable areas types

Map 5.3: Kurdaha Soil erosion map

Map 5.4: Kurdaha Erosion dynamics map

The "Multiple process due to bad land management" with the symbol "P", is the predominant form of unstable area and form 8% of the total area (14% up to 800m). The localised multi process due to bad land management form about 5% of the total area. This category is present in the southern and south-eastern parts. Sheet erosion is the second predominant form of erosion and spread over 6% of the total area (9% up to 800m), where the localised type of this category covers about 4% of the total area and the dominant type cover about 2% of the total area. Mainly, the sheet erosion occurs in the north-western and south-eastern parts. The southern part of Kurdaha city is dominated by unstable situation with gully erosion 1.6% of the total area where the individual gullies is the dominant type.

It is remarkable that managed areas with agricultural use extend over 18% of Kurdaha total area with low to moderate risk is the dominant instability risk grade. This category located mainly in western flat areas. The unmanaged areas with potential for forestry use only account for 9% of the total area, the low to moderate risk grade account for 6.5%, this area spread mainly in the eastern parts of Kurdaha, Map 5.3. The codes on the polygons of the map, multiple digits and letters, correspond to the legend of descriptive phase.

5.2.2 Sheikh Bader Descriptive Erosion Map

According to data obtained from the mapping activities using the predictive approach, the erosion status in Sheikh Bader is rather worse than that of Kurdaha area. About 38% of Sheikh Bader total area is fall under the category unstable areas in which bad land management and sheet erosion are predominant. While the stable areas account for 54% of Sheikh Bader total area. As for Kurdaha stable areas, the main causative agents belong to human activity and topography. About 27% of the total area (17% covered by dominant type) is affected by bad land management and thus classified under unstable areas category. The main reason for this classification is that erosion processes are active due to presence of partly destroyed terraces or abandoned terraces over large parts of Sheikh Bader district in particular in the north-western parts. About 10% of the total area is affected by sheet erosion in the north and north-western areas, Map 5.5. The codes on the polygons of the map, multiple digits and letters, correspond to the legend of descriptive phase. The final erosion diagnosis and assessments are showing in Table 5.2 and Figures 5.3 and 5.4.

According to Table 5.2, the dominant types of stable areas in the region, mainly in northern and north-eastern parts, are unmanaged areas with potential for forestry use only (18% of the total area), unmanaged areas with agriculture potential (12% of the total area) located in the southern parts, and managed areas with agriculture potential (10%) in the southern east and eastern parts.

Table 5.2: Erosion state of Sheikh Bader area according to the descriptive approach

Type	Erosion Situation (Sheikh Bader)	Erosion Risk/ Expansion Trend	Code	No. of Polygons	Area		
					Km^2	% (800m)	% (Total area)
Stable Areas (58%, 55% total)	Unmanaged areas with potential for forestry use only	Low to moderate risk	011	25	18.73	9.96	9.33
		High risk	012	16	17.65	9.39	8.79
	Unmanaged areas with agriculture potential	Low to moderate risk	021	12	20.39	10.84	10.15
		High risk	022	6	3.82	2.03	1.90
	Managed areas with forestry use only	No risk	030	1	0.69	0.36	0.34
		Low to moderate risk	031	16	13.44	7.15	6.69
		High risk	032	3	0.80	0.42	0.40
	Managed areas with agricultural use	Low to moderate risk	041	19	17.71	9.42	8.82
		High risk	042	3	3.17	1.68	1.58
	Natural or artificial re-vegetation	Low to moderate risk	051	1	0.89	0.47	0.44
		High risk	052	1	0.51	0.27	0.25
	Physical infrastructure	Low to moderate risk	061	11	8.71	4.63	4.33
		High risk	062	3	2.70	1.43	1.34
	Not Relevant	Not relevant	NR	3	1.25	0.66	0.62
Unstable areas (41%, 38% total)	Sheet erosion	Localised	L11	8	6.30	3.35	3.14
		Localised	L12	4	4.75	2.53	2.36
		Dominant	L22	9	10.45	5.56	5.20
	Bad land management	Localised	P11	9	9.10	4.84	4.53
		Localised	P12	7	12.04	6.40	5.99
		Dominant	P21	12	13.99	7.44	6.96
		Dominant	P22	12	19.90	10.58	9.91
	Total			**181**	**1374**	**1130**	**1,189**

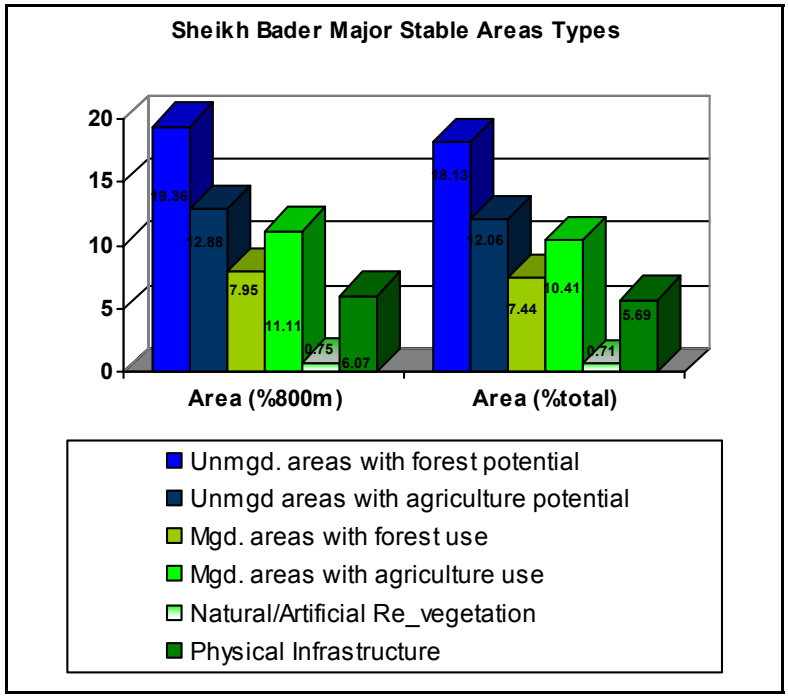


Figure 5.3: Sheikh Bader major stable areas types

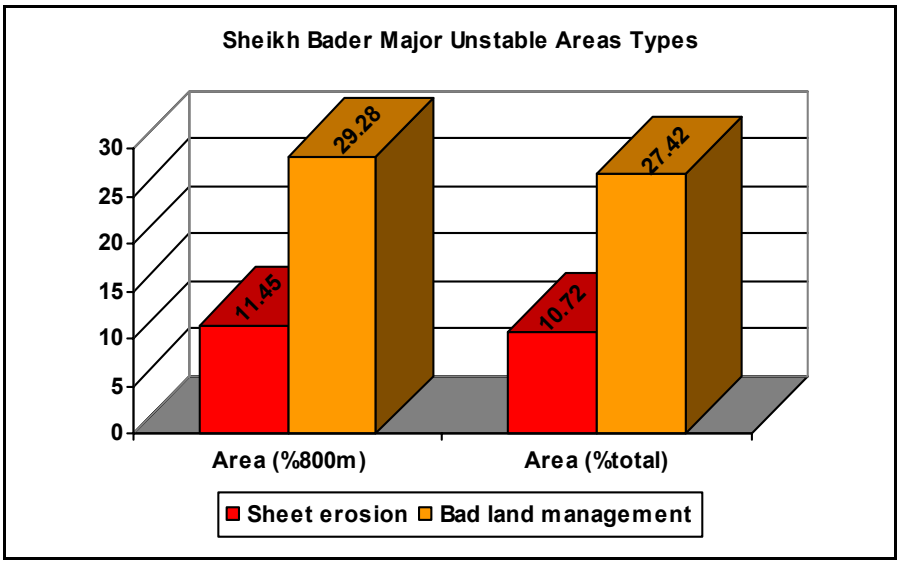


Figure 5.4: Sheikh Bader major unstable areas types

In total and for areas up to 800 meters, the stable areas account for 72% and the unstable areas account for 27% in Kurdaha area. While in Sheikh Bader the situation is worse where the stable areas decrease to 58% and the unstable areas increase to 41% as presented in Figure 5.5.

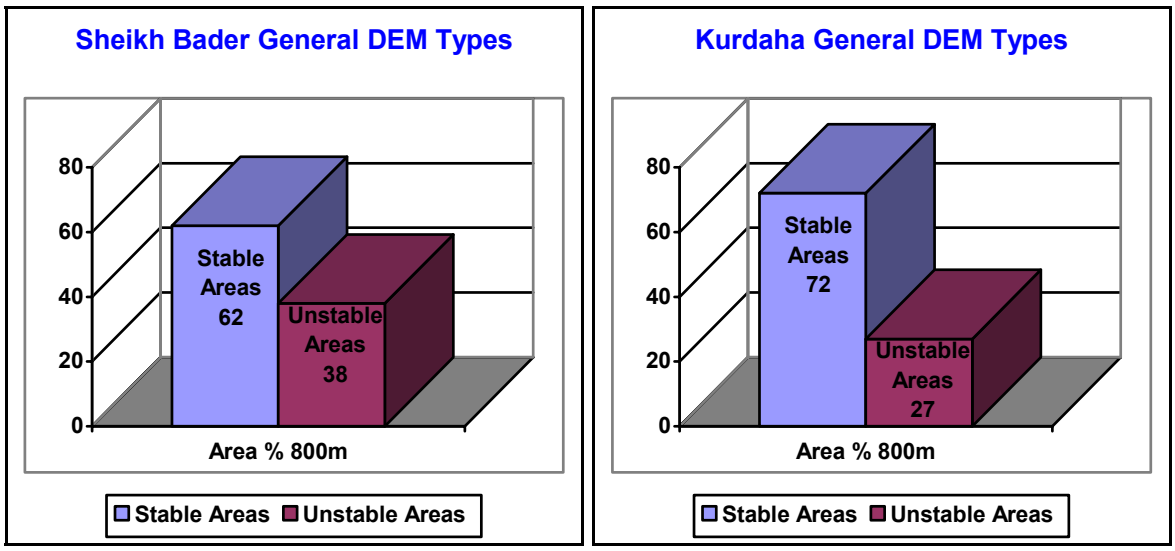


Figure 5.5: Total stable and unstable areas for both pilot areas

Map 5.5: Sheikh Bader Soil erosion map

Map 5.6: Sheikh Bader Erosion dynamics map

5.3 DESCRIPTION OF RELEVANT SOCIO-ECONOMIC FACTORS

In spite of the high population growth, the population density in both Kurdaha and Sheikh Bader, as mentioned in chapter 4 during description of pilot areas, is low due to the big area and immigration flow dynamics from mountains and hilly areas towards the coastal plains or in or around cities. However, this high population growth has generated several adverse environmental problems such as:

- The heavy population pressures in the cities and rural areas have caused housing deficiency, which in turn stimulated a sprawl of illegal housing in suburban areas and devastation of fertile land.
- Natural resources have been overexploited and destroyed.
- Over-pumping of water resources (particularly underground water) has caused intrusion of saline water into aquifers.
- In attempt to provide more food to sustain the rapidly growing population some forest areas have been cleared and turned into cultivated land causing accelerated soil erosion processes.

Furthermore, both areas of Kurdaha and Sheikh Bader are very poor with manufacturing and industry facilities as well as tourism facilities in spite of their favourable natural conditions. In contrast, agriculture is the dominant economic activity and considered as the backbone of the area economy. Besides in the last decades, the growth in industrial activity resulted in abandonment of traditional land use and gradually the area is suffering a progressive abandonment recently. Moreover, a very common phenomenon is founded in both areas is that most of people have double careers. They have a job with the government and simultaneously working in agriculture. Consequently, although the family income has two sources, income is insufficient and this makes local people careless about their arable lands.

Generally in both areas, a variety of physical problems such as soil loss, stoniness, and soil contamination are the result of erroneous and excessive utilisation of natural resources. In addition to those physical constraints, there are some socio-economic problems, like the misuse of agricultural land in discord with soil suitability, deficiency in the determination of optimum farm sizes with regard to agro-ecological conditions, insufficient and incorrect soil conservation measures (a degraded or partly-destroyed terraces), complexity of land tenure structures, particularisation of farm plots by inheritance, and absence of plant production planning.

In summary of the above, the following socio-economic conditions were considered as crucial for the prioritisation of future intervention areas.

- Overexploitation / rural exodus: The population dynamics in the two pilot areas result in many parts in land abandonment and in a few other parts in overexploitation. Land abandonment, mainly caused by the unfavourable market conditions of the predominant agricultural productions systems, especially olive production, has then the effect that conservation structures such as terraces are not maintained anymore. On the other hand, mismanagement and overexploitation result in environmental pollution by bad agricultural practices, extensive use of agrochemicals and improper irrigation followed by salinisation.
- Land tenure: Unfavourable land tenure conditions prevent investments in publicly owned land (state owned or communal) as well as in leased land, notably for the investment in water harvesting practices.

- Other factors such as frequent occurrence of forest fires in forest areas, difficulty of access to remote areas and absence of appropriate infrastructure measures, illegal urbanisation and quarrying, etc., to be applied as appropriate to individual units.

The identified socio-economic criteria are applied in the following chapter for the prioritisation of future intervention areas.

5.4 IDENTIFICATION AND PRIORITISATION OF FUTURE INTERVENTION AREAS (HOT SPOTS)

Successful land degradation control is based on the efficient use of available resources and therefore needs the establishment of clear priorities for both identification and planning of future interventions in the framework of control programmes.

In order to facilitate this task, a prioritisation procedure was developed, integrating the results of the physical assessment and related descriptive mapping (see 5.2) with the aggravating socio-economic conditions (see 5.3) and further considering actual and potential land use values according to different views, notably the perception of the local population (see the results of the participatory programme of CoLD), established national policies and assessment of potential for forestry, agricultural use and other land use forms.

For the different criteria, a rating grid from 1 (lowest possible score) to 3 (highest possible score was applied. The detailed meaning of the scores for the different criteria is explained below.

A. Physical instability risk (for stable areas, in compliance with the descriptive mapping code): 1: no or low to moderate instability risk; 2: high instability risk; 3: Critical instability risk.
B. Extent of area affected by a specific degradation process (for unstable areas, in compliance with the descriptive mapping code): 1: localised extent, i.e. less than 30% of the area affected; 2: dominant extent, i.e. 30 to 60% of the area affected; 3: generalised extent, i.e. more than 60% of the area affected.
C. Expansion trend of a specific degradation process (for unstable areas, in compliance with the descriptive mapping code): 1: no expansion or only trend to local expansion; 2: trend to widespread expansion; 3: trend to generalised degradation towards an irreversible state.
D. Multiplicator for increased importance of unfavourable combination of causative agents (for stable areas) or for increased importance of a specific degradation process (for unstable areas): 1: no increased importance; 2: increased importance; 3: highly increased importance.
E. Influence on adjacent areas: 1: no or low negative influence on adjacent areas; 2: highly negative influence on adjacent areas; 3: critical negative influence on adjacent areas.
F. Overexploitation as aggravating socio-economic factors: 1: no or insignificant influence; 2: significant influence; 3: crucial influence.
G. Rural exodus as aggravating socio-economic factors: 1: no or insignificant influence; 2: significant influence; 3: crucial influence.
H. Land tenure as aggravating socio-economic factors: 1: no or insignificant influence; 2: significant influence; 3: crucial influence.
I. Other aggravating socio-economic factors: 1: no or insignificant influence; 2: significant influence; 3: crucial influence.
J. Value of current land use according to the point of view of the local population: 1: low value; 2: increased value; 3: high or crucial value.

K. Value of current land use according to the national policies: 1: low value; 2: increased value; 3: high or crucial value.
L. Potential for forestry: 1: low potential; 2: increased potential; 3 high or crucial potential.
M. Potential for agricultural use: 1: low potential; 2: increased potential; 3 high or crucial potential.
N. Other land use potentials such as recreational use, construction sites, industrial activities: 1: low potential; 2: increased potential; 3 high or crucial potential.

After giving a score for each criterion to the identified areas, the final prioritisation scores were calculated in the following way:

For stable areas: [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]

For unstable areas: [(B * C * D + E) * F * G * H * I] + [(J + K) * L * M *N]

In a final step, the final scores were grouped into priority classes:

- High priority for application of measures (priority class 3): 60 points and more as final score
- Medium priority for application of measures (priority class 2): 21 to 59 points as final score
- Low priority for application of measures (priority class 1): 20 points and less as final score

The results of the assessment and related scores are given in Table 5.3 (stable areas) and Table 5.4 (unstable areas) for Kurdaha and in Table 5.5 (stable areas) and Table 5.6 (unstable areas) for Sheikh Bader. In addition, the prioritisation results and priority classes for Kurdaha and Sheikh Bader are given in Table 5.7 and Table 5.8 respectively. Furthermore, the distribution of prioritisation classes is shown on two maps, Kurdaha priority classes map (Map 5.7) and Sheikh Bader priority map (Map 5.8).

Table 5.3: Prioritisation scheme for stable areas in Kurdaha

Unit N°	1	2	3	4	5	6	7	8
Actual land use*	a,o,n	a,o,n	o,n	o,a	F,n,a,o	n,a,o,f	o,a	o,a
Code	001g	002tg	003tg	010	011h	011t	011th	011tv
Prioritisation criteria (score)**								
Actual degradation risk of the area								
Physical risk (A)	1	2	3	1	1	1	1	1
Multiplicator for importance of causative agents (D)	1	1	2	1	1	1	2	1
Influence on adjacent areas (E)	1	1	2	1	1	1	2	1
Importance of aggravating socio-economic factors								
Overexploitation (F)	1	1	1	1	1	1	1	1
Rural exodus (G)	2	2	2	1	1	1	1	1
Land tenure (H)	2	1	2	1	1	1	2	1
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1
Total score for actual degradation risk (A * D + E) * F * G * H * I	**8**	**6**	**32**	**2**	**2**	**2**	**8**	**2**
Land use value (actual and potential)								
Value of the current land use-local population view (J)	1	1	1	1	1	1	2	1
Value of the current land use-national policies (K)	2	2	2	3	3	3	2	3
Potential for forestry (L)	2	2	2	3	3	3	2	3
Potential for agricultural use (M)	1	1	1	1	1	1	1	1
Other land use potential (N)	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**6**	**6**	**6**	**12**	**12**	**12**	**8**	**12**
Total final score [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**14**	**12**	**30**	**14**	**14**	**14**	**16**	**14**
Priority for application of preventive measures* **	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.3: Prioritisation scheme for stable areas in Kurdaha (2)

Unit N°	9	10	11	12	13	14	15	16
Actual land use*	o,n	o,a,n,f	o,a,	a, o, n	o, n, a	a, o, n	f, n	a, n
Code	012gv	012h	012t	012th	021	022	030	031h
Prioritisation criteria (score)**								
Actual degradation risk of the area								
Physical risk (A)	2	2	2	2	1	2	1	1
Multiplicator for importance of causative agents (D)	2	2	2	2	1	2	1	1
Influence on adjacent areas (E)	2	2	1	2	1	1	1	1
Importance of aggravating socio-economic factors								
Overexploitation (F)	1	1	1	1	1	1	1	1
Rural exodus (G)	1	1	1	1	1	1	1	1
Land tenure (H)	2	2	1	1	1	2	1	1
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1
Total score for actual degradation risk (A * D + E) * F * G * H * I	**12**	**12**	**5**	**6**	**2**	**10**	**2**	**2**
Land use value (actual and potential)								
Value of the current land use-local population view (J)	2	1	1	1	2	2	1	1
Value of the current land use-national policies (K)	2	2	2	3	2	2	3	3
Potential for forestry (L)	3	3	3	3	1	1	3	3
Potential for agricultural use (M)	1	1	1	1	2	2	1	1
Other land use potential (N)	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**12**	**9**	**9**	**12**	**8**	**8**	**12**	**12**
Total final score [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**24**	**21**	**14**	**18**	**10**	**18**	**14**	**14**
Priority for application of preventive measures* **	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.3: Prioritisation scheme for stable areas in Kurdaha (3)

Unit N°	17	18	19	20	21	22	23	24
Actual land use*	a, n, o	o,c	o, c, s	o, s	o, n	o, n	o, c	o, c, a
Code	032th	040	041	042	051	052tg	061th	062
Prioritisation criteria (score)**								
Actual degradation risk of the area								
Physical risk (A)	1	1	1	2	1	2	1	2
Multiplicator for importance of causative agents (D)	2	1	1	2	1	2	1	2
Influence on adjacent areas (E)	2	1	1	1	1	1	1	1
Importance of aggravating socio-economic factors								
Overexploitation (F)	1	1	1	1	1	1	1	1
Rural exodus (G)	1	1	1	1	1	1	1	1
Land tenure (H)	1	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1
Total score for actual degradation risk (A * D + E) * F * G * H * I	**4**	**4**	**4**	**10**	**4**	**10**	**4**	**10**
Land use value (actual and potential)								
Value of the current land use-local population view (J)	1	3	3	3	2	2	3	3
Value of the current land use-national policies (K)	3	2	2	2	2	2	3	3
Potential for forestry (L)	3	1	1	1	1	1	1	1
Potential for agricultural use (M)	1	3	3	3	2	2	2	2
Other land use potential (N)	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**12**	**15**	**15**	**15**	**8**	**8**	**12**	**12**
Total final score [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**16**	**19**	**19**	**25**	**12**	**18**	**16**	**22**
Priority for application of preventive measures* **	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.4: Prioritisation scheme for unstable areas in Kurdaha

Unit N°	25	26	27	28	29	30	31	32	33
Actual land use*	o, a	o, a	o, a	o, a	o	o, a	o, a	o, c, s	o, s
Code	C11	C12	C21	C32	D12	D22	L11	L12	L21
Prioritisation criteria (score)**									
Actual degradation trend of the area									
Extent of area affected (B)	1	1	2	3	1	2	1	1	2
Expansion trend (C)	1	2	1	2	2	2	1	2	1
Multiplicator for importance of degradation process (D)	1	2	2	2	1	2	2	2	2
Influence on adjacent areas (E)	1	1	2	2	1	2	2	2	2
Importance of aggravating socio-economic factors									
Overexploitation (F)	1	1	1	1	1	1	1	1	1
Rural exodus (G)	1	1	1	2	1	1	1	1	1
Land tenure (H)	1	1	1	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1	1
Total score for actual degradation risk (B * C * D + E) * F * G * H * I	**2**	**5**	**6**	**56**	**6**	**20**	**8**	**12**	**12**
Land use value (actual and potential)									
Value of the current land use-local population view (J)	2	1	1	1	3	2	3	3	3
Value of the current land use-national policies (K)	2	2	2	1	2	2	3	3	3
Potential for forestry (L)	2	3	3	2	1	3	1	1	1
Potential for agricultural use (M)	1	1	2	2	3	2	3	3	3
Other land use potential (N)	1	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**8**	**9**	**18**	**8**	**15**	**24**	**18**	**18**	**18**
Total final score [(B * C * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**10**	**14**	**24**	**64**	**21**	**44**	**26**	**30**	**30**
Priority for application of remedial measures* **	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**2**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).
M21: this code is the dominant code and also includes the code M32.

Table 5.4: Prioritisation scheme for unstable areas in Kurdaha (2)

Unit N°	34	35	36	37	38	39	40	41	42
Actual land use*	o, a	o, a	o, s	o, a	o, a	o, a	o, a, s	q	o, s
Code	L22	M21[1]	P10	P11	P12	P21	P22	Q13	W11
Prioritisation criteria (score)**									
Actual degradation trend of the area									
Extent of area affected (B)	2	2	1	1	1	2	2	1	1
Expansion trend (C)	2	1	1	1	2	1	2	3	1
Multiplicator for importance of degradation process (D)	3	1	1	1	2	2	2	2	1
Influence on adjacent areas (E)	2	1	1	1	1	2	2	2	1
Importance of aggravating socio-economic factors									
Overexploitation (F)	1	1	1	1	1	1	1	1	1
Rural exodus (G)	2	1	1	1	2	2	2	1	1
Land tenure (H)	2	2	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1	1
Total score for actual degradation risk (B * C * D + E) * F * G * H * I	**56**	**6**	**4**	**4**	**20**	**24**	**40**	**16**	**4**
Land use value (actual and potential)									
Value of the current land use-local population view (J)	2	2	3	2	2	2	2	1	3
Value of the current land use-national policies (K)	2	2	2	2	2	2	2	1	3
Potential for forestry (L)	1	2	1	2	2	2	2	1	1
Potential for agricultural use (M)	3	1	3	3	3	3	3	3	3
Other land use potential (N)	1	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**12**	**8**	**15**	**24**	**24**	**24**	**24**	**6**	**18**
Total final score [(B * C * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**68**	**14**	**19**	**28**	**44**	**48**	**64**	**22**	**22**
Priority for application of remedial measures* **	**3**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**2**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

M21: this code is the dominant code and also includes the code M32.

Table 5.5: Prioritisation scheme for stable areas in Sheikh Bader

Unit N°	1	2	3	4	5	6	7	8
Actual land use*	a, f, o	a, n, o	a, n, o	o, s	o, s	o, c	o, s, c	f, n, o
Code	011h	011	012	021h	021t	021th	022	031
Prioritisation criteria (score)**								
Actual degradation risk of the area								
Physical risk (A)	1	1	2	1	1	1	2	1
Multiplicator for importance of causative agents (D)	1	1	2	1	1	1	2	1
Influence on adjacent areas (E)	1	1	2	1	1	1	1	1
Importance of aggravating socio-economic factors								
Overexploitation (F)	1	1	1	1	1	1	1	1
Rural exodus (G)	1	1	1	1	1	1	1	1
Land tenure (H)	2	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1	1
Total score for actual degradation risk (A * D + E) * F * G * H * I	**4**	**4**	**12**	**4**	**4**	**4**	**10**	**4**
Land use value (actual and potential)								
Value of the current land use-local population view (J)	2	1	2	3	2	3	3	1
Value of the current land use-national policies (K)	2	3	2	2	2	2	2	3
Potential for forestry (L)	3	3	2	1	1	1	1	3
Potential for agricultural use (M)	1	1	2	3	3	3	3	1
Other land use potential (N)	1	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**12**	**12**	**16**	**15**	**12**	**15**	**15**	**12**
Total final score [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**16**	**16**	**28**	**19**	**16**	**19**	**25**	**16**
Priority for application of preventive measures* **	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.5: Prioritisation scheme for stable areas in Sheikh Bader (2)

Unit N°	9	10	11	12	13	14	15
Actual land use*	f, o	o, s, c	o, c	F	f, o	o, c	o, s
Code	032	041	042	051h	052h	061	62
Prioritisation criteria (score)**							
Actual degradation risk of the area							
Physical risk (A)	2	1	2	1	2	1	2
Multiplicator for importance of causative agents (D)	2	1	2	1	2	1	2
Influence on adjacent areas (E)	2	1	1	1	2	1	1
Importance of aggravating socio-economic factors							
Overexploitation (F)	1	1	1	1	1	1	1
Rural exodus (G)	1	1	1	1	1	1	1
Land tenure (H)	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1
Total score for actual degradation risk (A * D + E) * F * G * H * I	**12**	**4**	**10**	**4**	**12**	**4**	**10**
Land use value (actual and potential)							
Value of the current land use-local population view (J)	1	3	3	1	1	3	3
Value of the current land use-national policies (K)	3	2	2	3	3	2	2
Potential for forestry (L)	3	1	1	3	3	1	1
Potential for agricultural use (M)	1	3	3	1	1	3	3
Other land use potential (N)	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**12**	**15**	**15**	**12**	**12**	**15**	**15**
Total final score [(A * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**24**	**19**	**25**	**16**	**24**	**19**	**25**
Priority for application of preventive measures* **	**2**	**1**	**2**	**1**	**2**	**1**	**2**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.6: Prioritisation scheme for unstable areas in Sheikh Bader

Unit N°	16	17	18	19	20	21	22
Actual land use*	o, s, a	o, a	o, s	o, a	o, a	o, a	o, a
Code	L11	L12	L22	P11	P12	P21	P22
Prioritisation criteria (score)**							
Actual degradation trend of the area							
Extent of area affected (B)	1	1	2	1	1	2	2
Expansion trend (C)	1	2	2	1	2	1	2
Multiplicator for importance of degradation process (D)	2	2	3	2	2	2	3
Influence on adjacent areas (E)	1	2	2	2	2	2	2
Importance of aggravating socio-economic factors							
Overexploitation (F)	1	1	1	1	1	1	1
Rural exodus (G)	1	2	2	2	2	2	2
Land tenure (H)	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1
Total score for actual degradation risk (B * C * D + E) * F * G * H * I	**6**	**24**	**56**	**16**	**24**	**24**	**56**
Land use value (actual and potential)							
Value of the current land use-local population view (J)	3	2	3	2	3	3	2
Value of the current land use-national policies (K)	2	2	2	2	2	2	2
Potential for forestry (L)	2	1	1	2	2	2	2
Potential for agricultural use (M)	2	2	3	2	3	3	3
Other land use potential (N)	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**20**	**8**	**15**	**16**	**30**	**30**	**24**
Total final score [(B * C * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**26**	**32**	**71**	**32**	**54**	**54**	**80**
Priority for application of remedial measures* **	**2**	**2**	**3**	**2**	**2**	**2**	**3**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.6: Prioritisation scheme for unstable areas in Sheikh Bader (2)

Unit N°	16	17	18	19	20	21	22
Actual land use*	o, s, a	o, a	o, s	o, a	o, a	o, a	o, a
Code	L11	L12	L22	P11	P12	P21	P22
Prioritisation criteria (score)**							
Actual degradation trend of the area							
Extent of area affected (B)	1	1	2	1	1	2	2
Expansion trend (C)	1	2	2	1	2	1	2
Multiplicator for importance of degradation process (D)	2	2	3	2	2	2	3
Influence on adjacent areas (E)	1	2	2	2	2	2	2
Importance of aggravating socio-economic factors							
Overexploitation (F)	1	1	1	1	1	1	1
Rural exodus (G)	1	2	2	2	2	2	2
Land tenure (H)	2	2	2	2	2	2	2
Others (social conflict, market, prices) (I)	1	1	1	1	1	1	1
Total score for actual degradation risk (B * C * D + E) * F * G * H * I	**6**	**24**	**56**	**16**	**24**	**24**	**56**
Land use value (actual and potential)							
Value of the current land use-local population view (J)	3	2	3	2	3	3	2
Value of the current land use-national policies (K)	2	2	2	2	2	2	2
Potential for forestry (L)	2	1	1	2	2	2	2
Potential for agricultural use (M)	2	2	3	2	3	3	3
Other land use potential (N)	1	1	1	1	1	1	1
Total score for land use value (J + K) * L * M *N	**20**	**8**	**15**	**16**	**30**	**30**	**24**
Total final score [(B * C * D + E) * F * G * H * I] + [(J + K) * L * M *N]	**26**	**32**	**71**	**32**	**54**	**54**	**80**
Priority for application of remedial measures* **	**2**	**2**	**3**	**2**	**2**	**2**	**3**

* Landuse: a. Open Maqui, o. Olive, n. Open Forest, f. Closed Forest, S. Field Crops, c. Citrus, q. Quarries.

** Minimum score is 1. Maximum score is 3.

*** 1: Low Priority (score of 20 and less), 2: Medium priority (score of 21 to 59), 3: High priority (score of 60 and more).

Table 5.7: Priority classes and prioritisation results of Kurdaha area

Unit N°	ID	Polygon No.	Area		Priority score	Priority Class	Priority
			Km^2	% (800m)			
1	001g	4	4.60	1.96	14	1	Low
2	002tg	3	3.48	1.48	12	1	
4	010	1	1.24	0.53	14	1	
5	011h	11	12.85	5.48	14	1	
6	011t	7	10.0	4.25	14	1	
7	011th	3	1.98	0.84	16	1	
8	011tv	1	1.27	0.54	14	1	
11	012t	1	0.49	0.21	14	1	
12	012th	5	2.61	1.11	18	1	
13	021	8	10.05	4.28	10	1	
14	022	11	9.65	4.11	18	1	
15	030	3	7.85	3.34	14	1	
16	031h	8	6.87	2.92	14	1	
17	032th	2	1.35	0.57	16	1	
18	040	2	21.58	9.18	19	1	
19	041	25	39.29	16.72	19	1	
21	051	2	1.07	0.45	12	1	
22	052tg	2	0.58	0.24	18	1	
23	061th	3	3.84	1.63	16	1	
Subtotal	**Stable**	**102**	**1096**	**935**	**-**	**-**	
25	C11	2	0.71	0.32	10	1	
26	C12	1	0.95	0.40	14	1	
35	M21	3	0.64	0.28	14	1	
36	P10	1	0.45	0.19	19	1	
Subtotal	**Unstable**	**211**	**2467**	**1989**	**-**	**-**	
Total	**Stable/Unstable**	**109**	**143.4**	**61.03**			
3	003tg	1	0.28	0.12	30	2	Medium
9	012gv	1	0.26	0.11	24	2	
10	012h	5	4.90	2.09	21	2	
20	042	10	14.45	6.15	25	2	
24	062	6	8.89	3.79	22	2	
Subtotal	**Stable**	**554**	**5385**	**4179**	**-**	**-**	
27	C21	3	1.01	0.43	24	2	
29	D12	1	0.96	0.41	21	2	
30	D22	1	0.65	0.27	44	2	
31	L11	6	5.77	2.45	26	2	
32	L12	9	9.52	4.05	30	2	
33	L21	5	4.04	1.72	30	2	
37	P11	7	3.73	1.58	28	2	
38	P12	16	13.50	5.76	44	2	
39	P21	1	0.63	0.27	48	2	
41	Q13	1	0.24	0.10	22	2	
42	W11	2	0.53	0.23	22	2	
Subtotal	**Unstable**	**1160**	**11363**	**8798**	**-**	**-**	
Total	**Stable/Unstable**	**75**	**69.39**	**29.53**			
28	C32	3	3.71	1.58	64	3	High
34	L22	4	2.36	1.00	68	3	
40	P22	13	13.88	5.91	64	3	
Total	**Unstable**	**20**	**23008.39**	**17781.53**	**-**	**-**	
43	Urban	5	2.26	0.96	-	-	

In total for Kurdaha area, about 8.49% (19.95 km^2) of the assessed area fall into the high priority class whereas 29.53% (69.39 km^2) were classified as medium priority areas and 61.03% (143.4 km^2) as low priority areas (Table 5.7).
The high priority areas in Kurdaha area were identified as unstable areas showing active erosion processes such as (Table 5.7):

- dominant multi process due to bad land management with a trend towards widespread expansion because the terraces are either degraded, partly-destroyed, broken, collapsed or abandoned terraces (P22).
- dominant gully networks with a trend towards widespread expansion or intensification (C32),
- dominant sheet erosion with a trend towards widespread expansion or intensification (L22).

In the medium priority class (Table 5.7), the stable areas form 12.26% (28.78 km^2) of the whole assessed area. These areas mainly comprise rehabilitated areas by means of terraces and a high instability risk (062). A smaller part is managed areas with agricultural use (042) with a high instability risk, and some areas are potential for forestry use only with high instability risk (012). Also some non-used wastelands with a high instability risk fall into the medium priority class. With regard to unstable areas, small proportion has been identified as medium priority (17.27% of the whole assessed area, i.e. 40.58 km^2). These areas showing active erosion processes with different degrees of instability risk such as:

- localised gully networks with trend towards local expansion (C21),
- localised and dominant rill erosion with trend towards widespread expansion or intensification (D12, D22),
- localised sheet erosion with trend towards local expansion and widespread expansion or intensification (L11, L12),
- dominant sheet erosion with trend towards local expansion or intensification (L21),
- localised multi process due to bad land management with a trend towards local expansion and widespread expansion (P11, P12),
- dominant multi process due to bad land management with a trend towards widespread expansion or intensification because the terraces are either degraded, partly-destroyed, broken, or abandoned terraces (P22),
- individual quarry with a trend towards increase generalised degradation (Q13),
- areas periodically flooded and/or sediment buried/ waterlogged areas with a trend towards local expansion (W11).

In the low priority classes (Table 5.7), the stable areas are dominant (59.84% of the whole assessed area, i.e. 140.65 km^2). These areas include all types of stability conditions as shown in the above table. While the unstable areas account for small proportion which is 1.19% (2.75 km^2) of the whole area. The priority classes for Kurdaha can be illustrated in Figure 5.6.

For Sheikh Bader area, about 16.17% (30.39 km^2) of the assessed area fall into the high priority class whereas 39.88% (74.91 km^2) were classified as medium priority areas and 42.53% (79.92 km^2) as low priority areas (Table 5.8).

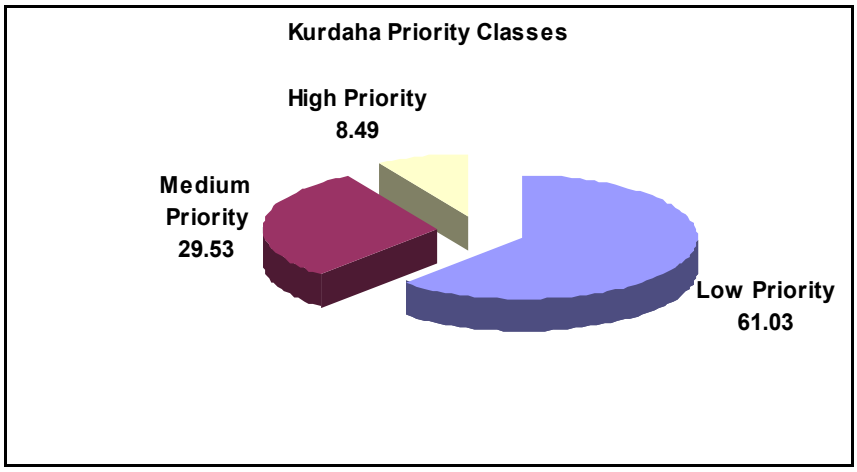


Figure 5.6: Kurdaha priority classes

In the high priority classes in Sheikh Bader area (Table 5.8), the unstable areas are dominant and showing two unstable conditions:

- dominant multi process due to bad land management with a trend towards widespread expansion or intensification due to the terraces are either degraded, partly-destroyed, broken, collapsed or abandoned terraces (P22), and
- dominant sheet erosion with a trend towards widespread expansion or intensification (L22).

In the medium priority class (Table 5.8), the stable areas form 15.26% of the whole assessed area, i.e. 28.68 km^2). These areas mainly comprise all types of stable areas with exception for stable non-used wastelands. With regard to unstable areas, larger proportion has been identified as medium priority and account for 24.62% of the whole assessed area, i.e. 46.23 km^2). These areas showing mainly two dominant unstable conditions, sheet erosion and multi process due to bad land management with varying degrees of instability risk:

- localised sheet erosion with trend towards local expansion and widespread expansion or intensification (L11, L12),
- localised multi process due to bad land management with a trend towards local expansion and widespread expansion (P11, P12),
- dominant multi process due to bad land management with a trend towards local expansion or intensification because the terraces are either partly-destroyed, broken, or abandoned terraces (P21).

In the low priority classes (Table 5.8), the stable areas form about 42.53% (79.92 km^2) of the whole area. These areas include all types of stability conditions as shown in the above table. The above mentioned priority classes for Sheikh Bader area can be illustrated in Figure 5.7.

Table 5.8: Priority classes and prioritisation results of Sheikh Bader area

Unit N°	ID	Polygon No.	Area		Priority score	Priority Class	Priority
			Km²	% (800m)			
1	011h	8	5.06	2.69	16	1	Low
2	011	17	13.67	7.27	16	1	
4	021h	4	12.38	6.58	19	1	
5	021t	3	1.37	0.73	16	1	
6	021th	5	6.64	3.54	19	1	
8	031	16	13.46	7.16	16	1	
10	041	18	17.72	9.44	19	1	
12	051h	1	0.90	0.48	16	1	
14	061	11	8.72	4.64	19	1	
Total	**Stable**	**83**	**567**	**491**	**-**	**-**	
3	012	16	17.66	9.39	28	2	Medium
7	022	6	3.82	2.03	25	2	
9	032	3	0.81	0.43	24	2	
11	042	3	3.17	1.69	25	2	
13	052h	2	0.52	0.28	24	2	
15	062	3	2.70	1.44	25	2	
Subtotal	Stable	33	1527	1221	-	-	
16	L11	8	6.31	3.36	26	2	
17	L12	4	4.76	2.52	32	2	
19	P11	9	9.11	4.85	32	2	
20	P12	7	12.05	6.43	54	2	
21	P21	12	14.00	7.46	54	2	
Subtotal	Unstable	40	3222	2726	-	-	
Total	**Stale / Unstable**	**73**	**74.91**	**39.88**	**-**	**-**	
18	L22	9	10.47	5.56	71	3	High
22	P22	12	19.92	10.61	80	3	
Total	**Unstable**	**21**	**30.39**	**16.17**	**-**	**-**	
23	Urban	4	1.94	1.04	-	-	

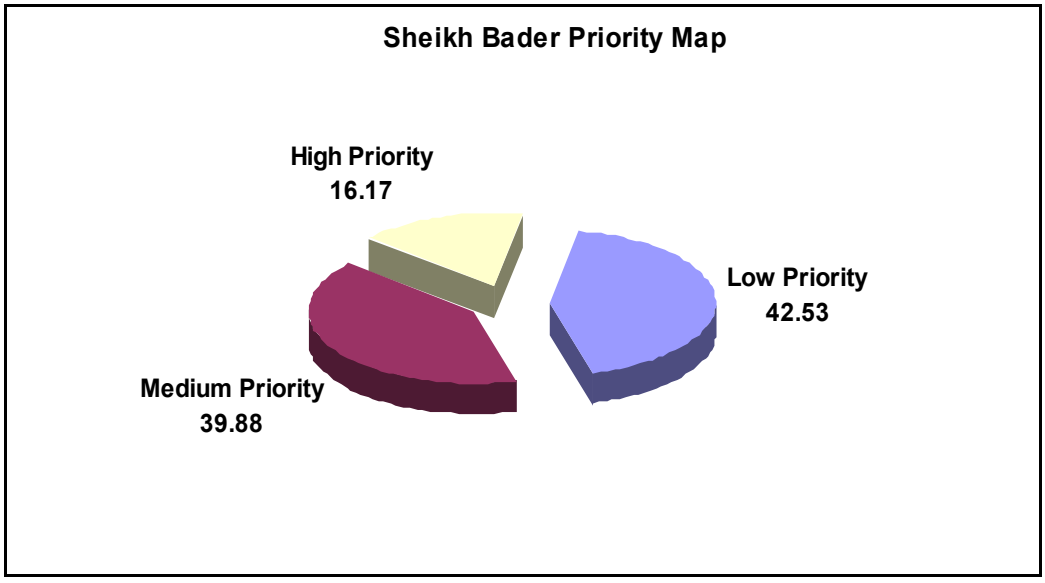


Figure 5.7: Sheikh Bader priority Classes

In general for Kurdaha area, the hot spots mainly occur in southern parts of Kurdaha city near the villages of Katrabia and Marj Mousa as well as in the south-eastern parts around the villages of Arosa Aljabal and Horan Albodi. The gully networks are common near the south of Kurdaha city where human activities and geology are the main erosive factors (Photo 1), refer to Annex 3, “Photos of Unstable Areas” for all photos. This area need the highest priority for remedial measures and represented by Unit No. 28 in the prioritisation scheme presented in Table 5.4. Also, near Katrabia the localised rill erosion (Photo 2) and individual gully networks (Photo 3) are very common due to the causative agents of human activities, geology and vegetation cover. According to the prioritisation procedure these areas have medium to high priority for remedial measures and represented by Unit No. 30 and Unit No. 28 respectively in Table 5.4. The sheet erosion is dominant with trend to widespread expansion near the village of Nina (Photo 4, Photo 5). Furthermore, the multi process due to bad land management is also dominant to the west and south of Nina near the villages of Bhoraia (Photos 6), Arkoub (Photo 7), Arosa Aljabal (Photo 8) and Boudi (Photo 9) due to collapsed or abandoned terraces. These areas need the highest priority for remedial measures and represented by Unit No. 40 in the prioritisation scheme presented in Table 5.4. To sum up, the main hot spot are in Kurdaha area (Map 5.7) is located to the south of Kurdaha city due to gully erosion, sheet erosion, rill erosion and multi process due to bad land management.

As for the area of Sheikh Bader, the hot spots largely occur (Map 5.8) to the north western and southern parts of Sheikh Bader city and suffer mostly from sheet erosion and bad land management due to broken or abandoned terraces. However, in the eastern parts separated spots near Mejber (Photo 10 and Photo 11) and the Green valley (Photo 12) suffer from the sheet erosion. These two spots are represented by Unit No. 17 and unit No. 16 respectively and thus have medium priority for remedial measures according to the prioritisation scheme presented in Table 5.6.

Firstly in the southern areas, the hot spot mainly occur near the villages of Srijis (Photo 13 and Photo 14), Bishmis (Photo 15 and Photo 16) and Bgamlikh (Photo 17). While these hot spots have the highest priority for remedial measures and represented by Unit No. 18 in the prioritisation scheme presented in Table 5.8.

Secondly in the north western areas, the hot spots suffer from sheet erosion mainly exist near Alkosiba (Photo 18) and Alssaflia (Photo 19). These areas suffer from serious dominant sheet erosion with a trend towards expansion and intensification due to the slope steepness, human activities and vegetation. Also, these areas need the highest priority for remedial measures and represented by Unit No. 18 in the prioritisation scheme presented in Table 5.8. Another area suffer form localised sheet erosion is located near Wardia village (Photo 20), and according to the prioritisation procedure this area has medium priority for remedial measures and belong to Unit No. 16 in the Table 5.8. While the hot spots which consider as unstable areas due to "multi process due to bad land management" mainly exist near the villages of:

- Zafarana (Photo 21) (Unit No. 22, High Priority);
- Plat (Photo 22) (Unit No. 22, High Priority);
- Kamseya (Photo 23) (Unit No. 21, Medium Priority);
- Arkobkamso (Photo 24) (Unit No. 19, Medium Priority); and
- Shbobia (Photo 25) (Unit No. 22, High Priority).

All these areas are classified as unstable areas because the terraces are either degraded, partly-destroyed, broken, collapsed or abandoned terraces. According to the prioritisation procedure these areas have medium to high priority for remedial measures.

Map 5.7: Kurdaha priority map

Map 5.8: Sheikh Bader priority map

Field data show that, for all those areas, erosion processes are much more active not only where no conservation practices are applied but also where such practices are not maintained. Furthermore, degraded or partly-destroyed terraces may cause or even accelerate intensive erosion processes, therefore, maintenance interventions such as repairing partially-collapsed terraces seem to have the same importance as the application of new land management measures.

Finally, in order to facilitate comparison of predictive mapping and descriptive mapping for a given situation comprehensive tables with detailed data on polygons for both pilot areas (predictive mapping code, descriptive mapping class, priority score and priority class) were given in Annex 4.

6. REMEDIAL MEASURES

It is an old adage that an ounce of prevention is worth a pound of cure. This certainly applies to soil erosion control. Generally in both pilot areas, all currently applied remedial measures are based on either reducing raindrops impact or reducing runoff to lessen detachment. Reducing raindrops impact is done by growing crops, or by leaving crop residues on the surface. Reducing or slowing runoff reduces the amount of soil that can be transported. Contour tillage and terracing both reduce runoff. Usually, the remedial programs aim at identifying the resources to be protected or restored, selecting elaborate remedial measures and then implementing the selected remedial measures according to priorities. Furthermore, both pilot areas are characterised by stony lands and hard accessibility. These two characteristics make implementing the remedial measures and reclamation activities hard, and need a large budget.

6.1 CURRENTLY APPLIED REMEDIAL MEASURES

The traditional remedial measures aimed at mitigation and control management of erosion processes, predominantly applied in the past and still prevailing in the present practice, proved in many occasions to be counter productive, inefficient, and implying failure risk. The currently applied remedial measures include all preventive, curative, and protective measures. In general the first objective of these measures is to prevent, or stop the spread of degradation, rehabilitate the degraded lands and recuperate their productivity wherever possible. The second objective is to restore and reserve soil productivity, and raise its productivity.

The *preventive measures* usually applied in order to secure erosion prone areas, prevent the occurrence of degradation phenomena in lands which are not yet degraded, or which are only slightly degraded. The currently applied preventive measures in both pilot areas include the following:

- Terracing: construction of terraces may be considered as the oldest and most common erosion control method in the region. In some places of the two pilot areas, entire hillsides have been modified into a series of steps by bench terraces, each one supported by a retaining wall made of stones. Terraces have been used compatibly with modern agriculture. In these cases ridges are built several meters apart across the slope of the hills to trap the water falling on the soil between terraces. Generally, Farmers establish terraces to shortening the length and steepness of slopes. These terraces are built on the expense of farmers without any financial and technical assistance, thus the terraces in a lot of places are poorly constructed and maintained. Besides, in areas where stones are scarce, terraces are built without stone walls. Consequently, these terraces are subject to the threat of rainfall and thus consider ineffective and unproductive preventive measure.
- Contour tillage: farmers especially in the hilly areas avoid ploughing straight up and down a slope and reduce tillage to protect the top soil against raindrop impact (splash effect). Tillage along contours can reduce the rate of runoff water flow down the slope. Slow-moving water does not have the energy to transport a large load, and the lower speed allows more time for the water to infiltrate.
- Adding crop residues into the soil and growing winter cover crops: this is an attempt to protect the soil surface with crop residue, increase fertility, and improve aggregate stability. Present trends are to maintain some residues on the soil surface to save moisture and prevent erosion. A mulch or cover of crop residues absorbs the energy of a falling raindrop, lessens detachment, and reduces the sealing of the soil surface. Mulches also slow down runoff water.

- Applying fallow periods: where some farmers leave their lands unplanted one season every one to two years, in order to increase soil fertility and rest the land. This procedure leads to increasing in organic matter content in the soil and thus binding soil particles together. This practice mainly occurs in the plain areas where filed crops, chickpea, wheat or tobacco, are planted. Unfortunately, this measure is adopted by a very small number of growers in both pilot areas and mainly where land property is large.
- Crop rotation: crop rotation means that a series of different crops (mainly wheat and tobacco) is planted on the same piece of ground in a repeating cycle. In parallel, many farmers don't rotate crops because it means planting some less profitable ones. Crop rotation has important benefits for those who practice it such as reducing erosion by improving soil's physical properties so that water seeps into the soil better as well as increase organic matter which binds individual particles together thus increasing aggregate strength, hence the resistance to detachment.
- Ban and restriction on forest cutting and forest fire: there are very restrictive laws preventing fire in the forestlands and other laws less restricted concerning forest cutting.
- Prevent grazing in the forestland: as of recently, grazing is extremely forbidden in the woodlands. Although grazing can still be seen in the marginal land.
- Prevent transferring forestland into arable or urban lands: the government legislated certain laws in order to stop transferring the woodlands into other urban or agricultural lands.

The *curative measures*, which are be applied in order to rehabilitate the eroded areas, in other words rehabilitate the productivity of moderately-degraded lands. As far as marginal land or less agriculture suitable areas are concerned, reforestation is the best ecologically adapted and most efficient soil erosion control technique. Currently applied curative measures are:

- Applying aforestation and reforestation programs: these programs offer the best ecologically adapted and most efficient soil erosion control techniques. Usually reforestation is used in degraded forest and marginal lands.
- The erosion control methods on the forestlands should be directed toward identification and characterisation of unstable ground and avoidance of disturbances on the steep slopes.
- Construction of water outlets: some farmers in Kurdaha area dig outlet channels to drain excess water accumulated at the edges of the terraces. This water is then collected and directed to places for reusing in irrigation or storing without causing any damage.
- Construction of rural roads: such measure may ease machinery and farmers access the difficult-access lands.

The *protective measures*, which are dedicated to protect stable areas from expanding erosion processes, include the currently applied measures:

- Build national reserve: the mountainous areas are a forestland, so there is a great need to build national reserves in order to minimise the soil erosion rates and simultaneously protect the endanger plant species. This action can keep the forestland productivity and biodiversity. Unfortunately, there is only one national reserve in the southern part of Kurdaha area.
- Creation of fire break lines: in some good woody areas, fire break lines are constructed in order to control the fire in case of forest fire.
- Execution of reclaiming projects: some projects are currently active in the area of Sheikh Bader such as the reforestation project and the agriculture development project. While in Kurdaha area the currently active projects are the reclamation of

stony-lands project, the fruit trees plantation project, the martyr Ali Al-Ali project, and the agriculture development project.

- Educate and instruct the local people on the importance of forestland and land management.

6.2 POSSIBLE PREVENTIVE AND CURATIVE MEASURES

Generally, the possible preventive and curative measures include agronomic measures, reforestation measures, physical measures, and socio-economic measures. All these measures should be applied in order to protect the land and forest as well as to improve the life condition of the rural community in both pilot areas. Some *preventive measures* to be considered are as follows:

- Incorporating green manure: this measure is necessary to increase soil productivity and improve its water infiltration rates due to improving in organic matter content which can greatly reduce erosion because moisture will seep into the soil more quickly.
- Installation of check dams for rill erosion control and stabilisation of rill heads, since concentration of runoff water through the hillside ditches increases rill development.
- Applying drainage control and land consolidation measures on active erosion processes to minimise disturbance of highly susceptible areas.
- Protection and improvement of the locally adapted bushy/shrubby formations: such procedures can decrease soil erosion rates.

The *curative measures* to be applied are as follows:

- Forest management to improve the extension and density of soil coverage by the means of natural vegetation in order to protect soil against the harmful impact of runoff.
- Reclaiming the moderate slope and unusable lands in a sound manner followed by reforestation activities directly.
- Increase cattle breeding rates in less productive lands, such as south of Kurdaha city, where bare soil is dominant. The cattle wastes lead to increase in soil productivity. This procedure should be supported by governmental loans and aids.
- Plantation of fruitful-forest species such as Pinus Pinea, Castania Vesca, Ceratonia Siliqua, and Crataegus Spp. in northern parts of Sheik Bader, valleys, and mountain peaks where soil is shallow and less productive. The same species could be planted in Kurdaha area especially the Laurel (Daphne) and species suitable for bee breeding.
- Prevent plantation of olive on mountain peaks, valleys and northern slopes against sun direction, because olive may face a lot of diseases and mainly *Bacterial Knot* and *Spiloceae Oleagina*. Olive plantation in these areas should be replaced by the above mentioned species in Sheikh Bader area.
- Opening remote and marginal rural areas, thus favouring new markets and commercial exchanges, this measure provides a media for information exchange, demarcate the human expansion away from the natural vegetation cover and fertile agriculture lands, and decrease soil compaction.
- Providing training and infrastructure to rural population for improved agriculture by the means of participatory approaches and actions, to keep the farmers updated with the latest techniques in soil conservation, and to find alternatives for their daily needs from the forest timber.
- Promoting mutual confidence between rural communities and government authorities.
- Provide financial aids to local farmers to enable them reclaim their lands in a sound manner.

- Allocate some of the industrial projects in rural areas in order to improve economic conditions in these areas and thus mitigate the emigration flow toward big cities.
- Installation and implementation of special funds and/or co-operative facilities to attend local emergencies and priorities.
- Capacity building for forest-guards. Recently, most of those guards are not well qualified and need training on forest management.
- Improvement and strengthening of local policies.
- Creation and promotion of extra-agriculture activities, such as tourism and handicrafts.

6.3 ASSESSMENT PROCEDURE FOR REMEDIAL MEASURES

This paragraph describes the assessment of the remedial measures presented in sections 6.1 and 6.2 by applying a procedure which allows us to select the right measures. The output is an assessment grid of remedial measures in the format of a rating table which includes several rating criteria such as:

- suitability for identified degradation processes (Low/High),
- investment costs/maintenance costs (Low/High),
- labour intensity (Low/High),
- suitability for national and/or local development priorities (Low/High),

In the assessment table, the rates are from 1 to 5, where 1 is low and 5 is high, as presented in Table 6.1and Table 6.2. After presenting the rates, it's very easy to select the suitable remedial measures for both pilot areas.

Table 6.1: Assessment procedure for current remedial measures

	Remedial Measures	Rating				Suitability to development at	
		effect on degradation	investment costs	maintenance costs	labour intensity	National level	Local level
Preventive	**Terracing**	5	5	5	5	5	5
	Contour tillage	5	5	5	3	5	5
	Adding crop residues into the soil	4	3	3	3	2	3
	Applying fallow periods	3	2	2	2	2	3
	Crop rotation	3	2	2	2	3	3
	Ban and restriction on forest cutting and forest fire	5	4	4	3	4	4
	Prevent grazing in the forestland	4	2	2	1	3	4
	Prevent transferring forestland into arable or urban land	5	3	2	1	4	4
Curative	**Applying afforestation and reafforestation programs**	5	5	5	5	4	4
	Identification and characterization of unstable ground	5	3	3	2	3	3
	Construction of water outlets	5	5	4	4	4	5
	Construction of rural roads	5	4	3	3	3	5
Protective	Build national reserves	5	2	2	3	5	5
	Construction of fire lines (breaks)	4	5	3	3	4	4
	Execution of Reclaiming project s	5	5	5	5	5	5
	Instruct and educate the local people	5	4	3	3	4	4

Based on the rate values presented in Table 6.1, the currently preventive remedial measures should be mainly directed towards construction of terrace, applying tillage practices along with contour lines, and towards formulation of legislations concerning forest cutting and forest fire respectively. While, the currently curative remedial measures should be directed towards applying aforestation and reforestation programs, construction of water outlets, and construction of rural roads respectively. Besides, the currently protective remedial measures should be directed towards execution of reclamation projects, construction of fire breaks, and educate the local people to the importance of forestland and land management respectively.

The same assessment procedure was applied to the possible remedial measures to be taken in both pilot areas. The assessment result is presented in Table 6.2 which can be used to select the appropriate remedial measure.

Based on the rate values presented in Table 6.2, the possible preventive remedial measures should be mainly directed towards applying drainage control and land consolidation measures on active erosion processes, Installation of check dams for rill erosion control, and protection and improvement of the locally adapted bushy/shrubby formations respectively. While, the possible curative remedial measures should be directed towards reclaiming the moderate slopes and unusable lands, providing training and extension facilities to rural population, provide financial aids to local farmers, allocate industrial projects, and increase cattle breeding rates respectively.

Table 6.2: Assessment procedure for possible remedial measures

	Remedial Measures	Rating				Suitability to development at	
		effect on degradation	investment costs	maintenance costs	labour intensity	National level	Local level
Preventive	Incorporating green manure	4	3	3	3	4	4
	Construction of check dams	**5**	**5**	**5**	**3**	**4**	**4**
	Applying drainage control	**5**	**5**	**5**	**5**	**5**	**5**
	Protection of the locally adapted bushy/shrubby formations	5	4	3	3	5	4
Curative	**Forest management**	**5**	**4**	**4**	**4**	**5**	**5**
	Reclaiming moderate slopes and unusable lands	**5**	**5**	**5**	**5**	**5**	**5**
	Increase cattle breeding rates	4	4	4	4	4	5
	Plantation of fruitful-forest species	4	4	3	3	4	5
	Prevent plantation of olive	3	2	2	2	4	5
	Opening remote and marginal rural areas	4	4	2	3	5	5
	Providing training to rural population	**5**	**5**	**5**	**4**	**5**	**5**
	Promoting mutual confidence	4	2	2	2	3	3
	Provide financial aids	**5**	**5**	**4**	**4**	**5**	**5**
	Allocation industrial projects	**4**	**5**	**4**	**4**	**5**	**5**
	Installation and implementation of special funds	3	4	3	2	3	5
	Capacity building for forest-guards	4	3	3	2	4	4
	Improvement and strengthening of local policies	5	4	2	2	5	5
	Promotion of extra-agriculture activities	4	3	3	2	4	4

6.4 RECOMMENDATIONS FOR REMEDIAL MEASURES

In this section recommendations are given for the remedial measures to be applied for each intervention area in both areas of Kurdaha and Sheikh Bader. The currently preventive remedial measures in those areas should be mainly directed towards terracing, contour tillage, and legislating of laws concerning forest cutting and forest fire. Recommendations for these currently preventive remedial measures can be described as follows:

- Construction of terraces is very common in the area, and is used to shorten the length and steepness of slopes to be used for plantation. Although terraces are costly to install the farmers construct them because there is either shortage of good land or easy accessible land. Terraces construction begins by designing them to fit conservation needs without overly hampering farming and should be directly followed by plantation. Growers must be careful to maintain terraces because without proper care terraces cannot be effective like those terraces near the villages of Srijis and Bishmis in the Sheikh Bader area. Two kinds of terraces can be built in the area:
  - Level terraces parallel with the slope and don't empty into a waterway. This type of terraces is used where the soil is permeable enough so water can seep in once it is captured in a terrace.
  - Graded terraces are needed where the water can not soak into the soil sufficiently. This may slope gently towards a waterway or be drained by an outlet, the drained water can then be collected and reused in various ways.
- Contouring tillage may be considered as conservation tillage because it reduces loss of soil or water relative to conventional tillage. Contour tillage techniques might be applied in various ways, as reduced tillage, no tillage, or direct drilling. Contour tillage should be practised on all terraced land. This reinforces the effectiveness of the terraces because each tillage furrow acts as a miniature terrace. On less steep land, contour tillage is also effective without terraces. An adaptation of contour tillage is contour furrowing. This consists of pulling a series of narrow chisels on the contour through the soil at a depth of 15 – 30 cm. The objective is to increase water infiltration. Contouring tillage should be implemented in rotation between the inner side and outer side of the terraces because the continuous tillage from one side leads to soil accumulation at the outer ridge of the terraces.
- Legislating of laws concerning forest cutting and forest fire, these laws should take into account the daily needs of the local people and the mutual benefit between forest and rural community.

As for the current curative remedial measures, these should be directed mainly towards applying aforestation and reforestation programs, construction of water outlets, and construction of rural roads respectively. Recommendations for these current curative remedial measures can be described as follows:

- For the aforestation, the Government plants trees on lands which were formerly used for land uses other than forestry. This usually takes place in difficult accessible areas. Also, the Government restocks the existing woodlands which have been depleted, i.e., reforestation. The reforestation should exceed the rate of forest removal, and plantation of fruitful-forest species such as *Pinus Pinea, Castania Vesca, Ceratonia Siliqua, and Crataegus Spp* in order to improve local income and thus decrease the negative influence of the human activity on natural resources.
- The construction of water outlets. Farmers have recently started digging water outlets in some areas mainly in Kurdaha in order to get rid of excess water of terraces. This measure is an extremely important matter when setting up the terraces network on the slopes, particularly in the case of draining terraces, since all excess water

accumulates at the edges of the terraces. It is necessary to collect this water and direct it to places for reusing in irrigation or for storing it without causing any damage. This shows us the importance of specifying the places and nature of the water outlet from the start, i.e. when planning the terrace network in order to prevent the formation of floods and soil erosion. The water outlet must be set up in a way that can secure the maximum flow of the flowing water. Among the most important outlets are:

  - Natural water outlets: which rely on benefiting from the natural depression, furrows, and natural prairies as water outlets and distribution.
  - Artificial water outlets: mainly there are two types for such kind of outlets. *Outlets covered with grass*: these are wide canals that are planted with grass, having maximum gradient of 0.5-4%. But when the terrain slope is very severe, cement barriers and skids are built to reduce the gradation of the slope. It's preferable that the length of the outlets doesn't exceed 800-1000 meters. *Outlets covered with different materials:* here mechanical methods are restored to for protecting the water outlet by cramming stones or asphalt and even using metal pipes.

- The construction of rural roads is currently used as a curative remedial measure. These roads are used by farmers and local people to reach their fields and communicate with each other. These roads should take into account the slope length and gradient, and do not totally go straight with slope direction. It is preferable to take the meander shape. Usually, the road is constructed by local farmers when it is short, and when it is long the road is constructed by projects working in the area. At present, there is a yearly plan in Kurdaha area to construct rural roads by those projects taking into account the total area and number of farmers who could benefit from the roads.

The current protective remedial measures should be directed towards execution of reclamation projects, construction of fire breaks, and educate the local people on the importance of forestland and land management respectively. Recommendations for these current protective remedial measures can be described as follows:

- The reclamation projects active in the area are mainly devoted to reforestation and terracing activities. These projects should consider planting of fruitful forest species, plantation processes should be implemented directly after construction of terraces, and growers should get help to construct terraces, water outlets, rural ways and plantation in their own fields.
- Construction of fire lines or fire breaks with suitable intervals in case of fire in the forest. Constructing these fire lines enables to reach the fire quickly and thus control it before spreading. These lines should be directed towards avoidance of disturbance on steep slopes and those slopes highly susceptible to soil erosion.
- Educating the local people on the importance of forestlands and land management and involving them in forest planning and management in attempt to find alternatives for their daily needs from the forest timber. This measure can be implemented through training courses, media, seminars, participatory programs, exhibitions, brochures, etc.

As mentioned earlier, the possible preventive remedial measures should mainly be directed towards applying drainage control and land consolidation measures on active erosion processes, installation of check dams for rill erosion control, and protection and improvement of the locally adapted bushy/shrubby formations respectively. Recommendations for those possible preventive remedial measures can be described as follows:

- Applying drainage control and land consolidation measures on active erosion processes: the currently adapted waterways outlets, conservation tillage, and terraces

are not constructed in a sound manner. Recommendations were given above for optimum implementation.

- Installation of check dams for rill erosion control: the function of installing these anti-erosive structures is to intercept surface runoff, convey it out of the field, and collect it to be reused in irrigation. One principle point to take into account is the concentration of runoff water through the hillside ditches increases rill and gully development if farmers do not take any specific conservation and maintenance measures.
- Protection and improvement of the locally adapted bushy and shrubby formations. This measure leads to improvement of the extension and density of soil coverage by the means of natural vegetation. These formations are subject to human pressure more than forestlands in the context of transferring into arable lands.

The possible curative remedial measures should be directed towards reclaiming the moderate slopes and unusable lands, providing training and infrastructure to rural population, providing financial aids to local farmers, allocating industrial projects, and increasing cattle breeding rates. Recommendations for these possible curative remedial measures can be described as follows:

- Forest management to improve the extension and density of soil coverage by the means of natural vegetation in order to protect soil against the harmful impact of runoff.
- Reclaiming the moderate slopes and unusable lands. This measure should be directly followed by plantation processes. At present, the main two obstacles facing reclaiming activities are related to land tenure and accessibility. The total land needing reclamation should belong to one specific farmer otherwise reclaiming activities cannot be implemented. So, this issue needs to be solved in order to facilitate reclamation processes.
- Providing training and infrastructure to rural population for improved agriculture by means of participatory approaches and actions.
- Provide adequate and satisfactory financial aids to local farmers and in particular to farmers in mountainous regions. This measure can motivate farmers to adopt the desired measures. In this respect, incentives and disincentives are policy instruments that change the comparative advantage of an economic activity and, thus, stimulate or deter specific behaviour. Direct subsidies should be broadly distributed because erosion control management programs require expenditures, in most cases far above the amounts immediately and regularly available.
- Allocate industrial projects. This measure can mitigate emigration flow and improve the economic conditions of the rural community where there is a great shortage of such installations in the area.
- Increase cattle breeding rates, in areas where there is a shortage in soil fertility and productivity. The areas south of Kurdaha city are unstable areas, and encouraging local people to adopt cattle breeding activities can support the soil with organic matter and thus improve its fertility and productivity. Thus, the Government should implement a flexible loan system to enable farmers to adopt cattle.

Based on the results of the assessment procedures presented in Tables 6.1 and 6.2, the measures recommended for each main intervention area (as identified in chapter 5) are summarised in below Tables 6.3 and 6.4. These measures include both current and possible remedial measures.

Table 6.3: Recommended remedial measures for the stable intervention areas

Intervention areas	Optimum Remedial Measures	
	Preventive	**Protective**
Non-used wasteland (00)	▪ Protection of the bushy/shrubby formations	▪ Execution of reclaiming projects
Unmanaged areas with potential for forestry use only (01)	▪ Restriction on forest cutting and forest fire	▪ Construction of fire break lines ▪ Instruct and educate the local people to the importance of forest lands
Unmanaged areas with agricultural potential (02)	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Applying drainage control measures	▪ Execution of reclaiming projects ▪ Instruct and educate the local people to the importance of forest lands and land management
Managed areas with forestry use only (03)	▪ Restriction on forest cutting and forest fire	▪ Construction of fire break lines ▪ Instruct and educate the local people to the importance of forest lands and land management
Managed areas with agricultural use (04)	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Applying drainage control measures	▪ Execution of reclaiming projects ▪ Instruct and educate the local people to the importance of forest lands and land management
Rehabilitated areas by means of natural or artificial re-vegetation (05)	▪ Protection of the bushy/shrubby formations ▪ Restriction on forest cutting and forest fire	▪ Instruct and educate the local people to the importance of forest lands ▪ Execution of reclaiming projects
Rehabilitated areas by means of physical infrastructures (06)	▪ Construction of check dams ▪ Applying drainage control measures	▪ Execution of reclaiming projects

The above table shows the preventive measures needed for the stable intervention areas with emphasis on forest management and forest treatment, construction of terraces, applying contour tillage, installation of anti-erosive structures mainly check dams, and applying drainage control and land consolidation measures on active erosion processes to minimise disturbance of highly susceptible areas. The curative measures to be applied for the stable intervention areas should emphasise the education of the rural community on the importance of forestland and land management, execution of reclaiming projects, and construction of fire break lines.

Table 6.4: Recommended remedial measures for the unstable intervention areas

Intervention areas	Optimum Remedial Measures	
	Curative	Protective
Localised sheet erosion (L1)	▪ Construction of water outlets ▪ Construction of rural roads ▪ Provide training to rural population for improved agriculture ▪ Provide financial aids	▪ Execution of reclaiming projects
Dominant sheet erosion (L2)	▪ Applying reforestation programs ▪ Avoid disturbance of unstable ground ▪ Construction of water outlets ▪ Construction of rural roads ▪ Forest management	▪ Instruct and educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects
Localised rill erosion (D1)	▪ Applying reforestation programs ▪ Forest management ▪ Avoid disturbance of unstable ground	▪ Instruct and educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects
Dominant rill erosion (D2)	▪ Construction of water outlets ▪ Construction of rural roads ▪ Avoid disturbance of unstable ground	▪ Instruct and educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects
Individual gullies (C1)	▪ Avoid disturbance of unstable ground	▪ Execution of reclaiming projects
Localised gully networks (C2)	▪ Construction of water outlets ▪ Avoid disturbance of unstable ground	▪ Execution of reclaiming projects
Dominant gully erosion (C3)	▪ Applying reforestation programs ▪ Avoid disturbance of unstable ground ▪ Construction of water outlets	▪ Execution of reclaiming projects
Localised land slides (M2)	▪ Applying reforestation programs ▪ Avoid disturbance of unstable ground	▪ Execution of reclaiming projects
Dominant mass earth movements (M3)	▪ Applying reforestation programs ▪ Avoid disturbance of unstable ground	▪ Execution of reclaiming projects
Areas periodically flooded and/or sediment buried (W1)	▪ Applying reforestation programs	▪ Instruct and educate the local people to the importance of forest lands and land management
Localised quarrying (Q1)	▪ Avoid disturbance of unstable ground	
Localised multiple processes due to bad land management (P1)	▪ Construction of water outlets ▪ Provide financial aids	▪ Instruct and educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects
Dominant multiple processes due to bad land management (P2)	▪ Construction of water outlets ▪ Construction of rural roads ▪ Provide training to rural population for improved agriculture ▪ Provide financial aids	▪ Instruct and educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects

The above table reveals that curative measures to be applied for the unstable intervention areas should be directed to construction of water outlets and rural roads, provide financial aids and training to rural population, and apply reforestation programs and forest management activities. The protective measures needed for the unstable intervention areas show the importance of two main procedures: instruct and educate the local people on the importance of forest lands and land management, as well as execute reclaiming projects.

7. DRAFT MANAGEMENT PLANS

7.1 OUTLINE OF MANAGEMENT PLANS

Effective land degradation control consists of site-specific land management and related remedial measures. In the following text the findings of chapter 5, 6, and 9 are summarised in the form of outlines of management plans (Tables 7.1 and 7.2) for both pilot areas, Kurdaha and Sheikh Bader, stating:.

- identification and precise delineation of specific intervention areas, their type of problems and grade of priority, and the selection of remedial measures to be applied;
- specification of institutional and administrative arrangements, including local contributions, and participation modalities at both decisional and implementation levels; and
- monitoring indicators for on-going activities and potential environment impacts.

Furthermore, the overall activities necessary for realisation of the proposed management plans are briefly specified in Table 7.3 in the format of an overall project planning.

Table 7.1: Outline of draft management plan for Kurdaha area

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
C32 (28)	High	▪ Applying reforestation programs ▪ Restriction on forest cutting and forest fire ▪ Avoid disturbance of unstable ground ▪ Construction of water outlets ▪ Execution of Reclaiming projects ▪ Educate the local people ▪ Construction of check dams ▪ Protection of the locally adapted bushy/shrubby formations	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Rills and gullies on the soil surface ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation
L22 (34)	High	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
P22 (40)	High	▪ Terracing ▪ Avoid disturbance of unstable ground ▪ Construction of water outlets ▪ Construction of rural roads ▪ Reclaiming moderate slopes and unusable lands ▪ Providing training to rural population ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
003tg (3)	Medium	▪ Protection of the bushy/shrubby formations ▪ Applying reforestation programs ▪ Execution of reclaiming projects ▪ Avoid disturbance of unstable ground ▪ Educate the local people	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land productivity ▪ Land cover degradation ▪ Landuse/land cover changes
012 (9, 10)	Medium	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area
042 (20)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Farmers ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Poorer plant growth ▪ Roots appearance ▪ Collapsed terraces

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
062 (24)	Medium	▪ Construction of check dams ▪ Construction of water outlets ▪ Applying drainage control measures ▪ Execution of reclaiming projects ▪ Provide financial aids ▪ Educate the local people	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Landuse/land cover changes ▪ Land productivity ▪ Rebuilding of terraces ▪ Percentage of land under active conservation management ▪ Sediments in streams, lakes and reservoirs
C21 (27)	Medium	▪ Applying reforestation programs ▪ Restriction on forest cutting and forest fire ▪ Protection of the locally adapted bushy/shrubby formations ▪ Construction of water outlets ▪ Avoid disturbance of unstable ground ▪ Execution of reclaiming projects	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Rills and gullies on the soil surface ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation
D12 (29)	Medium	▪ Contour tillage ▪ Applying reforestation programs ▪ Protection of the locally adapted bushy/shrubby formations ▪ Forest management ▪ Avoid disturbance of unstable ground ▪ Educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Farmers ▪ Media	▪ Rills and gullies on the soil surface ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators
D22 (30)	Medium	▪ Tillage ▪ Protection of the locally adapted bushy/shrubby formations ▪ Construction of water outlets ▪ Construction of rural roads ▪ Avoid disturbance of unstable ground ▪ Educate the local people to the importance of forest lands and land management ▪ Execution of reclaiming projects	▪ Directorates of Agriculture in Latakia ▪ Directorate of Forest in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Farmers ▪ Media	▪ Rills and gullies on the soil surface ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators
L11 (31)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Sediments in streams, lakes, and reservoirs ▪ Poorer plant growth ▪ Collapsed terraces

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
L12 (32)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
L21 (33)	Medium	▪ Terracing ▪ Construction of water outlets ▪ Construction of rural roads ▪ Execution of Reclaiming projects ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
P11 (37)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
P12 (38)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
P21 (39)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
Q13 (41)	Medium	▪ Avoid disturbance of unstable ground ▪ Allocation of industrial projects	▪ Municipality in Kurdaha ▪ Business sector	▪ Habitats indicator and biodiversity indicators ▪ Landuse/landcover change ▪ Population growth ▪ Employment rate
W11 (42)	Medium	▪ Applying reforestation programs ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Latakia ▪ Media	▪ Sediments in streams, lakes, and reservoirs ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
001g (1)	Low	▪ Protection of the bushy/shrubby formations ▪ Applying reforestation programs ▪ Execution of reclaiming projects ▪ Avoid disturbance of unstable ground ▪ Educate the local people	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land productivity ▪ Land cover degradation ▪ Landuse/land cover changes
002tg (2)	Low	▪ Protection of the bushy/shrubby formations ▪ Applying reforestation programs ▪ Execution of reclaiming projects ▪ Avoid disturbance of unstable ground ▪ Educate the local people	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land productivity ▪ Land cover degradation ▪ Landuse/land cover changes
010 (4)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area
011 (5, 6, 7, 8)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area
012 (11, 12)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area
021 (13)	Low	▪ Terracing ▪ Contour tillage ▪ Applying drainage control measures ▪ Construction of rural roads ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Farmers ▪ Agricultural Bank ▪ Media	▪ Loss of top soil ▪ Root appearance ▪ Abandoned Agriculture lands ▪ Treatment of vacant lands ▪ Landuse/land cover changes

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
022 (14)	Low	▪ Terracing ▪ Contour tillage ▪ Applying drainage control measures ▪ Construction of rural roads ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Municipalities in Latakia ▪ Farmers ▪ Agricultural Bank ▪ Media	▪ Loss of top soil ▪ Root appearance ▪ Abandoned agriculture lands ▪ Treatment of vacant lands ▪ Landuse/land cover changes
030 (15)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands and land management ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Landuse/landcover changes
031h (16)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands and land management ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Landuse/landcover changes
032th (17)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands and land management ▪ Forest management	▪ Directorates of Forest in Latakia ▪ Municipalities in Latakia ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Landuse/landcover changes
040 (18)	Low	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Farmers ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Poorer plant growth ▪ Roots appearance ▪ Collapsed terraces
041 (19)	Low	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Farmers ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Poorer plant growth ▪ Roots appearance ▪ Collapsed terraces
051 (21)	Low	▪ Protection of the bushy/shrubby formations ▪ Restriction on forest cutting and forest fire ▪ Educate the local people to the importance of forest lands ▪ Execution of reclaiming projects	▪ Directorate of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Roots appearance ▪ Habitats indicators and biodiversity indicators ▪ Percentage of aforested lands

ID (Unit No.)	Priority	Remedial measures (Current & Possible)	Institutional / administrative arrangements	Monitoring indicators
052tg (22)	Low	▪ Protection of the bushy/shrubby formations ▪ Restriction on forest cutting and forest fire ▪ Educate the local people to the importance of forest lands ▪ Execution of reclaiming projects	▪ Directorate of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Roots appearance ▪ Habitats indicators and biodiversity indicators ▪ Percentage of aforested lands
061th (23)	Low	▪ Construction of check dams ▪ Construction of water outlets ▪ Applying drainage control measures ▪ Execution of reclaiming projects ▪ Provide financial aids ▪ Educate the local people	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Landuse/land cover changes ▪ Land productivity ▪ Rebuilding of terraces ▪ Percentage of land under active conservation management ▪ Sediments in streams, lakes and reservoirs
C11 (25)	Low	▪ Applying reforestation programs ▪ Restriction on forest cutting and forest fire ▪ Protection of the locally adapted bushy/shrubby formations ▪ Avoid disturbance of unstable ground ▪ Execution of reclaiming projects	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Rills and gullies on the soil surface ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation
C12 (26)	Low	▪ Applying reforestation programs ▪ Restriction on forest cutting and forest fire ▪ Protection of the locally adapted bushy/shrubby formations ▪ Avoid disturbance of unstable ground ▪ Execution of reclaiming projects	▪ Directorates of Forest in Latakia ▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Media	▪ Rills and gullies on the soil surface ▪ Poorer plant growth ▪ Root appearance ▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation
M21 (35)	Low	▪ Applying reforestation programs ▪ Avoid disturbance of unstable ground ▪ Execution of reclaiming projects	▪ Directorates of Forest in Latakia ▪ Development Projects in Latakia	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Sediments in streams, lakes, and reservoirs ▪ Collapsed terraces
P10 (36)	Low	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Latakia ▪ Development Projects in Latakia ▪ Municipalities in Latakia ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
Urban	n.a.			

Table 7.2: Outline of draft management plan for Sheikh Bader area

ID (Unit No.)	Priority	Remedial measures	Institutional / administrative arrangements	Monitoring indicators
L22 (18)	High	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
P22 (22)	High	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
012 (3)	Medium	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Tartous ▪ Directorates of Agriculture in Tartous ▪ Municipalities in Tartous ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area
022 (7)	Medium	▪ Terracing ▪ Contour tillage ▪ Applying drainage control measures ▪ Construction of rural roads ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Municipalities in Tartous ▪ Farmers ▪ Agricultural Bank ▪ Media	▪ Loss of top soil ▪ Root appearance ▪ Abandoned Agriculture lands ▪ Treatment of vacant lands ▪ Landuse/land cover changes
032 (9)	Medium	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands and land management ▪ Forest management	▪ Directorates of Forest in Tartous ▪ Municipalities in Tartous ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Landuse/landcover changes
042 (11)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Farmers ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Poorer plant growth ▪ Roots appearance ▪ Collapsed terraces
052h (13)	Medium	▪ Protection of the bushy/shrubby formations ▪ Restriction on forest cutting and forest fire ▪ Educate the local people to the importance of forest lands ▪ Execution of reclaiming projects	▪ Directorate of Forest in Tartous ▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Roots appearance ▪ Habitats indicators and biodiversity indicators ▪ Percentage of aforested lands

ID (Unit No.)	Priority	Remedial measures	Institutional / administrative arrangements	Monitoring indicators
062 (15)	Medium	▪ Construction of check dams ▪ Construction of water outlets ▪ Applying drainage control measures ▪ Execution of reclaiming projects ▪ Provide financial aids ▪ Educate the local people	▪ Directorate of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Landuse/land cover changes ▪ Land productivity ▪ Rebuilding of terraces ▪ Percentage of land under active conservation management ▪ Sediments in streams, lakes and reservoirs
L11 (16)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
L12 (17)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Educate the local people ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Poorer plant growth ▪ Collapsed terraces
P11 (19)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
P12 (20)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
P21 (21)	Medium	▪ Terracing ▪ Contour tillage ▪ Construction of water outlets ▪ Construction of rural roads ▪ Providing training to rural population ▪ Reclaiming moderate slopes and unusable lands ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Municipalities in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Collapsed terraces ▪ Removal of the topsoil ▪ Soil deposition ▪ Changes of soil horizon thickness ▪ Soil quality and nutrient loss
011 (1, 2)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands ▪ Forest management	▪ Directorates of Forest in Tartous ▪ Directorates of Agriculture in Tartous ▪ Municipalities in Tartous ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Land cover degradation ▪ Landuse/land cover changes ▪ Percentage of aforested area

ID (Unit No.)	Priority	Remedial measures	Institutional / administrative arrangements	Monitoring indicators
021 (4, 5, 6)	Low	▪ Terracing ▪ Contour tillage ▪ Applying drainage control measures ▪ Construction of rural roads ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management ▪ Provide financial aids	▪ Directorates of Agriculture in Tartous ▪ Municipalities in Tartous ▪ Farmers ▪ Agricultural Bank ▪ Media	▪ Loss of top soil ▪ Root appearance ▪ Abandoned Agriculture lands ▪ Treatment of vacant lands ▪ Landuse/land cover changes
031 (8)	Low	▪ Restriction on forest cutting and forest fire ▪ Construction of fire break lines ▪ Educate the local people to the importance of forest lands and land management ▪ Forest management	▪ Directorates of Forest in Tartous ▪ Municipalities in Tartous ▪ Media	▪ Habitats indicators and biodiversity indicators ▪ Landuse/landcover changes
041 (10)	Low	▪ Terracing ▪ Contour tillage ▪ Construction of check dams ▪ Execution of reclaiming projects ▪ Educate the local people to the importance of forest lands and land management	▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Farmers ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Poorer plant growth ▪ Roots appearance ▪ Collapsed terraces
051h (12)	Low	▪ Protection of the bushy/shrubby formations ▪ Restriction on forest cutting and forest fire ▪ Educate the local people to the importance of forest lands ▪ Execution of reclaiming projects	▪ Directorate of Forest in Tartous ▪ Directorates of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Media	▪ Land productivity ▪ Landuse/land cover changes ▪ Roots appearance ▪ Habitats indicators and biodiversity indicators ▪ Percentage of aforested lands
061 (14)	Low	▪ Construction of check dams ▪ Construction of water outlets ▪ Applying drainage control measures ▪ Execution of reclaiming projects ▪ Provide financial aids ▪ Educate the local people	▪ Directorate of Agriculture in Tartous ▪ Development Projects in Tartous ▪ Agricultural Bank ▪ Farmers ▪ Media	▪ Landuse/land cover changes ▪ Land productivity ▪ Rebuilding of terraces ▪ Percentage of land under active conservation management ▪ Sediments in streams, lakes and reservoirs
urban	n.a.			

Table 7.3: Outline of overall project planning activities for realisation of management plans

Objectives	Program Phases	Activities	Milestones
▪ To lay the foundations for sound program implementation	Inception (Duration: 8 months)	▪ Conclude contracting arrangements with implementing agencies ▪ Mobilise resources ▪ Establish working relationship with stakeholders ▪ Hold inception workshop(s) ▪ Review and update site-specific management recommendations, using a participatory approach ▪ Develop a detailed project plan ▪ Establish monitoring and evaluation systems	▪ Project team in place ▪ Updated project plan ▪ All stakeholders are aware of project activities
▪ To efficiently implement management plans	Implementation (Duration: 24 months)	On an ongoing basis: ▪ Procure and deploy resources, including personnel ▪ Implement activities and deliver results ▪ Monitor and review progress ▪ Revise operational plans in light of experience ▪ Report on progress	▪ Project activities progress as planned ▪ Annual budgets are prepared ▪ Site-specific management plans are realised
▪ To prepare for sustainable land degradation control and management by stakeholders	Phase out (Duration: 4 months)	Progressively: ▪ Hand over all responsibilities to local partners ▪ Ensure maintenance plans are in place ▪ Ensure relevant skills are effectively transferred ▪ Help ensure recurrent cost requirements are secured	▪ Local partners are enabled to take over responsibilities ▪ Maintenance plans are developed ▪ All recurrent costs are covered by regular budgets of involved institutions
	Total duration: 36 months		

7.2 MANAGEMENT RECOMMENDATIONS FOR PILOT AREAS

The remedial measures to be applied have been discussed in detail in Chapter 6, including general recommendations for their application in the two pilot areas (see 6.4).

In summary, for stable areas the preventive measures needed should place emphasis on forest management and forest treatment, construction of terraces, applying contour tillage, installation of anti-erosive structures mainly check dams, and applying drainage control and land consolidation measures on active erosion processes to minimise disturbance of highly susceptible areas. The curative measures to be applied for the stable intervention areas should put emphasis on the education of the rural community on the importance of forestland and land management, execution of reclaiming projects, and construction of fire break lines. For the unstable intervention areas, the curative measures to be applied should be directed to construction of water outlets and rural roads, provide financial aids and training to rural population, and apply reforestation programs and forest management activities. The protective measures needed for the unstable intervention areas show the importance of two main procedures: instruct and educate the local people on the importance of forest lands and land management, as well as execute reclaiming projects

In the following text, additional considerations on peculiarities and differences between the two pilot areas as well as on the appropriate timing of the interventions are given in Table 7.4.

Table 7.4: Specific features to be considered in the realisation of management recommendations

Recommended measure	Peculiarities (Kurdaha area)	Peculiarities (Sheikh Bader area)	Best time for realisation of measure	Technical key questions / issues
Preventive				
▪ Construction of terraces	Land ownership	Land ownership	April to November	▪ Level terraces or graded terraces? ▪ Technical sound design? ▪ Costs of establishment? ▪ Maintenance guaranteed?
▪ Contour tillage / conservation tillage	Land ownership	Land ownership	April to November	▪ Reduced tillage or no tillage / direct drilling? ▪ Rotation of drilling direction?
▪ Drainage control and land consolidation	Land ownership	Land ownership	April to November	▪ Technical sound design and construction? ▪ Costs of establishment? ▪ Maintenance guaranteed?
▪ Installation of check dams for rill erosion control	None	None	April to November	▪ Technical sound design and construction? ▪ Costs of establishment? ▪ Maintenance guaranteed?
▪ Protection and improvement of the locally adapted bushy and shrubby formations	None	None	Throughout the year	▪ Consideration of needs of local population? ▪ Critical density ensured?
▪ Legislating of laws concerning of forest cutting and forest fire	None	None	Throughout the year	▪ Enforcement of laws? ▪ Consideration of needs of local population? ▪ Benefits of forests for rural community?

Curative				
▪ Aforestation	Recommended species Pinus Pinea Castania Vesca Ceratonia Siliqua Crataegus Spp.	Recommended species Pinus Pinea Castania Vesca Ceratonia Siliqua Crataegus Spp.	Throughout the year	▪ Accessibility of aforestation areas? ▪ Protection of trees in the early phases of establishment? ▪ Benefits of forests for rural community?
▪ Construction of water outlets	Mainly in Kurdaha	Less applicable	April to November	▪ Direction/collection of drainage water? ▪ Natural water outlets vs. artificial water outlets? ▪ Length of outlet (less than 800 to 1000 meters)? ▪ Maximum gradient (0,5 to 4%)? ▪ Plantation of outlet with grass? ▪ Material for stabilisation of outlet (stones, asphalt, pipes, etc.)?
▪ Construction of rural roads	Specific planning arrangements	Specific planning arrangements	April to November	▪ Technical sound design? ▪ Costs of establishment? ▪ Maintenance guaranteed? ▪ Assessment of negative side effects before establishment?
▪ Increasing cattle breeding rates	Suitability	Suitability	Throughout the year	▪ Negative side effects? ▪ Favourable market conditions?
▪ Provision of training and extension facilities to rural population	Responsibilities	Responsibilities	Throughout the year	▪ Accessibility? ▪ Training needs considered?
▪ Provision of adequate financial aids to local farmers	Priorities	Priorities	Throughout the year	▪ Sustainability? ▪ Negative side effects of incentives/disincentives?
▪ Allocation of industrial projects	Which kind of projects?	Which kind of projects?	Throughout the year	▪ Environmental impact? ▪ Local employment opportunities?
Protective				
▪ Reclamation projects	Which projects?	Which projects?	April to November	▪ Oriented towards sustainable benefits for local stakeholders?
▪ Construction of fire lines	None	None	April to November	▪ Disturbance on steep slopes or areas highly susceptible to erosion?
▪ Education of local people to the importance of forestlands and sound land management	Responsibilities	Responsibilities	Throughout the year	▪ Oriented towards real needs of target groups? ▪ Participatory principles considered? ▪ Right mixture of different tools (training, media, brochures, etc.)?

The above table reveals that the two pilot areas are quite similar in their peculiarities as well as most of the conservation measures usually executed after winter which is the major rainy season which generally begins in November and extends till April. Thus, the conservation measures are usually implemented in the period from April to November due to the fact that there is no rain and therefore the land will be dry which enables implementing the necessary measures.

The recommended remedial measures to be reliable should consider the needs of the local community as well as their professional and financial level which are the major issues not only to implement sound remedial measures but also to guarantee maintaining of the these measures. Furthermore, the outlines of draft management plans would need a further verification by applying a participatory approach. Besides, the analysis covered only the area up to 800m elevation and therefore only part of the system dynamics were assessed.

8. PREREQUISITES FOR IMPLEMENTATION OF DRAFT MANAGEMENT PLAN

The success of land degradation control programmes depends on favourable framework conditions. These framework conditions comprise appropriate organisational, institutional, legal and political structures and processes as basis for programme planning and implementation. The management efficiency of the institutions involved is crucial in this respect. If the framework conditions are found to be insufficient, appropriate steps, such as capacity building efforts, have to be initiated in order to ensure sustainable programme implementation (PAP, 2000).

8.1 ANALYSIS OF FACTORS INFLUENCING INSTITUTIONAL RESPONSE TO CAPACITY BUILDING

In the context of land degradation control programmes the term capacity can be broadly defined as the ability of a country or a society to identify and solve land degradation related problems. Capacity building is then the process by which this ability is developed. Capacity building depends on organisational and institutional capabilities as well as technological, scientific and human resources. People's participation and conflict resolution mechanisms play a key role in the capacity building process because of the complex human learning processes taking place and its stimulating effects on institutional and social development (PAP. 2000).

Capacity building processes may be analysed by the application of a system approach which places emphasis on the different factors involved. Usually, the perception of land degradation problems leads actors to develop and implement strategies (typically against opposing target groups) under certain conditions. The outcome is then influenced mainly by the following factors (Janicke and Weidner, 1997):

a) Actors;
b) Strategies;
c) Structural framework conditions;
d) Specific context of a single situation; and
e) Problems

Both the structure of problems and the capacity to respond to them are strongly influenced by economic performance.

a. **Actors**: actors can be broadly classified into promoting or opposing ones, such as: (i) government organisations and institutions, i.e. government ministries, state administration, state-owned extension services, etc. (ii) non government organisation and institutions, i.e. NGO's, private extension services, private companies etc. There are often coalitions of relevant outstanding personalities across organisations and institutions. These informal networks may have a strong influence on successful programme implementation. Both promoting and opposing actors in Latakia and Tartous related to erosion control management are listed in Table 8.1.

Table 8.1: Promoting and opposing actors related to erosion control in the study area

Character	Actors	
Promoting	**Government**	1. Ministry of agriculture – Directorates of Land in Latakia and Tartous – Directorates of Forest in Latakia and Tartous – Directorates of agriculture in Latakia and Tartous – Directorates of agriculture in Kurdaha and Sheikh Bader 2. Ministry of environment 3. Development projects in Latakia and Tartous – Reforestation project – Fruit tree plantation project – Rural development project – Agricultural development project – Reclamation of stony lands project – Martyr Ali Al-Ali project 4. Agricultural Bank. 5. Municipalities in Kurdaha and Sheikh Bader 6. Local Media in Latakia and Tartous
	Non Government	1. Scientific community 2. Non Government Organisations (NGOs)
Opposing		1. Farmers 2. Business sector

The above table reveals that ministry of agriculture is the main promoting actor in the capacity building process in the field of erosion and desertification control management. While the farmers and private sector can be considered as the main opposing actors.

b. **Strategies**: strategy is the general approach to a problem by the purposeful use of instruments, capacities and related opportunities to achieve long-term goals. Strategies may be top-down or bottom-up oriented, as well as sector-oriented or integrated. Successful land degradation control management depends highly on appropriate strategies in order to compensate the general weak promoting actors. In this context the intelligent use of time for the right timing of intervention is very important. In the Syrian study area, the strategies applied by actors to achieve long term goals for land degradation combating are listed in Table 8.2.

Table 8.2: Strategies for land degradation control management by different actors

Strategies	Actors
Modify the agricultural policies (pesticide, fertilisers.....)	▪ Ministry of Agriculture
Stop/ reduce land degradation	▪ Ministry of Agriculture
Protection of land natural resources (water, forest...)	▪ Ministry of Agriculture ▪ Ministry of Environment
Improve and secure the quality of living level of farmers	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Agricultural bank
Invest long term projects in the area	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Privet sector
Assure sustainable development	▪ Ministry of Agriculture ▪ Development projects ▪ Agricultural bank
Activate the role of local media	▪ Media
Activate the role of NGOs	▪ Media
Control urban planning regulations	▪ Municipalities
Financial aid for farmers in land reclamation	▪ Ministry of Agriculture ▪ Development projects
Increase public awareness	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Media
Terracing over moderate slopes	▪ Development projects ▪ Farmers
Maintenance of terraces	▪ Farmers
Applying contour tillage, crop rotation, adding crop residues, and fallow periods	▪ Farmers
Implement environmental projects	▪ Ministry of Agriculture ▪ Ministry of Environment
Rehabilitation of degraded forest lands	▪ Ministry of Agriculture ▪ Development projects
Construction of water outlets, and rural roads	▪ Ministry of Agriculture ▪ Development projects ▪ Municipalities ▪ Farmers
Forest management	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Development projects ▪ Media ▪ Municipalities

c. **Structural framework conditions**: these conditions consist of several linked factors:

- Knowledge as a basis for problem perception, public awareness and subsequent policy generations.
- Organisational, institutional and legal structures for institutionalisation and internalisation of rules and standards for effective land degradation control management. Participation plays a key role in this respect. The organisational and institutional structures are currently implementing specific roles match their function and responsibility as follow:

A. Organisational

- Some international projects play an important role in education and capacity building related to natural resources protection. However, this role is still not adequate and needs more co-ordination and management.

- Farmers union and youth union may also play significant roles in land protection control management. However, these unions need more activation and more fund as well as better co-ordination with the institutional bodies.

B. Institutional

- Ministry of Agriculture: currently, there are 14 extension units in Kurdaha which belong to Directorate of agriculture in Kurdaha and 8 extension units in Sheikh Bader belong to Directorate of agriculture in Sheikh Bader. All these extension units apply forest laws and agriculture policies. However, this application still needs more professional staff and needs better co-ordination and management.
- Development projects in Latakia and Tartous: these projects apply land reclamation control management by building terraces, constructing of agricultural roads, and supplying farmers with trees transplants and irrigation water by tankers for the first two years. Moreover, these activities still need more improvements in terraces construction and terraces maintenance.
- Ministry of Environment: through its relevant bodies, it applies environmental laws. Moreover, the application of these laws is still very fragile and weak.
- Municipalities: these bodies in both Kurdaha and Sheikh Bader are applying the laws of urbanisation, controlling the illegal discharge of waste to the natural streams, controlling the land use plan, and the illegal transfer of arable and forest lands into urban land. Furthermore, the role of municipalities still need more support and provision in order to enforce their roles in a sensible and reliable manner.
- Universities and research centres: these bodies are conducting some researches related to land degradation and soil erosion. But the transfer of the research results to the authorities and growers is still very weak and need good participatory programs to ensure the transfer of these results to the end users. Besides, the co-operation between universities and some research centres and related ministries also need more activation.
- Media: the role of media is very important in introducing the problems of land degradation and soil erosion. Furthermore, this role still needs more activation and involvement of professional experts to discuss theses problems.
- Non-governmental organisations (NGO's) and private sectors: these organisations have good structures, but still need more activation and management.

In this respect, the Syrian legislative framework has to be taken into consideration. The major laws dealing with environment protection and erosion control management are presented in Table 8. 3.

Table 8.3: Major laws related to environment protection/degradation control

No	Law name and date of issue	Areas of concern
1	▪ Municipalities law number 9 issued at 1974	▪ Division and organisation of land use planning in cities (administrative and industrial areas, green areas, residential, commercial, transport, public services, etc.).
2	▪ Municipalities decree law number 96 issued at 1974	▪ Principles and basis of land use planning in cities, towns and villages afar from the forest lands
3	▪ Forest protection law number 7 issued at 1994	▪ Forest protection and investment
4	▪ Decree law number 86 issued at 1953.	▪ Organisation of reforestation activities
5	▪ Environment protection and land security law number 50 issued at 2003	▪ Establishing the Higher Council for Environment Protection as well as to protect the environment and secure lands
6	▪ Badia protection law number 13 issued at 1973	▪ Protection of Badia lands in the inner part of Syria against human activity
7	▪ Environment Impact Assessment law number 1 issued at 2000	▪ Evaluation of the environmental impact particularly for any tourist project

d. **Specific context of a single situation**: the specific context of a single situation describes the variable short-term condition such as urgent problems (landslides, draught, etc) which, for instant, cause direct public pressure. In regard to the problem of land degradation in the two pilot areas, there are some important conditions which are:

- Constructions of terraces over the moderate slopes and maintain them when needed.
- Applying contour tillage, crop rotation, crop residues, and fallow periods.
- Construction of water outlet and rural roads.
- Control illegal housing construction in the arable and forest lands.
- Reforestation in the degraded forest land or in the fired forest land.
- Investing development projects.
- Construction of reservoirs and improving drinking water net.

e. **Problem**: the character of the problem influences considerably the capacity building process. The fact that erosion and land degradation are causing direct impacts and are perceived as urgent problems will be decisive for the felt need to take actions and solve problems after their identification. Generally in the two pilot areas, the type of soil erosion is water erosion and in particular sheet erosion. The severity of erosion in the hilly areas is mainly due to heavy rain and steep slopes as well as poorly planted slopes, and partially barren mountains. While in the plane areas, the severity of erosion is mainly due to inappropriate agricultural practices and urban expansion.

8.2 RECOMMENDATIONS FOR CAPACITY BUILDING

Capacity building is a continuous process. But, in individual erosion and desertification control programmes, an implementation cycle with three stages can usually be recognised (FAO, 1989). The stages are as follow:

a) Motivation stage: using normal mass education techniques to generate land users' awareness and interest in conservation issues, and to promote participation in erosion and desertification programme.
b) Technical assistance stage: actual planning, design, layout, and installation of conservation measures. This is normally undertaken jointly by soil conservation and extension agencies in co-operation with target groups.
c) Follow up stage: assistance to select target groups by the extension agency in obtaining loans for farming inputs and in marketing their products; and by the responsible government institutions in the maintenance of conservation structures and practices.

Capacity building efforts are needed at three different levels to enable taking specific responsibilities in the promotion of land degradation control programme at national, sub-national, and local levels. It has to be ensured that all authorities, institutions and organisations involved integrate their activities within appropriate co-ordinating mechanisms in order to give consistent signals for the management of erosion and land degradation control.

8.2.1 Capacity building at national level

Capacity building at national level has to build upon existing institutional structures. It might be mainly consider with the following:

- Development and promotions of institutions and organisations which deal with policy creation and legislation.
- Establishment of a multidisciplinary committee for erosion and desertification control management and exchange of related expertise should be considered, preferably under the overall guidance of the Ministry of Agriculture at the ministerial level. The committee should consist of the major ministries concerned, such as Ministry of Agriculture, Environment, Water resources, and others, as appropriate.
- Training courses on capacity building under direct support from international organisations.
- Comprehensive national planning is needed to inform sub-national and local authorities of the intentions of national development policies, and mainly the erosion and desertification control policies to be enforced.
- The implications of the usage of incentive and disincentives have to be considered

8.2.2 Capacity building at sub-national level

At sub national level, depending on the existence and power of sub national authorities, capacity building at this level should consider the following:

- Improving the ability of the concerned authorities to facilitate links between national level and local level.
- Providing the link for the two-way feed back process between national and local level activities.
- Establishment of more detailed integrated planning and management within the responsibilities of respective authorities.
- Ensuring the consistency with activities at the local level and the compliance with the national planning and policies.
- Ensuring the quality of sub national agencies which support local level activities. Related government agencies are often liable to be understaffed, poorly equipped or immobilised by lack of transport means and insufficient infrastructure. Under these circumstances it will be difficult to win the trust and support of the land users. The situation can be worsened when extension officers are charged with several duties of which conservation is only one and not necessarily seen to be the most important.
- Provide adequate training and resources for extension staff and officers for successful implementation of erosion and desertification control management programmes.
- Using mass education techniques to generate land users' awareness and interest in conservation issues, and to promote participation in erosion and desertification programs.

8.2.3 Capacity building at local level

Obviously at this level more detailed planning, development and implementation should take place. A necessary precondition for sustainable adoption of solutions is that the changes must

be profitable and provide tangible benefits to the land users. Mechanisms need to be developed to influence the behaviour of land users by applying the following measures:

- Provide financial support and incentive policy.
- Motivation of land users to adopt the desired erosion and desertification control measures.
- Strengthen existing agricultural extension services.
- Raising public awareness on land degradation process and its control management.
- Organisation of land users in small groups. Thus, several local communities could better co-operate and effectively manage the local erosion and desertification control activities. Therefore, it may be easier to promote small groups because they are easier to manage especially when a contact farmer or farm leader can be identified within the group and is given proper training to serve as an effective link to the program implementation institution.

Indicators for identification of the status of capacity development in erosion and desertification control management are the existence and performance of environmental governmental institutions, integrative capacities of government, performance of NGO's, participation by different stakeholders, performance of the business sector, activities of universities, available statistics and performance of the media (see Table 8.4)

Table 8.4: Indicators for identification of the status of capacity development

Actors	Positive characteristics	Negative characteristics
▪ Government institutions deal with environment	Institutions for integrated planning at all levels	No central institutions
▪ Integrative capacities of government	Long-term intersectional planning on a broad societal basis	Only additive environmental institutions and fragmentation of jurisdiction
▪ NGO's	Competent lobbies/organisations playing a consultative role in political decision making	Only local organisations with no clear autonomous national lobby or organisation
▪ Participation by different stakeholders	Participation includes also ecologically long term planning which pay attention to different stakeholders	Participation is restricted to general elections
▪ Business sector	Pioneer enterprises have a strong impact on the economy	Related business interests are scarcely articulated
▪ Universities, science and research	Relevant knowledge is actively generated	Only scattered or irrelevant data
▪ Statistics	Solid data is available	Only scattered or irrelevant data
▪ Media	Erosion and desertification problems are widely reported in all the media	Only few, largely official reports on the situation

8.3 PARTICIPATORY MODALITIES: TOOLS AND RECOMMENDATIONS

Participation is the key to success in any land degradation control programme. Regardless of how technically sound a plan is, it cannot be successfully implemented without the support and participation of the target groups (FAO, 1989). In the past, erosion and desertification control projects and programmes often failed because they were top-down, not oriented to the needs of the land users, and capital intensive, with little or no sense of ownership or participation by the target groups in project conception, implementation or maintenance. Therefore, an emphasis has to be placed participatory approaches to design and implementation of erosion and desertification control activities. However, local extension and project staff often lack experience in participatory approaches to erosion and desertification control activities.

The main aim should be an Interactive Participatory Programme (IPP) to erosion and desertification control management. The term "interactive participation" describes a process of communication among local people *(insiders)* and development agents *(outsiders)* during which *insiders* take the leading role to analyse their problems, for example erosion and desertification, and to plan, implement and evaluate solutions, such as erosion and desertification control activities. Interactive participation is understood as a two-way learning process of dialogue, negotiation and decision making between insiders and outsiders to elaborate a common agenda for future activities (Pretty *et al.,* 1995).

Interactive participation can be based on the use of different tools for initiating, maintaining and evaluating the two-way learning process. In general, the approaches and tools used along all phases of this process (preparatory, participatory, implementation, and evaluation) during field work related to detailed analysis, in both areas of Kurdaha and Sheikh Bader, can be listed as follows:

- **Questionnaire:** regarding implementing of the IPP in context of our project, circulating a very comprehensive questionnaire was the first basic step to implement the participatory approach. Generally, the questionnaire consist of all aspect related to soil erosion, nature, currently applied measure, and possible applied measure. It was found that the questionnaires activated the participatory processes during answering the various questions and through the evaluation of questionnaire.
- **Probing and Interviews:** the purpose of this approach is to learn about local situation through informal and in-depth questioning by outsiders with insiders as resource persons. The project team held several meetings, information meetings and consultation meetings, and interviews with local authorities and local farmers in both pilot areas.
- **Seminars and Workshops:** these activities were dedicated to gather together outsiders with insiders from both genders in order to create a sort of dialogue and communication among them. Several workshops and seminars have been applied in both pilot areas in order to introduce the project and its various activities as well as to highlight the issue of land degradation and to activate the interactive process through various reactions and opinions. This approach played an important role in introducing the project and the participatory program as well as collecting the current and possible remedial measures, and recommendations related to land degradation control management.
- **Lectures**: in order to increase public awareness, several lectures were given at the rural school in both pilot areas about the land degradation phenomena and the project.
- **Transect walks:** this approach means that a group of insiders and outsiders conducts a walk along a predetermined route through the community. During this walk different features observed of land degradation are discussed. This approach has been applied in some villages in both Kurdaha and Sheikh Bader and directly gave growers brief introduction on erosion and its control. However, this approach needs much efforts and time.
- **Field visits:** the great benefit of this approach is meeting growers in their own lands. Thus, giving growers the opportunity to frankly speak about their problems. Consequently, these visits are very useful in direct discussion the problems about land, water and crop management and marketing. It was clear that visiting farmers in their own lands make better reaction than reaction of those who attend the workshops due to the fact that farmers feel more comfortable to speak in their lands. However, this method needs more time and efforts.

A key to successful implementation of erosion and desertification control programmes consists in implementation of participatory training which complements other programme activities. Training of local target groups should start without any delay as soon as an area or watershed is chosen for erosion and desertification control management. Frankly speaking, the main drawback and weakness in our implementation of IPP was that we didn't adopt such training after choosing Kurdaha and Sheikh Bader as pilot areas.

Obviously, the above mentioned approaches serve as a tool for encouraging and strengthen the implementation of IPP as well as source of gathering information related to erosion and desertification control management.

The main recommendations for participatory modalities are listed below. For further recommendations please refer to the national report on implementation of IPP. In general, the recommendations for participatory modalities at both decisional and implementation levels are the following.

8.3.1 Recommendations for participatory modalities at decisional level:

- Participatory modalities should be simple, clear and easy to be understood and adopted by local authorities.
- Provide the training for extension staff units. The agricultural extension units working in both pilot areas are often liable to be understaffed where the staffs are not enough qualified and usually charged with several duties thus it will be difficult to win the trust of land users.
- Provide the appropriate resources for the agricultural extension units existing in both pilot areas. These units are often liable to be poorly equipped or immobilised by lack of transport means. Providing transportation means may enhance the participation process through the frequent field extension survey.
- Promoting and activating the role of national and local media particularly in the field of erosion and desertification control management.
- Promoting and activating the role of NGOs in the participatory modalities and activities.
- Improving the ability of the concerned authorities to facilitate links between the decisional and implementation level.
- Providing the link for the two-way feed back process between the decisional and implementation level.
- Ensuring the consistency with activities at the local level and the compliance with the national planning and policies.
- Ensuring the quality of sub national agencies which support local level activities.
- Establishing a focal point institution for participation in Syria. The general Organisation of Remote Sensing (GORS) can play such a role due to the fact that it has already adopted such kind of programmes.
- Promoting of organisations deal with erosion and desertification control management.
- Increasing public awareness in regard to participatory programmes and erosion and desertification control management.
- Improving the tools and methods of the participation activities.
- Improving and promoting the co-operation and communication among local authorities, institutions and local people.
- Create co-operation and democracy atmosphere between the local authorities, institutions and local people.

- Allocate appropriate and adequate funds.
- Provide feedback information to stakeholders and in particular to ensure result of their contributions in order to create confidence of the participation in the future.
- Involvement in national projects concerning land degradation and or participation.
- Proposing projects concerning land degradation and sustainable development with the involvement of participation program.
- Involvement in international projects relevant to the field of land degradation, sustainable development and participation.

8.3.2 Recommendations for participatory modalities at implementation level:

- Participatory modalities should be simple, clear and easy to be understood and adopted by local people.
- Participatory modalities should take the daily needs of local people as a high priority concern.
- Participatory modalities should consider the consensus and educational background of local people.
- Providing training courses on participatory programmes and erosion and desertification control management.
- Motivation of land users to adopt the desired erosion and desertification control measures.
- Strengthen existing agricultural extension services.
- Raising public awareness on land degradation process and its control management.
- Using mass education techniques to generate land users' awareness and interest in conservation issues, and to promote participation in erosion and desertification programs.
- Arguing farmers to apply all agricultural activities correctly.
- Persuading local people to protecting the forestland and other natural resources.
- Encouraging local people to participate in participatory programmes or projects in their areas.
- Encouraging farmers never to leave behind and abandon their lands in order to mitigate the immigration flow.
- Encouraging all family members, particularly women and the young, to participate in all agricultural activities in order to improve the house income conditions.
- Improving and promoting the co-operation spirit among local people.
- Improving and promoting the co-operation and communication among local authorities and local people.
- Create co-operation and democracy atmosphere between the local authorities and local people.
- Promoting the implications of the usage of incentive and disincentives and provide tangible benefits to the local people.

8.4 MONITORING PROCEDURES AND INDICATORS

Monitoring of erosion and desertification control means regular assessment of activities, recording of impact, and periodical analysis of relevant information in order to determine whether:

- Activities are implemented according to the plan;
- The available time is sufficient to complete the activities according to the plan;
- Manpower and materials are being used efficiently;
- The quality of activity implementation is maintained; and
- The progress made is sufficient to achieve the envisaged objectives.

Thus, monitoring provides feedback information on programme implementation and results. Monitoring can be understood as an early warning system which identifies problems at an early stage in order to make appropriate adjustments for achievement of the planned outputs.

Monitoring of water erosion is based on key indicators such as occurrence of specific erosion phenomena. The main water erosion types in both pilot areas include the following:

- Sheet erosion;
- Rill erosion;
- Gully erosion;
- Mass earth movements;
- Degradation induced by land management;
- Water or sediment excess.

Usually, after the establishment of the indicators for monitoring, the next step to determine how the identified indicators will be monitored and who will execute the monitoring activities. It's recommendable that an independent monitoring and evaluation body is established in order to undertake regular control. Furthermore, a monitoring unit should be established under the responsible agency for data collection and monitoring. Every potential for application of participatory approaches and methods should be used for monitoring of erosion and desertification control.

The main specific indicators related to water erosion in both pilot areas are mainly the following:

- Removal of the topsoil: topsoil affords the best root environment by providing the best structure, the most air, most of the soil's organic matter and plant nutrients, and an active population of living organisms. Once the topsoil is lost, only the less productive subsoil remains.
- Soil deposition: when the velocity of the moving water is reduced, the carrying capacity of water is reduced and the suspended soil settle out and starts to accumulate at the base of slopes, field boundaries, and ridges of terraces.
- Changes of soil horizon thickness: as erosion strips away the soil surface, the profile becomes thinner, decreasing the root zone. This is a particular problem on already shallow soils. A major effect of this shrinking root zone is a reduced value of total water-holding capacity. Keeping in mind that soil depth is relatively very shallow over the hilly areas in both Kurdaha and Sheikh Bader.
- Rills and gullies on the soil surface: continued surface runoff lead to formation of channels in the soil that is small enough to be erased by tillage. The concentrated surface runoff transfers these small channels into relatively large channels or gullies which are too deep to be obliterated by ordinary tillage practices.
- Sediments in streams, lakes, and reservoirs: eroded soil contains nutrients and pesticides that pollute lake and streams and thus can disturb fish habitats and reduce water quality. Besides, these sediments create a need for expensive dredging, reduce the ability of streams to carry water, resulting in an increase in flooding, and make reservoirs hold less water.

- Poorer plant growth: removing the top soil reduce organic matter content and plant nutrients as well as decrease the root zone. Consequently, eroded soil lead to inadequate plant growth environment.

Other potential indicators related to erosion and desertification control management programmes in both areas can be listed as follows:

- Population growth;
- Employment and unemployment rates;
- Landuse/land cover classification;
- Abandoned agricultural lands;
- Treatment of vacant (follow periods) lands;
- Percentage of land under active conservation management;
- Areas under irrigation and type;
- Percentage of aforested area;
- Rebuilding of terraces;
- Soil quality and nutrient loss;
- Habitats indicators and biodiversity indicators.

All the above mentioned indicators, their pressure and the responsible authorities and institutions to collect and distribute related monitoring information can be summarised in Table 8.5.

Table 8.5: Monitoring indicators related to water erosion control in coastal area

Indicators	Pressure	Responsibility
- Removal of the topsoil	- Increasing occupation of marginal lands	- Directorates of agriculture in Latakia and Tartous
- Soil deposition	- Nutrient depletion	- Directorates of agriculture in Latakia and Tartous
- Changes of soil horizon thickness	- Decreasing soil productivity	- Directorates of agriculture in Latakia and Tartous
- Rills and gullies on the soil surface	- Increasing occupation of marginal lands	- Directorates of agriculture in Latakia and Tartous
- Sediments in streams, lakes, and reservoirs	- Water Contamination, (water pollution)	- General directorate of coastal plain
- Poorer plant growth	- Intensity use of fertilisers	- Directorates of agriculture in Latakia and Tartous
- Population growth	- Overexploitation of land and water resources	- Central Bureau of Statistics
- Employment and unemployment rates	- Overexploitation of land and water resources	- Central Bureau of Statistics
- Landuse/land cover classification	- Landuse changes from natural state	- General organisation of remote sensing - Directorates of agriculture in Latakia and Tartous
- Abandoned agricultural lands	- Reducing rates of lands suitable for agriculture	- Directorates of agriculture in Latakia and Tartous
- Treatment of vacant (follow periods) lands	- Reducing rates of lands suitable for agriculture	- Directorates of agriculture in Latakia and Tartous
- Percentage of land under active conservation management	- Overexploitation of land	- Directorates of agriculture in Latakia and Tartous - Directorates of Land in Latakia and Tartous - Development projects
- Areas under irrigation and type	- Intensity of use of surface & underground water	- Directorates of agriculture in Latakia and Tartous
- Percentage of aforested area	- Reducing rates of lands suitable for agriculture	- Directorates of Forest in Latakia and Tartous
- Rebuilding of terraces	- Increasing occupation of marginal lands (mainly the mountainous sloping land)	- Directorates of agriculture in Latakia and Tartous - Development projects
- Soil quality and nutrient loss	- Overexploitation and Nutrient depletion	- Directorates of agriculture in Latakia and Tartous
- Habitats and biodiversity indicators	- Biodiversity depletion	- Directorates of agriculture in Latakia and Tartous - Development projects

8.5 Outline of Verification and Approval Procedure for Draft Management Plans

Generally, the preparation of an erosion and desertification control management plan, should foresee the following steps (PAP, 2000):

- Preparation and proposal of a draft erosion/desertification control management plan;
- Testing consistency of the draft plan with the national planning perspectives and priorities; and
- Formulation of the final plan (operational erosion control and management plan).

1. **Formulation**: the control management strategy for both pilot areas, which was formulated in chapter 7 and summarised in Tables 7.1 and 7.2, needs to be updated in case there is a considerable time gap before the evaluation and verification procedures starts.

2. **Evaluation and verification**: the plan, once formulated should be subject to evaluation or revision. Such verification is made: (i) at scientific level, as appropriate; (ii) by public consultation, through a public participation programme; and (iii) by the responsible authorities. Table 8.6 shows how this procedure will be for the two pilot areas as well as the involved institutions with their role in the process.

3. **Detailed programme elaboration**: after verification, the programme needs a detailed elaboration of the prerequisites. This might require the preparation of a feasibility study containing details of: the institutional arrangements; the needed capacity building programme; workplan and timetable; the costs calculated, budget proposal, financing sources and cost sharing. GORS could play such a role in detailed programme elaboration as shown in Table 8.6.

4. **Approval**: the elaborated document is submitted to the authority(ies), entitled to approve the programme/project (local authority, local assembly, ministry, government, national assembly). Table 8.6 shows how this procedure will be for the two pilot areas as well as the involved institutions

Table 8.6: Verification and approval procedures for draft management plan

Remedial measures (Current & Possible)		Planning and Frequency	Indicators (to cheek meeting objectives)	Responsible Authority	Funding	GORS collaboration with	GORS Public Consultation with
						Pilot Areas	
Current Measures	▪ Terracing	▪ Agro-practices-Seasonal	▪ Controlled agro-practice	▪ Ministry of Agriculture	▪ National ▪ Private	▪ Ministry of Agriculture	▪ Farmers ▪ Researchers
	▪ Contour tillage	▪ Agro-practices-Seasonal	▪ Controlled agro-practice	▪ Ministry of Agriculture	▪ National ▪ Private	▪ Ministry of Agriculture	▪ Farmers
	▪ Restriction on forest cutting and forest fire	▪ Protected areas landuse ▪ Annual	▪ Extent of healthy forestlands	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ National	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Municipalities ▪ Local people
	▪ Applying reforestation programs	▪ Protected areas landuse ▪ Annual	▪ Extent of healthy forestlands	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ National ▪ International	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Researchers
	▪ Avoid disturbance of unstable ground	▪ Protected areas landuse ▪ Seasonal	▪ Efficiency of control measure	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Tourism ▪ Ministry of Development and Reconstruction ▪ Ministry of Local Administration	▪ National	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Tourism ▪ Ministry of Development and Reconstruction ▪ Ministry of Local Administration	▪ Researchers ▪ Municipalities ▪ Private sector
	▪ Construction of water outlets	▪ Agro-practices ▪ Seasonal	▪ Efficiency of control measure	▪ Ministry of Agriculture	▪ National ▪ Private	▪ Ministry of Agriculture	▪ Researchers ▪ Farmers
	▪ Construction of rural roads	▪ Medium term plans	▪ Efficiency of control measure	▪ Ministry of Agriculture ▪ Ministry of Local Administration	▪ National ▪ Private	▪ Ministry of Agriculture ▪ Ministry of Local Administration	▪ Municipalities ▪ Local people
	▪ Construction of fire lines	▪ Protected areas ▪ Medium term plans	▪ Extent of healthy forestlands	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Local ▪ Administration	▪ National	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Local Administration	▪ Municipalities
	▪ Apply reclaiming projects	▪ Short & medium term plans	▪ Conservation of high capable lands	▪ Ministry of Agriculture	▪ National ▪ International	▪ Ministry of Agriculture	▪ Researchers
	▪ Educate the local people	▪ Short & medium term plans	▪ Efficiency of education means	▪ Ministry of Information ▪ Ministry of Agriculture	▪ National	▪ Ministry of Information ▪ Ministry of Agriculture	▪ Researchers

Remedial measures (Current & Possible)		Planning and Frequency	Indicators (to cheek meeting objectives)	Responsible Authority	Funding	GORS collaboration with	GORS Public Consultation with
						Pilot Areas	
Possible measures	▪ Applying drainage control	▪ Short & medium term plans	▪ Efficiency of control measure	▪ Ministry of Agriculture ▪ Ministry of Local Administration	▪ National ▪ International	▪ Ministry of Agriculture ▪ Ministry of Local Administration	▪ Researchers ▪ Municipalities
	▪ Protect adapted bushy/shrubby formations	▪ Protected areas landuse ▪ Annual	▪ Efficiency of control measure	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Local Administration	▪ National	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Local Administration	▪ Municipalities ▪ Local people
	▪ Forest management	▪ Protected areas landuse ▪ Annual	▪ Extent of healthy forestlands	▪ Ministry of Agriculture	▪ National	▪ Ministry of Agriculture	▪ Local people
	▪ Reclaiming moderate slopes and unusable lands	▪ Protected areas landuse ▪ Short & medium term plans	▪ Conservation of high capable lands	▪ Ministry of Agriculture	▪ National ▪ International	▪ Ministry of Agriculture	▪ Researchers
	▪ Provide training to rural population	▪ Short & medium term plans	▪ Efficiency of education means	▪ Ministry of Information ▪ Ministry of Agriculture ▪ Ministry of Environment	▪ National ▪ International	▪ Ministry of Information ▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Researchers
	▪ Provide financial aids	▪ Short & medium term plans	▪ Efficiency of aids	▪ Ministry of Agriculture ▪ Ministry of Finance	▪ National	▪ Ministry of Agriculture ▪ Ministry of Finance	▪ Local people
	▪ Allocation industrial projects	▪ Short & medium term plans	▪ Efficiency of projects	▪ Ministry of Agriculture	▪ National	▪ Ministry of Agriculture	▪ Municipalities ▪ Private sector

8.6 RECOMMENDATIONS FOR FUNDING OF DRAFT MANAGEMENT PLANS

Erosion and desertification control management programmes, same as any other programme, require expenditures, in most cases far above the amounts immediately and regularly available. The formulated programme must be "implementable", the criterion implying, among others, the availability of funds needed. Financial considerations have to be taken into account from the very beginning of the initial phase of programme formulation, and the funding sources carefully analysed (PAP, 2000).

The level of programme expenditures and their dynamics are programme specific, depending on strategies selected and investment needed. Accordingly, a wishful workplan and timetable will be prepared initially. After comparing it with the availability of funds and the expected cash flow, a realistic workplan, timetable, cost sharing and cash flow analysis have to be elaborated. Programmes needing high investment expenditures and longer implementation period have to be structured and implemented in a logical sequence of phases.

In this respect, the main sources of funding should be taken into consideration. These main sources are budget funds and international sources. Budget funds are addressed in particular for matching funds and expenditures of responsible administrative structures. The programme must identify the institutions to be addressed. Due to the multisectoral character of programmes, several sources will usually have to be involved, the fact implying also the active involvement of future investors in programme formulation. International sources are related to specific international funds and programmes; those of the EU, GEF, METAP, and MAP-UNEP. Should international funding be envisaged, the potential donor(s) or partner(s) have to be informed and, if possible, involved from the early stage of the programme formulation. Finally, for large programmes in particular, a mix of funding sources is recommendable to be secured.

Funding of the draft management plan for the two pilot areas may depend on budget funds and international sources. The main budget funds for the management plan can be motivated from the ministry of agriculture and ministry of environment. Table 8.7 shows these main fund sources with the respective recommendations.

Table 8.7: Recommendations for funding of draft management plan

	Remedial measures (Current & Possible	Funding source	Recommendations
Current measures	▪ Terracing	▪ Ministry of Agriculture	▪ Funds should provide to farmers to construct terraces in a sound way. ▪ Funds should also be provided to maintain terraces in order to keep them effective. ▪ Provide free cost machinery to construct and maintain terraces.
	▪ Contour tillage	▪ Ministry of Agriculture	▪ Provide farmer with free cost tractors ▪ Construct roads to enable tractors reach destination
	▪ Restriction on forest cutting and fire	▪ Ministry of Agriculture	▪ Supply low cost fuel to local people
	▪ Applying reforestation programs	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ International	▪ Provide suitable funds to local people in the marginal lands to prevent them harm the forestland ▪ Planting the fruitful-forest species to improve local income
	▪ Avoid disturbance of unstable ground	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Provide suitable funds to local people to prevent them harm the unstable lands
	▪ Construction of water outlets	▪ Ministry of Agriculture	▪ Offer suitable funds to farmers to construct outlets in sound way ▪ Machinery supply
	▪ Construction of rural roads	▪ Ministry of Agriculture	▪ Machinery supply
	▪ Construction of fire lines	▪ Ministry of Agriculture	▪ Machinery supply
	▪ Apply reclaiming projects	▪ Ministry of Agriculture ▪ International	▪ Machinery supply
	▪ Educate local people	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ Ministry of Information	▪ Applying incentives and disincentives policy
Possible measures	▪ Applying drainage control	▪ Ministry of Agriculture	▪ Machinery supply
	▪ Protect adapted bushy/shrubby formations	▪ Ministry of Agriculture	▪ Provide suitable funds to local people to prevent them harm these formulations
	▪ Forest management	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Offer suitable funds to local people to prevent them harm the forestland ▪ Supply low cost fuel to local people
	▪ Reclaiming slopes and unusable lands	▪ Ministry of Agriculture ▪ International	▪ Machinery supply
	▪ Provide training to rural population	▪ Ministry of Agriculture ▪ Ministry of Environment	▪ Applying incentives and disincentives policy
	▪ Provide financial aids	▪ Ministry of Agriculture ▪ Ministry of Environment ▪ International	▪ Offer suitable and adequate financial aids to farmer to enable them adopt conservation measures and preventing them from leaving there lands
	▪ Allocation industrial projects	▪ Ministry of Agriculture ▪ Private sector	▪ Offer suitable and adequate loans to establish light industrial projects in the area

9. CONCLUSIONS

Both pilot areas of Kurdaha and Sheikh Bader have excellent agricultural conditions. However, as a result of agricultural development, urban expansion, deforestation, inappropriate agricultural practices, and forest fire soil erosion by water is becoming a major problem in several areas. Furthermore, large areas of the rolling hills and gentle mountain slopes have been turned into waste fields. If soils are not properly managed, soil erosion leads to a decrease in soil productivity in the short term and to complete soil degradation in the long term. Therefore, an accurate prediction technology is needed to solve these problems and assess the extent and severity of erosion as well as to effectively develop and apply modern techniques for preserving farmland and forestland. Erosion mapping is a very essential tool for the assessment of the distribution and geographic extent of the phenomena, as well as for its qualitative characterisation. The erosion map provides information about nature, intensity and distribution of the relevant phenomena. On this basis it is possible to identify the most severely affected areas and the dominant type of erosion processes. Mapping of water erosion in Kurdaha and Sheikh Bader areas was executed according to the common consolidate UNEP-PAP methodology of Mapping of Rainfall-Induced Erosion processes in the Mediterranean Coastal Area.

Most of the areas of Kurdaha can be considered as stable or stabilised zones, where the total area of the lands having little to high erosion risk account for 42% of Kurdaha total area with the main causative agents belong to human activity and topography. While 16% of the total area is consider as unstable zones due to bad land management, sheet and gully erosion. While, the erosion status in Sheikh Bader is rather worse than that of Kurdaha area because 38% of Sheikh Bader total area is fall under the category unstable areas in which bad land management and sheet erosion are predominant. While the stable areas account for 54% of Sheikh Bader total area. As for Kurdaha stable areas, the main causative agents belong to human activity and topography.

Generally in both areas, a variety of physical problems such as soil loss, stoniness, and soil contamination are the result of erroneous and excessive utilisation of natural resources. In addition to those physical constraints, there are some socio-economic problems, like the misuse of agricultural land in contradiction to soil suitability, deficiency in the determination of optimum farm sizes with regard to agro-ecological conditions, insufficient and incorrect soil conservation measures (e.g. degraded or partly-destroyed terraces), complexity of land tenure structures, particularisation of farm plots by inheritance, and absence of plant production planning.

Successful land degradation control is based on the efficient use of available resources and therefore needs the establishment of clear priorities for both identification and planning of future interventions in the framework of control programmes.

In total for Kurdaha area, about 8.49% of the assessed area falls into the high priority class whereas 29.53% were classified as medium priority areas and 61.03% as low priority areas. The high priority areas in Kurdaha area were identified as unstable areas showing active erosion processes such as dominant multiple processes due to bad land management, dominant gully network, and dominant sheet erosion. For Sheikh Bader area, about 16.17% of the assessed area falls into the high priority class whereas 39.88% were classified as medium priority areas and 42.53% as low priority areas. In the high priority classes in Sheikh Bader area, the unstable areas are dominant, showing two unstable conditions; dominant multiple processes due to bad land management and dominant sheet erosion. Based on the priority procedure the hot spots in Kurdaha mainly occur in southern parts of Kurdaha city as well as in the south-eastern parts. As for the

area of Sheikh Bader, the hot spots largely occur to the north western and southern parts of Sheikh Bader city.

The traditional remedial measures to mitigation and control management of erosion processes, predominantly applied in the past and still prevailing in the present practice, proved in many occasions to be counter productive, not efficient, and implying failure risk. The currently applied remedial measures include all preventive, curative, and protective measures. In general the first objective of these measures is to prevent, or stop the spread of degradation, rehabilitate the degraded lands and recuperate their productivity wherever possible. The second objective is to restore and reserve soil productivity, and raise its production productivity. Usually, the remedial programs aim to identify the resources to be protected or restored, select elaborate remedial measures and then implement selected remedial measures according to priorities. Furthermore, both pilot areas characterised with stony lands and hard accessibility. These two characters make implementation of remedial measures and reclamation activities hard to be applied and need a considerable amount of financial resources.

General recommendations for the preparation of management plans of areas affected by degradation cannot disregard the guiding principles of sustainable development, in terms of management and conservation of the resources base, and of orientation of technological and institutional progress so to ensure a continuous satisfaction of human needs for present and future generations. The application of the principles of sustainable development makes it possible to preserve natural and genetic resources, while promoting a development which is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. The application of sustainable development principles to fragile ecosystems such as arid and semiarid zones, very common in Mediterranean areas, must cope with the issues of land degradation and desertification.

A sound knowledge of causes of land degradation and of desertification processes is needed in order to select, for each management area, the most appropriate actions for natural resources conservation.

In this connection, the benefits of thematic mapping should be considered mainly in terms of possibilities of selecting areas for priority interventions, where it can be carried out more detailed studies and field inquires aimed at determining the type and intensity of active erosion processes.

Generally speaking, areas characterised by slightly or not yet degraded land, or moderately degraded one, are often the most widespread and should be devoted special attention and priority.

Actions to restore seriously-degraded land should be limited to specific cases in which land degradation is clearly identified and recovery measures are deemed suitable, effective and sustainable.

The success of land degradation control programmes depends on favourable framework conditions. These framework conditions comprise appropriate organisational, institutional, legal and political structures and processes as basis for programme planning and implementation. The management efficiency of the institutions involved is crucial in this respect. If the framework conditions are found to be insufficient, appropriate steps, such as capacity building efforts, have to be initiated in order to ensure sustainable programme implementation.

Participation is the key to success in any land degradation control programme. Regardless of how technically sound a plan is, it cannot be successfully implemented

without the support and participation of the target groups. Therefore, an emphasis has to be placed participatory approaches to design and implementation of erosion and desertification control activities.

Monitoring of erosion and desertification control means regular assessment of activities, recording of impact, and periodical analysis of relevant information. Thus, monitoring provides feedback information on programme implementation and results. Monitoring can be understood as an early warning system which identifies problems at an early stage in order to make appropriate adjustments for achievement of the planned outputs.

The formulated management plan must be "implementable", the criterion implying, among others, the availability of funds needed. Financial considerations have to be taken into account from the very beginning of the initial phase of programme formulation, and the funding sources carefully analysed.

Finally, both pilot areas have excellent agricultural conditions and simultaneously are facing various types of land degradation, excessive deforestation and improper agricultural practices. Consequently, soil erosion is a serious problem over Kurdaha and Sheikh Bader lands, and it will continue to get worse if action does not take place in order to protect forestlands, preserve soil resources from improper development, help in soil management to minimise erosion and sedimentation rates, keep the soil and forest productivity, and play an important role in soil resource management.

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ANNEX 1: EROSION MAPPING LEGEND

The erosion mapping legend, presented below, provides a methodological basis for erosion/desertification mapping, as described in detail in the PAP/RAC Guidelines for Mapping of Rainfall-Induced Erosion Processes in the Mediterranean Coastal Areas, 1997 and the UNEP/MAP/PAP Guidelines for Erosion and Desertification Control Management with Particular Reference to Mediterranean Coastal Areas, 2000.

A. PREDICTIVE MAPPING: INFERRED GLOBAL EROSION HAZARDS

Symbols

(0)	**none** (Equivalent to **stable non-used wasteland** in **descriptive mapping: 010**)
(1)	**very slight**
(2)	**slight**
(3)	**moderate**
(4)	**severe**
(5)	**very severe**

B. SITE-DESCRIPTIVE MAPPING:GRADE OF STABILITY/EROSION PROCESSES

I. Stable, non-erosion-affected areas (*)

00	**stable, non-used wasteland** (rock outcrops, cliffs, stony or sandy areas)
01	**stable, unmanaged areas with potential for forestry use only**
02	**stable, unmanaged areas with agricultural potential** (crops and pasture)
03	**stable, managed areas with forestry use only**
04	**stable, managed areas with agricultural use** (crops and pasture)

• **Rehabilitated areas by means of:**

05	**natural or artificial re-vegetation**
06	**physical infrastructures** (terraces, check dams, etc.)

***Grade of instability risk**

Assessment of **instability risk** for all **stable** environments (00 to 04) and of risk for **rehabilitated** environments, i.e. 05+06 (i.e. a risk in the first years of rehabilitation;) to be expressed by a complementary digit (0 to 3) to the original **stable units'** code:

4: No risk (= highest grade of **stability**)
5: Low to moderate
6: High
7: Areas in hazardous/precarious/critical state (Stability threshold = highest grade of **instability risk**)

Example : 03 = **stable** managed areas with forestry use only
: 032 = **stable** managed areas with forestry use only with a high **erosion risk**

***Identification of main causative agents**

Instability risk assessment may be reinforced by the identification of its most probable/ prevailing **causative agents** inherent in the **landscapes'** main basic components, i.e.:

t: Topography
g: Geology
v: Vegetation
h: Human activities
a: Animal activities (trampling, terracing, etc.)

Extra codes might be freely added according to local specific contexts and situations.

Example: 023 **g** = stable unmanaged areas with agricultural potential with erosion risk mainly due to geologic factors.

II. Unstable areas (**)

• ***Splash erosion***

A1	**localised** (<30% of the area is affected)
A2	**dominant** (30-60%)
A3	**generalised** (>60%)

• ***Sheet erosion***

L1	**localised**
L2	**dominant**
L3	**generalised with soil profile removal**
Lx	**= unreclaimable areas due to total soil removal**

• ***Rill erosion***

D1	**localised**
D2	**dominant**
D3	**generalised**

• ***Gully erosion***

C1	**individual gullies**
C2	**localised gully networks**
C3	**dominant**
C4	**generalised**
Cx	**= unreclaimable areas due to generalised bad lands**

- ***Wind erosion***

E1	**localised loss of topsoil/overblowing/deflection**
E2	**dominant**
E3	**generalised**
Ex	**= unreclaimable areas due to total sand or sediment burying or topsoil removal**

- ***Mass earth movements***

M1	**local gravitational soil creep/solifluction**
M2	**localised land slides/mudflows**
M3	**dominant**
M4	**generalised**
MX	**= unreclaimable areas due to total slope slides**

Symbols

- ***Water or sediment excess***

W1	**areas periodically flooded and/or sediment buried**
W2	**areas permanently flooded and/or sediment buried/waterlogged areas**

- ***Degradation induced by land management***

S1	**soil compacting**
K1	**soil crusting**
Z1	**cattle trampling/terraceting**
H1	**salinisation**

- ***Associated processes***

See “Note” in para (**)

Multiple processes

P1 P2 P3 etc.(for description of different closely interacting erosion processes)

****Erosion expansion trend (rate)**

Assessment of erosion rate/trend for all **unstable** erosion-affected areas to be expressed by a complementary digit (0 to 3) to the original **unstable units'** code:

4: Trend to **stabilisation, recession** or limitation of spatial **expansion**

5: Trend to local **expansion** or **intensification**

6: Trend to widespread **expansion** or **intensification**

7: Trend to increase **generalised degradation** towards an **irreversible state**

Example:

L2 = dominant sheet erosion

L23 = dominant sheet erosion with a trend towards generalisation and an irreversible state (Lx type units)

Note: All multiple or mixed but clearly identifiable erosion processes can be mapped by associating or combining the corresponding codes (the sequence of the codes should be established according to the relative importance of the processes: first code = the most important process):

Example: L_{11}/C_{12} = Localised sheet erosion combined with dominant gully networks with a trend to widespread expansion or intensification.

- ***Point/line erosion data (Individual erosion processes)***


rocky canyon


individual gully and/or gully head


individual landslide/mudflow


gravitational stone fan


waterways bank erosion


coastal erosion line

ANNEX 2: FIELD QUESTIONNAIRE USED FOR THE DESCRIPTIVE MAPPING APPROACH DURING FIELD WORK




Improving Coastal Land Degradation Monitoring in Lebanon and Syria

	Date		Photo		Releve
					Location
	Elevation		Easting		Northing
	Surveyors				

Unstable Types			**Stable Types**		
Splash erosion	A		Non-used wasteland	00	
Sheet erosion	L		Unmanaged areas with potential for forest use only	01	
Rill erosion	D		Unmanaged areas with agriculture potential	02	
Gully erosion	C		Managed areas with forest use only	03	
Mass earth movement	M		Managed areas with agriculture use	04	
Water or sediment excess	W		Natural/Artificial Re-vegetation	05	
Bad Land management	P		Physical Infrastructure	06	
Grade of Extent			Grade of Risk		
Localised (< 30%)	1		No risk	0	
Dominant (30 ~ 60%)	2		Low risk	1	
Generalised (>60%)	3		High risk	2	
			Critical risk	3	
Expansion Trend			Causative agents		
Stabilisation	0		Topography	t	
Expansion	1		Geology	g	
Intensification	2		Vegetation	v	
Irreversible	3		Human practice	h	
			Animal practice	a	
	Final Code			**Final Code**	
	ERM Class			**ERM Class**	

Notes

ANNEX 4: PILOT AREAS PREDICTIVE, DESCRIPTIVE AND PRIORITY CLASSES

(These tables facilitate comparison of predictive mapping and descriptive mapping for a given situation)

TABLE I Kurdaha Predictive Mapping Code, Descriptive Mapping Code and priority Class

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
166	3	34.0	Moderately susceptible to erosion	P12	Bad land management	2.089	0.89	0.52	2	Unstable
163	3	28.0	Moderately susceptible to erosion	031 h	Managed areas with forest use	0.829	0.35	0.21	1	Stable
162	5	43.7	Very highly susceptible to erosion	061 th	Physical Infrastructure	0.866	0.37	0.22	1	Stable
15	3	28.0	Moderately susceptible to erosion	030	Managed areas with forest use	1.397	0.59	0.35	1	Stable
165	3	30.0	Moderately susceptible to erosion	042 h	Managed areas with agriculture use	0.954	0.41	0.24	2	Stable
168	3	26.0	Moderately susceptible to erosion	042 h	Managed areas with agriculture use	1.975	0.84	0.49	2	Stable
17	3	32.4	Moderately susceptible to erosion	001 tv	Non-used wasteland	0.652	0.28	0.16	1	Stable
170	3	31.0	Moderately susceptible to erosion	M21	Mass earth movement	0.287	0.12	0.07	1	Unstable
14	4	38.3	Highly susceptible to erosion	002 g	Non-used wasteland	1.059	0.45	0.26	1	Stable
159	3	31.0	Moderately susceptible to erosion	L11	Sheet erosion	0.549	0.23	0.14	2	Unstable
12	3	28.0	Moderately susceptible to erosion	021 h	Unmanaged areas with agriculture potential	0.206	0.09	0.05	1	Stable
157	3	31.0	Moderately susceptible to erosion	L12	Sheet erosion	4.347	1.85	1.09	2	Unstable
13	3	28.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	2.164	0.92	0.54	1	Stable
11	3	28.0	Moderately susceptible to erosion	012 h	Unmanaged areas with forest potential	0.543	0.23	0.14	2	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
164	3	34.0	Moderately susceptible to erosion	012 h	Unmanaged areas with forest potential	1.969	0.84	0.49	2	Stable
169	3	31.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.299	0.13	0.07	1	Stable
160	3	31.0	Moderately susceptible to erosion	C11	Gully erosion	0.364	0.15	0.09	1	Unstable
9	4	37.0	Highly susceptible to erosion	P12	Bad land management	0.825	0.35	0.21	2	Unstable
156	3	31.0	Moderately susceptible to erosion	P12	Bad land management	0.261	0.11	0.07	2	Unstable
158	3	31.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	4.607	1.96	1.15	1	Stable
18	4	35.5	Highly susceptible to erosion	P11	Bad land management	0.894	0.38	0.22	2	Unstable
16	3	32.4	Moderately susceptible to erosion	P11	Bad land management	0.438	0.19	0.11	2	Unstable
167	3	30.0	Moderately susceptible to erosion	L11	Sheet erosion	0.948	0.40	0.24	2	Unstable
19	4	35.5	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.641	0.27	0.16	1	Stable
155	3	31.3	Moderately susceptible to erosion	L12	Sheet erosion	0.822	0.35	0.21	2	Unstable
10	3	33.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	2.228	0.95	0.56	1	Stable
8	3	28.0	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	0.135	0.06	0.03	1	Stable
21	4	35.5	Highly susceptible to erosion	L11	Sheet erosion	0.932	0.40	0.23	2	Unstable
20	3	32.2	Moderately susceptible to erosion	051 h	Natural/Artificial Re-vegetation	0.565	0.24	0.14	1	Stable
161	3	31.0	Moderately susceptible to erosion	C21	Gully erosion	0.172	0.07	0.04	2	Unstable
154	3	31.3	Moderately susceptible to erosion	P22	Bad land management	1.622	0.69	0.41	3	Unstable
24	4	35.5	Highly susceptible to erosion	001 g	Non-used wasteland	2.521	1.07	0.63	1	Stable
171	3	26.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	1.352	0.58	0.34	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
23	5	43.7	Very highly susceptible to erosion	021 vh	Unmanaged areas with agriculture potential	1.282	0.55	0.32	1	Stable
1	3	29.5	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	1.124	0.48	0.28	1	Stable
153	3	31.3	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	3.748	1.59	0.94	2	Stable
201	3	30.0	Moderately susceptible to erosion	062 th	Physical Infrastructure	2.180	0.93	0.54	1	Stable
22	4	37.4	Highly susceptible to erosion	M32	Mass earth movement	0.296	0.13	0.07	1	Unstable
26	3	33.0	Moderately susceptible to erosion	002 h	Non-used wasteland	2.263	0.96	0.57	1	Stable
199	3	34.0	Moderately susceptible to erosion	031 t	Managed areas with forest use	0.395	0.17	0.10	1	Stable
202	3	26.0	Moderately susceptible to erosion	021 h	Unmanaged areas with agriculture potential	2.959	1.26	0.74	1	Stable
7	3	29.5	Moderately susceptible to erosion	042 h	Managed areas with agriculture use	0.115	0.05	0.03	2	Stable
178	4	37.4	Highly susceptible to erosion	C12	Gully erosion	0.948	0.40	0.24	1	Unstable
179	4	35.5	Highly susceptible to erosion	011 th	Unmanaged areas with forest potential	0.514	0.22	0.13	1	Stable
2	5	43.7	Very highly susceptible to erosion	P11	Bad land management	0.617	0.26	0.15	2	Unstable
101	1	19.0	Not or insignificantly susceptible to erosion	040	Managed areas with agriculture use	20.826	8.86	5.20	1	Stable
208	1	19.5	Not or insignificantly susceptible to erosion	041 t	Managed areas with agriculture use	2.335	0.99	0.58	1	Stable
5	4	37.0	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.230	0.10	0.06	1	Stable
3	3	33.0	Moderately susceptible to erosion	032 th	Managed areas with forest use	0.445	0.19	0.11	1	Stable
28	3	33.0	Moderately susceptible to erosion	001	Non-used wasteland	0.143	0.06	0.04	1	Stable
200	3	30.0	Moderately susceptible to erosion	031 h	Managed areas with forest use	0.126	0.05	0.03	1	Stable
27	3	33.0	Moderately susceptible to erosion	P10	Bad land management	0.454	0.19	0.11	1	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
6	3	30.0	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	2.064	0.88	0.52	1	Stable
152	3	31.3	Moderately susceptible to erosion	L11	Sheet erosion	1.993	0.85	0.50	2	Unstable
4	3	28.0	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	1.393	0.59	0.35	1	Stable
181	3	31.3	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	1.507	0.64	0.38	2	Stable
133	3	28.0	Moderately susceptible to erosion	030	Managed areas with forest use	6.335	2.70	1.58	1	Stable
198	3	33.0	Moderately susceptible to erosion	022 h	Unmanaged areas with agriculture potential	0.835	0.36	0.21	1	Stable
197	3	33.0	Moderately susceptible to erosion	P12	Bad land management	0.128	0.05	0.03	2	Unstable
172	3	26.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.642	0.27	0.16	1	Stable
196	3	33.0	Moderately susceptible to erosion	021 t	Unmanaged areas with agriculture potential	0.709	0.30	0.18	1	Stable
182	3	33.0	Moderately susceptible to erosion	040	Managed areas with agriculture use	0.757	0.32	0.19	1	Stable
29	3	33.0	Moderately susceptible to erosion	021 h	Unmanaged areas with agriculture potential	2.085	0.89	0.52	1	Stable
180	3	31.3	Moderately susceptible to erosion	012 gv	Unmanaged areas with forest potential	0.256	0.11	0.06	2	Stable
150	3	31.3	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	1.284	0.55	0.32	2	Stable
151	3	31.3	Moderately susceptible to erosion	041 t	Managed areas with agriculture use	0.854	0.36	0.21	1	Stable
145	1	16.4	Not or insignificantly susceptible to erosion	P22	Bad land management	0.849	0.36	0.21	3	Unstable
173	3	31.3	Moderately susceptible to erosion	022 h	Unmanaged areas with agriculture potential	0.362	0.15	0.09	1	Stable
130	4	38.5	Highly susceptible to erosion	012 h	Unmanaged areas with forest potential	1.290	0.55	0.32	2	Stable
175	3	33.0	Moderately susceptible to erosion	P11	Bad land management	0.451	0.19	0.11	2	Unstable
999	3	31.3	Moderately susceptible to erosion	NR	Not Relevant	0.363	0.15	0.09	4	Urban

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
177	3	32.1	Moderately susceptible to erosion	P22	Bad land management	0.898	0.38	0.22	3	Unstable
149	3	31.3	Moderately susceptible to erosion	L11	Sheet erosion	0.750	0.32	0.19	2	Unstable
176	3	31.3	Moderately susceptible to erosion	011 t	Unmanaged areas with forest potential	0.457	0.19	0.11	1	Stable
146	1	16.4	Not or insignificantly susceptible to erosion	041 h	Managed areas with agriculture use	1.812	0.77	0.45	1	Stable
134	3	33.0	Moderately susceptible to erosion	P12	Bad land management	0.438	0.19	0.11	2	Unstable
174	3	31.3	Moderately susceptible to erosion	022 h	Unmanaged areas with agriculture potential	0.482	0.21	0.12	1	Stable
148	3	31.3	Moderately susceptible to erosion	L12	Sheet erosion	0.767	0.33	0.19	2	Unstable
205	3	31.3	Moderately susceptible to erosion	061 th	Physical Infrastructure	1.253	0.53	0.31	1	Stable
999	0	-990.0	Not relevant	NR	Not Relevant	0.162	0.07	0.04	4	Urban
183	3	31.3	Moderately susceptible to erosion	P22	Bad land management	0.981	0.42	0.25	3	Unstable
147	3	31.3	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	2.269	0.97	0.57	2	Stable
132	3	30.0	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	0.834	0.35	0.21	2	Stable
195	3	33.0	Moderately susceptible to erosion	062 gh	Physical Infrastructure	0.467	0.20	0.12	1	Stable
135	5	43.7	Very highly susceptible to erosion	011 t	Unmanaged areas with forest potential	1.578	0.67	0.39	1	Stable
999	0	-990.0	Not relevant	NR	Not Relevant	0.902	0.38	0.23	4	Urban
184	3	30.0	Moderately susceptible to erosion	022 th	Unmanaged areas with agriculture potential	0.706	0.30	0.18	1	Stable
193	4	37.0	Highly susceptible to erosion	012 th	Unmanaged areas with forest potential	0.613	0.26	0.15	1	Stable
138	3	33.0	Moderately susceptible to erosion	031 h	Managed areas with forest use	0.400	0.17	0.10	1	Stable
136	3	26.6	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	2.178	0.93	0.54	1	Stable
139	3	33.0	Moderately susceptible to erosion	L12	Sheet erosion	0.340	0.14	0.08	2	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
999	0	-990.0	Not relevant	NR	Not Relevant	0.179	0.08	0.04	4	Urban
140	3	33.0	Moderately susceptible to erosion	012 h	Unmanaged areas with forest potential	0.085	0.04	0.02	2	Stable
203	3	32.1	Moderately susceptible to erosion	L12	Sheet erosion	0.137	0.06	0.03	2	Unstable
191	3	30.0	Moderately susceptible to erosion	D12	Rill erosion	0.955	0.41	0.24	2	Unstable
204	3	31.3	Moderately susceptible to erosion	022 th	Unmanaged areas with agriculture potential	1.056	0.45	0.26	1	Stable
207	3	31.3	Moderately susceptible to erosion	062 th	Physical Infrastructure	2.978	1.27	0.74	1	Stable
194	4	37.0	Highly susceptible to erosion	C11	Gully erosion	0.341	0.15	0.09	1	Unstable
142	3	34.9	Highly susceptible to erosion	P12	Bad land management	0.326	0.14	0.08	2	Unstable
192	3	30.0	Moderately susceptible to erosion	061 th	Physical Infrastructure	1.718	0.73	0.43	1	Stable
190	3	30.0	Moderately susceptible to erosion	L12	Sheet erosion	2.067	0.88	0.52	2	Unstable
143	4	37.0	Highly susceptible to erosion	011 h	Unmanaged areas with forest potential	1.109	0.47	0.28	1	Stable
141	4	37.0	Highly susceptible to erosion	011 th	Unmanaged areas with forest potential	0.845	0.36	0.21	1	Stable
137	6	46.0	Extremely susceptible to erosion	P12	Bad land management	2.249	0.96	0.56	2	Unstable
206	1	16.4	Not or insignificantly susceptible to erosion	041 t	Managed areas with agriculture use	0.750	0.32	0.19	1	Stable
31	3	34.0	Moderately susceptible to erosion	C32	Gully erosion	1.812	0.77	0.45	3	Unstable
68	3	28.0	Moderately susceptible to erosion	011 t	Unmanaged areas with forest potential	4.423	1.88	1.10	1	Stable
58	3	26.6	Moderately susceptible to erosion	P12	Bad land management	1.472	0.63	0.37	2	Unstable
30	3	34.0	Moderately susceptible to erosion	022 th	Unmanaged areas with agriculture potential	0.313	0.13	0.08	1	Stable
189	3	26.6	Moderately susceptible to erosion	041 th	Managed areas with agriculture use	1.996	0.85	0.50	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
32	3	34.0	Moderately susceptible to erosion	L22	Sheet erosion	0.964	0.41	0.24	3	Unstable
144	4	37.0	Highly susceptible to erosion	012 t	Unmanaged areas with forest potential	0.494	0.21	0.12	1	Stable
105	1	16.4	Not or insignificantly susceptible to erosion	P12	Bad land management	0.389	0.17	0.10	2	Unstable
63	3	26.6	Moderately susceptible to erosion	041 th	Managed areas with agriculture use	1.422	0.61	0.36	1	Stable
62	3	26.6	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.169	0.07	0.04	1	Stable
59	3	26.6	Moderately susceptible to erosion	Q13	Quarry	0.236	0.10	0.06	2	Unstable
69	3	31.5	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	1.542	0.66	0.39	1	Stable
60	4	37.0	Highly susceptible to erosion	051	Natural/Artificial Re-vegetation	0.501	0.21	0.13	1	Stable
186	3	26.6	Moderately susceptible to erosion	032 th	Managed areas with forest use	0.900	0.38	0.22	1	Stable
103	1	16.4	Not or insignificantly susceptible to erosion	041 h	Managed areas with agriculture use	2.192	0.93	0.55	1	Stable
61	3	26.6	Moderately susceptible to erosion	030	Managed areas with forest use	0.120	0.05	0.03	1	Stable
122	3	26.6	Moderately susceptible to erosion	P22	Bad land management	2.045	0.87	0.51	3	Unstable
188	3	26.6	Moderately susceptible to erosion	P22	Bad land management	0.854	0.36	0.21	3	Unstable
67	3	31.5	Moderately susceptible to erosion	041 th	Managed areas with agriculture use	0.501	0.21	0.13	1	Stable
64	3	28.8	Moderately susceptible to erosion	W11	Water or sediment excess	0.371	0.16	0.09	2	Unstable
123	4	37.0	Highly susceptible to erosion	011 h	Unmanaged areas with forest potential	0.207	0.09	0.05	1	Stable
999	1	16.4	Not or insignificantly susceptible to erosion	NR	Not Relevant	0.221	0.09	0.06	4	Urban
34	3	34.0	Moderately susceptible to erosion	C21	Gully erosion	0.727	0.31	0.18	2	Unstable
999	0	-990.0	Not relevant	NR	Not Relevant	0.436	0.19	0.11	4	Urban

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
115	3	26.6	Moderately susceptible to erosion	002 tg	Non-used wasteland	0.157	0.07	0.04	1	Stable
33	4	35.7	Highly susceptible to erosion	052 tg	Natural/Artificial Re-vegetation	0.408	0.17	0.10	1	Stable
121	3	26.6	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	0.747	0.32	0.19	2	Stable
65	6	46.0	Extremely susceptible to erosion	013 th	Unmanaged areas with forest potential	1.074	0.46	0.27	2	Stable
116	3	26.6	Moderately susceptible to erosion	P12	Bad land management	2.487	1.06	0.62	2	Unstable
187	3	26.6	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	0.487	0.21	0.12	1	Stable
119	3	34.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.473	0.20	0.12	1	Stable
126	3	28.8	Moderately susceptible to erosion	P22	Bad land management	1.328	0.57	0.33	3	Unstable
102	1	16.4	Not or insignificantly susceptible to erosion	021 th	Unmanaged areas with agriculture potential	0.630	0.27	0.16	1	Stable
114	3	26.6	Moderately susceptible to erosion	W11	Water or sediment excess	0.159	0.07	0.04	2	Unstable
71	3	32.4	Moderately susceptible to erosion	012 h	Unmanaged areas with forest potential	1.008	0.43	0.25	2	Stable
74	3	32.4	Moderately susceptible to erosion	P12	Bad land management	0.137	0.06	0.03	2	Unstable
129	3	33.0	Moderately susceptible to erosion	P22	Bad land management	0.400	0.17	0.10	3	Unstable
66	6	46.0	Extremely susceptible to erosion	P22	Bad land management	0.233	0.10	0.06	3	Unstable
185	1	16.4	Not or insignificantly susceptible to erosion	022 h	Unmanaged areas with agriculture potential	3.662	1.56	0.91	1	Stable
33	4	35.7	Highly susceptible to erosion	052 tg	Natural/Artificial Re-vegetation	0.176	0.07	0.04	1	Stable
184	4	37.6	Highly susceptible to erosion	022 th	Unmanaged areas with agriculture potential	0.203	0.09	0.05	1	Stable
70	6	46.0	Extremely susceptible to erosion	011 t	Unmanaged areas with forest potential	1.575	0.67	0.39	1	Stable
113	3	34.0	Moderately susceptible to erosion	062 th	Physical Infrastructure	1.581	0.67	0.39	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
75	3	31.5	Moderately susceptible to erosion	P12	Bad land management	0.368	0.16	0.09	2	Unstable
109	3	31.3	Moderately susceptible to erosion	L22	Sheet erosion	0.268	0.11	0.07	3	Unstable
128	3	33.0	Moderately susceptible to erosion	062 th	Physical Infrastructure	0.795	0.34	0.20	1	Stable
120	4	35.7	Highly susceptible to erosion	P22	Bad land management	0.091	0.04	0.02	3	Unstable
118	3	34.0	Moderately susceptible to erosion	003 tg	Non-used wasteland	0.282	0.12	0.07	2	Stable
110	3	31.3	Moderately susceptible to erosion	M21	Mass earth movement	0.061	0.03	0.02	1	Unstable
35	3	34.0	Moderately susceptible to erosion	C21	Gully erosion	0.114	0.05	0.03	2	Unstable
127	4	37.0	Highly susceptible to erosion	L22	Sheet erosion	0.833	0.35	0.21	3	Unstable
117	3	34.0	Moderately susceptible to erosion	L11	Sheet erosion	0.598	0.25	0.15	2	Unstable
79	4	40.0	Highly susceptible to erosion	031 h	Managed areas with forest use	1.037	0.44	0.26	1	Stable
72	3	31.5	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.706	0.30	0.18	1	Stable
35	3	34.0	Moderately susceptible to erosion	L21	Sheet erosion	0.417	0.18	0.10	2	Unstable
80	4	40.0	Highly susceptible to erosion	P12	Bad land management	0.228	0.10	0.06	2	Unstable
125	3	28.8	Moderately susceptible to erosion	L12	Sheet erosion	0.641	0.27	0.16	2	Unstable
111	3	31.3	Moderately susceptible to erosion	022 h	Unmanaged areas with agriculture potential	0.444	0.19	0.11	1	Stable
73	4	40.0	Highly susceptible to erosion	011 t	Unmanaged areas with forest potential	0.503	0.21	0.13	1	Stable
112	3	31.3	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.355	0.15	0.09	1	Stable
124	4	37.0	Highly susceptible to erosion	041 th	Managed areas with agriculture use	6.703	2.85	1.67	1	Stable
40	4	35.7	Highly susceptible to erosion	021 h	Unmanaged areas with agriculture potential	1.562	0.66	0.39	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
36	3	26.6	Moderately susceptible to erosion	C32	Gully erosion	0.432	0.18	0.11	3	Unstable
82	3	34.5	Moderately susceptible to erosion	012 th	Unmanaged areas with forest potential	0.317	0.13	0.08	1	Stable
39	4	35.7	Highly susceptible to erosion	022 th	Unmanaged areas with agriculture potential	1.202	0.51	0.30	1	Stable
41	6	48.0	Extremely susceptible to erosion	P22	Bad land management	2.453	1.04	0.61	3	Unstable
81	3	34.5	Moderately susceptible to erosion	L21	Sheet erosion	0.847	0.36	0.21	2	Unstable
78	3	31.5	Moderately susceptible to erosion	041 th	Managed areas with agriculture use	1.638	0.70	0.41	1	Stable
83	3	32.2	Moderately susceptible to erosion	031 tg	Managed areas with forest use	3.101	1.32	0.77	1	Stable
51	4	38.8	Highly susceptible to erosion	P22	Bad land management	1.451	0.62	0.36	3	Unstable
76	6	46.0	Extremely susceptible to erosion	P11	Bad land management	0.433	0.18	0.11	2	Unstable
37	4	35.7	Highly susceptible to erosion	C32	Gully erosion	1.469	0.63	0.37	3	Unstable
84	3	31.5	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	1.503	0.64	0.38	1	Stable
77	6	46.0	Extremely susceptible to erosion	011 t	Unmanaged areas with forest potential	0.296	0.13	0.07	1	Stable
50	4	38.8	Highly susceptible to erosion	L21	Sheet erosion	0.492	0.21	0.12	2	Unstable
44	4	38.8	Highly susceptible to erosion	P11	Bad land management	0.772	0.33	0.19	2	Unstable
52	4	37.0	Highly susceptible to erosion	P22	Bad land management	0.678	0.29	0.17	3	Unstable
97	3	29.4	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	1.187	0.51	0.30	1	Stable
38	4	37.0	Highly susceptible to erosion	D22	Rill erosion	0.645	0.27	0.16	2	Unstable
54	3	29.5	Moderately susceptible to erosion	011 tv	Unmanaged areas with forest potential	1.272	0.54	0.32	1	Stable
43	6	46.0	Extremely susceptible to erosion	P11	Bad land management	0.127	0.05	0.03	2	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
45	4	37.0	Highly susceptible to erosion	010	Unmanaged areas with forest potential	1.237	0.53	0.31	1	Stable
53	4	37.0	Highly susceptible to erosion	L21	Sheet erosion	0.447	0.19	0.11	2	Unstable
46	3	33.0	Moderately susceptible to erosion	012 th	Unmanaged areas with forest potential	0.170	0.07	0.04	1	Stable
48	3	33.0	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	0.235	0.10	0.06	1	Stable
49	3	33.0	Moderately susceptible to erosion	022 vh	Unmanaged areas with agriculture potential	0.382	0.16	0.10	1	Stable
98	4	37.0	Highly susceptible to erosion	L21	Sheet erosion	1.839	0.78	0.46	2	Unstable
47	3	33.0	Moderately susceptible to erosion	L12	Sheet erosion	0.102	0.04	0.03	2	Unstable
56	5	43.7	Very highly susceptible to erosion	062 th	Physical Infrastructure	0.887	0.38	0.22	1	Stable
96	3	33.0	Moderately susceptible to erosion	P12	Bad land management	0.690	0.29	0.17	2	Unstable
99	4	37.0	Highly susceptible to erosion	011 g	Unmanaged areas with forest potential	0.238	0.10	0.06	1	Stable
57	4	38.8	Highly susceptible to erosion	001 g	Non-used wasteland	1.287	0.55	0.32	1	Stable
87	5	43.7	Very highly susceptible to erosion	031	Managed areas with forest use	0.804	0.34	0.20	1	Stable
100	3	32.0	Moderately susceptible to erosion	042 hv	Managed areas with agriculture use	1.020	0.43	0.25	2	Stable
92	4	38.8	Highly susceptible to erosion	P12	Bad land management	0.880	0.37	0.22	2	Unstable
93	4	38.8	Highly susceptible to erosion	L22	Sheet erosion	0.298	0.13	0.07	3	Unstable
209	3	31.5	Moderately susceptible to erosion	P12	Bad land management	0.533	0.23	0.13	2	Unstable
94	5	43.7	Very highly susceptible to erosion	011 th	Unmanaged areas with forest potential	0.616	0.26	0.15	1	Stable
91	4	38.8	Highly susceptible to erosion	031 h	Managed areas with forest use	0.178	0.08	0.04	1	Stable
86	5	43.7	Very highly susceptible to erosion	012 th	Unmanaged areas with forest potential	0.437	0.19	0.11	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
90	3	33.0	Moderately susceptible to erosion	011 h	Unmanaged areas with forest potential	4.675	1.99	1.17	1	Stable
85	5	43.7	Very highly susceptible to erosion	P21	Bad land management	0.628	0.27	0.16	2	Unstable
88	3	33.0	Moderately susceptible to erosion	021 h	Unmanaged areas with agriculture potential	0.616	0.26	0.15	1	Stable
95	3	33.0	Moderately susceptible to erosion	011 t	Unmanaged areas with forest potential	1.170	0.50	0.29	1	Stable
89	3	33.0	Moderately susceptible to erosion	L12	Sheet erosion	0.300	0.13	0.07	2	Unstable
					TOTAL	**234.973**	**99.99**	**58.66**		

TABLE II Sheikh Bader Predictive Mapping Code, Descriptive Mapping Code and priority Class

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
377	2	22.5	Slightly susceptible to erosion	L22	Sheet erosion	3.271	1.740	1.629	3	Unstable
372	4	37.0	Highly susceptible to erosion	L22	Sheet erosion	2.746	1.461	1.368	3	Unstable
374	3	34.8	Moderately susceptible to erosion	021 h	Unmanaged areas with agriculture potential	7.488	3.983	3.729	1	Stable
378	3	28.0	Moderately susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.304	0.162	0.151	1	Stable
376	2	22.5	Slightly susceptible to erosion	011 th	Unmanaged. areas with forest potential	2.579	1.372	1.284	1	Stable
373	3	33.0	Moderately susceptible to erosion	P22	Bad land management	9.229	4.909	4.596	3	Unstable
375	3	33.0	Moderately susceptible to erosion	P21	Bad land management	1.681	0.894	0.837	2	Unstable
371	4	38.3	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.902	0.480	0.449	2	Stable
240	4	37.0	Highly susceptible to erosion	011 tgh	Unmanaged. areas with forest potential	0.203	0.108	0.101	1	Stable
303	5	44.0	Very highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.258	0.137	0.128	1	Stable
243	4	37.0	Highly susceptible to erosion	032 th	Managed areas with forest use	0.226	0.120	0.113	2	Stable
242	4	37.0	Highly susceptible to erosion	P22	Bad land management	0.877	0.466	0.437	3	Unstable
301	4	37.0	Highly susceptible to erosion	031 h	Managed areas with forest use	3.239	1.723	1.613	1	Stable
379	4	37.0	Highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	1.669	0.888	0.831	2	Stable
368	4	39.0	Highly susceptible to erosion	021 h	Unmanaged areas with agriculture potential	2.443	1.299	1.217	1	Stable
241	4	37.0	Highly susceptible to erosion	012 tv	Unmanaged. areas with forest potential	0.943	0.502	0.470	2	Stable
238	4	38.3	Highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	0.546	0.290	0.272	2	Stable
239	4	37.0	Highly susceptible to erosion	041 t	Managed areas with agriculture use	0.347	0.185	0.173	1	Stable
367	2	24.0	Slightly susceptible to erosion	061 h	Physical Infrastructure	0.310	0.165	0.154	1	Stable
302	3	28.0	Moderately susceptible to erosion	031 th	Managed areas with forest use	2.747	1.461	1.368	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
321	3	30.5	Moderately susceptible to erosion	030	Managed areas with forest use	0.694	0.369	0.346	1	Stable
244	4	37.0	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.438	0.233	0.218	1	Stable
366	3	29.0	Moderately susceptible to erosion	P21	Bad land management	3.179	1.691	1.583	2	Unstable
239	4	38.3	Highly susceptible to erosion	041 t	Managed areas with agriculture use	1.731	0.921	0.862	1	Stable
300	5	45.0	Very highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	1.636	0.870	0.815	2	Stable
297	5	45.0	Very highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.459	0.244	0.229	1	Stable
369	4	38.8	Highly susceptible to erosion	L12	Sheet erosion	1.881	1.001	0.937	2	Unstable
309	5	45.0	Very highly susceptible to erosion	L11	Sheet erosion	0.365	0.194	0.182	2	Unstable
380	3	33.0	Moderately susceptible to erosion	P12	Bad land management	3.299	1.755	1.643	2	Unstable
296	5	45.0	Very highly susceptible to erosion	031 h	Managed areas with forest use	0.323	0.172	0.161	1	Stable
246	4	38.3	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.196	0.104	0.098	2	Stable
299	4	37.0	Highly susceptible to erosion	041 t	Managed areas with agriculture use	0.710	0.378	0.354	1	Stable
295	3	28.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.951	0.506	0.474	1	Stable
254	4	38.8	Highly susceptible to erosion	L11	Sheet erosion	2.080	1.106	1.036	2	Unstable
381	3	29.0	Moderately susceptible to erosion	P11	Bad land management	2.492	1.326	1.241	2	Unstable
298	4	38.8	Highly susceptible to erosion	L12	Sheet erosion	0.607	0.323	0.302	2	Unstable
252	6	46.0	Extremely susceptible to erosion	031 th	Managed areas with forest use	0.547	0.291	0.272	1	Stable
305	4	38.8	Highly susceptible to erosion	P11	Bad land management	0.645	0.343	0.321	2	Unstable
304	4	38.8	Highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	0.318	0.169	0.158	2	Stable
255	4	38.8	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.860	0.457	0.428	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
245	4	38.8	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.747	0.397	0.372	2	Stable
292	4	38.8	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	1.152	0.613	0.574	1	Stable
247	4	38.3	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.580	0.309	0.289	1	Stable
370	3	29.5	Moderately susceptible to erosion	011 th	Unmanaged. areas with forest potential	3.005	1.598	1.497	1	Stable
293	4	38.8	Highly susceptible to erosion	P11	Bad land management	0.629	0.335	0.313	2	Unstable
362	4	37.0	Highly susceptible to erosion	P22	Bad land management	0.606	0.322	0.302	3	Unstable
294	4	38.8	Highly susceptible to erosion	032 h	Managed areas with forest use	0.450	0.239	0.224	2	Stable
353	4	37.0	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.751	0.399	0.374	1	Stable
248	4	38.3	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	1.821	0.969	0.907	2	Stable
264	4	37.0	Highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	1.189	0.632	0.592	2	Stable
308	4	38.8	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.372	0.198	0.185	2	Stable
360	4	37.0	Highly susceptible to erosion	012 h	Unmanaged. areas with forest potential	4.615	2.455	2.298	2	Stable
365	4	37.0	Highly susceptible to erosion	P22	Bad land management	0.817	0.435	0.407	3	Unstable
361	3	29.0	Moderately susceptible to erosion	P22	Bad land management	1.340	0.713	0.667	3	Unstable
249	4	38.8	Highly susceptible to erosion	021 t	Unmanaged areas with agriculture potential	0.360	0.191	0.179	1	Stable
306	4	38.8	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.336	0.179	0.167	1	Stable
291	4	38.8	Highly susceptible to erosion	011 tv	Unmanaged. areas with forest potential	0.367	0.195	0.183	1	Stable
307	4	38.8	Highly susceptible to erosion	062 th	Physical Infrastructure	1.055	0.561	0.525	2	Stable
265	4	37.0	Highly susceptible to erosion	L11	Sheet erosion	1.093	0.581	0.544	2	Unstable
389	4	37.0	Highly susceptible to erosion	P12	Bad land management	5.452	2.900	2.715	2	Unstable
236	4	38.8	Highly susceptible to erosion	P22	Bad land management	0.240	0.128	0.120	3	Unstable
250	4	38.8	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.478	0.254	0.238	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
363	4	37.0	Highly susceptible to erosion	022 t	Unmanaged areas with agriculture potential	0.184	0.098	0.092	2	Stable
253	4	38.8	Highly susceptible to erosion	031 th	Managed areas with forest use	1.139	0.606	0.567	1	Stable
237	4	38.8	Highly susceptible to erosion	L12	Sheet erosion	0.457	0.243	0.228	2	Unstable
235	4	38.3	Highly susceptible to erosion	061 h	Physical Infrastructure	0.271	0.144	0.135	1	Stable
352	3	33.0	Moderately susceptible to erosion	L11	Sheet erosion	1.017	0.541	0.506	2	Unstable
263	4	38.3	Highly susceptible to erosion	P21	Bad land management	0.466	0.248	0.232	2	Unstable
279	5	45.0	Very highly susceptible to erosion	P12	Bad land management	0.503	0.268	0.251	2	Unstable
234	4	38.3	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	1.136	0.604	0.566	1	Stable
257	4	38.3	Highly susceptible to erosion	062 th	Physical Infrastructure	1.234	0.656	0.615	2	Stable
258	4	38.8	Highly susceptible to erosion	041 th	Managed areas with agriculture use	1.242	0.661	0.619	1	Stable
355	4	37.0	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.216	0.115	0.108	1	Stable
256	4	38.3	Highly susceptible to erosion	041 t	Managed areas with agriculture use	0.924	0.491	0.460	1	Stable
280	4	38.3	Highly susceptible to erosion	022 tv	Unmanaged areas with agriculture potential	0.379	0.202	0.189	2	Stable
233	4	38.3	Highly susceptible to erosion	P11	Bad land management	0.412	0.219	0.205	2	Unstable
278	5	45.0	Very highly susceptible to erosion	011 tg	Unmanaged. areas with forest potential	0.709	0.377	0.353	1	Stable
251	4	38.8	Highly susceptible to erosion	061 h	Physical Infrastructure	0.663	0.353	0.330	1	Stable
262	4	38.3	Highly susceptible to erosion	061 t	Physical Infrastructure	0.593	0.315	0.295	1	Stable
349	3	29.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	0.836	0.445	0.416	1	Stable
364	2	24.5	Slightly susceptible to erosion	P22	Bad land management	2.405	1.279	1.198	3	Unstable
232	4	38.3	Highly susceptible to erosion	061 th	Physical Infrastructure	0.877	0.466	0.437	1	Stable
350	4	37.0	Highly susceptible to erosion	L11	Sheet erosion	0.389	0.207	0.194	2	Unstable
261	4	38.3	Highly susceptible to erosion	031 th	Managed areas with forest use	0.311	0.165	0.155	1	Stable
274	4	38.3	Highly susceptible to erosion	031 th	Managed areas with forest use	0.712	0.379	0.355	1	Stable
277	4	38.3	Highly susceptible to erosion	L22	Sheet erosion	0.250	0.133	0.125	3	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
276	4	38.3	Highly susceptible to erosion	022 g	Unmanaged areas with agriculture potential	0.444	0.236	0.221	2	Stable
354	4	37.0	Highly susceptible to erosion	L11	Sheet erosion	0.503	0.268	0.251	2	Unstable
390	3	26.6	Moderately susceptible to erosion	P12	Bad land management	1.087	0.578	0.541	2	Unstable
282	4	38.3	Highly susceptible to erosion	061 h	Physical Infrastructure	2.387	1.270	1.189	1	Stable
275	5	45.0	Very highly susceptible to erosion	P11	Bad land management	0.257	0.137	0.128	2	Unstable
358	3	33.0	Moderately susceptible to erosion	L12	Sheet erosion	1.810	0.963	0.901	2	Unstable
273	4	36.3	Highly susceptible to erosion	P12	Bad land management	0.592	0.315	0.295	2	Unstable
351	3	33.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	1.293	0.688	0.644	1	Stable
385	3	33.0	Moderately susceptible to erosion	P21	Bad land management	2.202	1.171	1.097	2	Unstable
260	4	38.3	Highly susceptible to erosion	021 th	Unmanaged areas with agriculture potential	0.342	0.182	0.170	1	Stable
259	4	38.3	Highly susceptible to erosion	L11	Sheet erosion	0.431	0.229	0.215	2	Unstable
999	4	39.0	Highly susceptible to erosion	NR	Not Relevant	0.161	0.086	0.080	4	Urban
281	4	38.3	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.427	0.227	0.213	1	Stable
272	4	38.3	Highly susceptible to erosion	P21	Bad land management	0.255	0.136	0.127	2	Unstable
356	3	29.0	Moderately susceptible to erosion	P21	Bad land management	0.160	0.085	0.080	2	Unstable
268	4	38.3	Highly susceptible to erosion	041 vh	Managed areas with agriculture use	1.801	0.958	0.897	1	Stable
231	4	38.8	Highly susceptible to erosion	NR	Not Relevant	0.430	0.229	0.214	4	Urban
229	4	38.3	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.641	0.341	0.319	1	Stable
271	3	33.0	Moderately susceptible to erosion	022 th	Unmanaged areas with agriculture potential	1.312	0.698	0.653	2	Stable
348	3	29.0	Moderately susceptible to erosion	P21	Bad land management	0.644	0.343	0.321	2	Unstable
346	4	37.0	Highly susceptible to erosion	021 h	Unmanaged areas with agriculture potential	2.011	1.070	1.002	1	Stable
228	4	39.0	Highly susceptible to erosion	P21	Bad land management	0.310	0.165	0.154	2	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
230	4	38.3	Highly susceptible to erosion	061 tv	Physical Infrastructure	0.149	0.079	0.074	1	Stable
267	4	39.0	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	1.811	0.963	0.902	1	Stable
270	4	38.3	Highly susceptible to erosion	021 h	Unmanaged areas with agriculture potential	0.435	0.231	0.217	1	Stable
247	3	29.0	Moderately susceptible to erosion	L11	Sheet erosion	0.430	0.229	0.214	2	Unstable
357	4	37.0	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.209	0.111	0.104	2	Stable
227	4	39.0	Highly susceptible to erosion	061 h	Physical Infrastructure	0.777	0.413	0.387	1	Stable
266	4	38.3	Highly susceptible to erosion	P11	Bad land management	0.324	0.172	0.161	2	Unstable
359	4	37.0	Highly susceptible to erosion	031 h	Managed areas with forest use	1.287	0.685	0.641	1	Stable
219	3	33.0	Moderately susceptible to erosion	021 v	Unmanaged areas with agriculture potential	0.330	0.176	0.164	1	Stable
382	3	28.0	Moderately susceptible to erosion	052 h	Natural/Artificial Re-vegetation	0.519	0.276	0.258	2	Stable
384	4	37.0	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.328	0.174	0.163	2	Stable
343	3	29.0	Moderately susceptible to erosion	P21	Bad land management	0.526	0.280	0.262	2	Unstable
383	4	37.0	Highly susceptible to erosion	P22	Bad land management	0.315	0.168	0.157	3	Unstable
388	3	33.0	Moderately susceptible to erosion	P11	Bad land management	2.525	1.343	1.258	2	Unstable
386	3	26.6	Moderately susceptible to erosion	P12	Bad land management	0.895	0.476	0.446	2	Unstable
226	4	39.0	Highly susceptible to erosion	061 h	Physical Infrastructure	0.659	0.351	0.328	1	Stable
210	3	33.0	Moderately susceptible to erosion	042 th	Managed areas with agriculture use	2.651	1.410	1.320	2	Stable
341	3	33.0	Moderately susceptible to erosion	041 h	Managed areas with agriculture use	1.315	0.699	0.655	1	Stable
216	3	33.0	Moderately susceptible to erosion	L22	Sheet erosion	0.307	0.163	0.153	3	Unstable
345	4	37.0	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.328	0.174	0.163	1	Stable
213	3	33.0	Moderately susceptible to erosion	061 th	Physical Infrastructure	0.706	0.376	0.352	1	Stable
269	4	39.0	Highly susceptible to erosion	062 h	Physical Infrastructure	0.414	0.220	0.206	2	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
224	4	39.0	Highly susceptible to erosion	P21	Bad land management	0.837	0.445	0.417	2	Unstable
999	0	-990.0	Not relevant	NR	Not Relevant	0.659	0.351	0.328	4	Urban
344	3	33.0	Moderately susceptible to erosion	022 vh	Unmanaged areas with agriculture potential	1.313	0.698	0.654	2	Stable
211	3	33.0	Moderately susceptible to erosion	041 th	Managed areas with agriculture use	0.976	0.519	0.486	1	Stable
223	4	39.0	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.775	0.412	0.386	1	Stable
214	3	28.0	Moderately susceptible to erosion	051 h	Natural/Artificial Re-vegetation	0.897	0.477	0.447	1	Stable
387	4	37.0	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.617	0.328	0.307	1	Stable
212	3	33.0	Moderately susceptible to erosion	P11	Bad land management	0.540	0.287	0.269	2	Unstable
225	4	36.3	Highly susceptible to erosion	011 h	Unmanaged. areas with forest potential	0.133	0.071	0.066	1	Stable
340	3	33.0	Moderately susceptible to erosion	031	Managed areas with forest use	1.025	0.545	0.510	1	Stable
283	4	39.0	Highly susceptible to erosion	021 th	Unmanaged areas with agriculture potential	1.955	1.040	0.974	1	Stable
284	4	39.0	Highly susceptible to erosion	012 th	Unmanaged. areas with forest potential	1.197	0.637	0.596	2	Stable
342	3	33.0	Moderately susceptible to erosion	061 t	Physical Infrastructure	1.321	0.703	0.658	1	Stable
287	4	36.3	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.295	0.157	0.147	1	Stable
289	4	39.0	Highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.206	0.110	0.103	1	Stable
290	4	39.0	Highly susceptible to erosion	P12	Bad land management	0.216	0.115	0.108	2	Unstable
339	5	42.0	Very highly susceptible to erosion	P11	Bad land management	1.276	0.679	0.635	2	Unstable
288	2	23.0	Slightly susceptible to erosion	031 t	Managed areas with forest use	0.215	0.114	0.107	1	Stable
218	5	42.0	Very highly susceptible to erosion	041 t	Managed areas with agriculture use	0.419	0.223	0.209	1	Stable
215	3	28.0	Moderately susceptible to erosion	031 v	Managed areas with forest use	0.193	0.103	0.096	1	Stable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
320	4	37.0	Highly susceptible to erosion	042 h	Managed areas with agriculture use	0.411	0.219	0.205	2	Stable
336	3	33.0	Moderately susceptible to erosion	P22	Bad land management	1.252	0.666	0.624	3	Unstable
217	5	42.0	Very highly susceptible to erosion	L22	Sheet erosion	0.478	0.254	0.238	3	Unstable
286	3	28.0	Moderately susceptible to erosion	031 t	Managed areas with forest use	0.291	0.155	0.145	1	Stable
310	5	42.0	Very highly susceptible to erosion	P22	Bad land management	0.614	0.327	0.306	3	Unstable
317	3	34.5	Moderately susceptible to erosion	L22	Sheet erosion	1.445	0.769	0.720	3	Unstable
338	5	42.0	Very highly susceptible to erosion	011 th	Unmanaged. areas with forest potential	0.616	0.328	0.307	1	Stable
285	3	28.0	Moderately susceptible to erosion	031 t	Managed areas with forest use	0.451	0.240	0.225	1	Stable
319	4	38.3	Highly susceptible to erosion	041 h	Managed areas with agriculture use	0.890	0.473	0.443	1	Stable
311	3	30.9	Moderately susceptible to erosion	011 th	Unmanaged. areas with forest potential	1.387	0.738	0.691	1	Stable
313	3	26.7	Moderately susceptible to erosion	012 th	Unmanaged. areas with forest potential	0.969	0.515	0.483	2	Stable
335	5	42.0	Very highly susceptible to erosion	021 th	Unmanaged areas with agriculture potential	3.670	1.952	1.828	1	Stable
337	3	33.0	Moderately susceptible to erosion	L22	Sheet erosion	0.560	0.298	0.279	3	Unstable
314	3	26.7	Moderately susceptible to erosion	L22	Sheet erosion	1.043	0.555	0.519	3	Unstable
312	5	42.0	Very highly susceptible to erosion	011th	Unmanaged. areas with forest potential	0.526	0.280	0.262	1	Stable
318	2	25.0	Slightly susceptible to erosion i	021 th	Unmanaged areas with agriculture potential	0.347	0.185	0.173	1	Stable
315	3	28.0	Moderately susceptible to erosion	031 th	Managed areas with forest use	0.528	0.281	0.263	1	Stable
334	3	29.0	Moderately susceptible to erosion	021 t	Unmanaged areas with agriculture potential	0.703	0.374	0.350	1	Stable
322	4	38.3	Highly susceptible to erosion	P21	Bad land management	2.473	1.315	1.232	2	Unstable

Releve	Risk Class	Risk Rating	Predictive Erosion Type	Descriptive Code	Descriptive Erosion Type	Area (Km^2)	Area (%800m)	Area (%total)	Priority	Description
316	3	34.8	Moderately susceptible to erosion	P22	Bad land management	1.479	0.787	0.737	3	Unstable
332	4	35.0	Highly susceptible to erosion	P21	Bad land management	1.258	0.669	0.627	2	Unstable
333	3	29.0	Moderately susceptible to erosion	041 t	Managed areas with agriculture use	1.224	0.651	0.610	1	Stable
323	1	19.2	Not or insignificantly susceptible	031 h	Managed areas with forest use	0.155	0.082	0.077	1	Stable
326	4	38.3	Highly susceptible to erosion	L22	Sheet erosion	0.357	0.190	0.178	3	Unstable
327	3	29.0	Moderately susceptible to erosion	032 th	Managed areas with forest use	0.130	0.069	0.065	2	Stable
325	2	24.0	Slightly susceptible to erosion	041 g	Managed areas with agriculture use	0.204	0.109	0.102	1	Stable
330	3	29.0	Moderately susceptible to erosion	P22	Bad land management	0.732	0.389	0.365	3	Unstable
324	3	34.8	Moderately susceptible to erosion	031 h	Managed areas with forest use	0.283	0.151	0.141	1	Stable
328	3	29.0	Moderately susceptible to erosion	022 t	Unmanaged areas with agriculture potential	0.191	0.102	0.095	2	Stable
331	3	34.5	Moderately susceptible to erosion	042 h	Managed areas with agriculture use	0.111	0.059	0.055	2	Stable
329	3	34.5	Moderately susceptible to erosion	021 t	Unmanaged areas with agriculture potential	0.306	0.163	0.152	1	Stable
			Total			**187.088**	**99.519**	**93.180**		

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