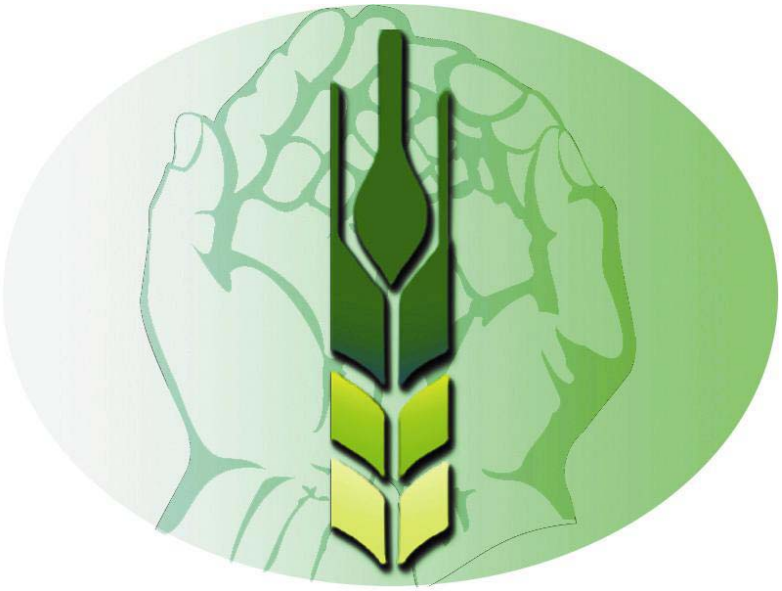
CONSERVATION AND SUSTAINABLE USE OF DRYLAND AGROBIODIVERSITY

Jordan/Lebanon/Syria/Palestinian Authority



Report

AGROECOLOGICAL CHARACTERIZATION OF THE AGRO-BIODIVERSITY SITES IN SYRIA

Project "Regional Conservation
and Sustainable Use of
Dryland Agro-biodiversity of the Near East"

AGROECOLOGICAL CHARACTERIZATION OF THE AGRO-BIODIVERSITY SITES IN SYRIA

Wild pear tree (Pyrus syriaca) on a basaltic rock outcrop, high plateau at 1500 m , Mushannaf, Sweida study area

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ABSTRACT

In view of their value as biodiversity sanctuaries in Syria, Hafe and Sweida were selected as target areas for the UNDP/GEF Agro-Biodiversity Project. To understand the biophysical environment within these target areas a comprehensive inventory was undertaken of the land resources, including climate, landscapes, soils and land use. This report summarizes the results of this inventory.

ASTER satellite imagery was the basis for developing a digital elevation model (DEM). From the DEM elevation and slopes were extracted, which allowed the definition of landforms and terrain characteristics.

Representative soil profiles were dug at the monitoring sites and in some other areas of interest, and their morphological, physical and chemical characteristics were determined. The information of the soil profiles was combined with already existing local soil map information to create new soil maps at approximate scales of 1:65.000 for Hafe and 1:175.000 for Sweida. To predict where similar terrain and soil conditions occur as in the monitoring sites, a similarity map was prepared for both target areas.

A general analysis of the land cover/land use was conducted through supervised classification of Landsat images using the CORINE II classification. A more detailed study, based on Landsat imagery in combination with intensive fieldwork, was undertaken to prepare a land cover/land use map using the CORINE Level 3 classification. The CORINE III land cover map is linked with a spatial database that contains information on land cover/use, the occurrence of small landscape elements and a biodiversity rating which depends on the quantity and the kind of natural vegetation present.

Although the Hafe study area is much smaller, its ecological diversity is larger than in the Sweida area. This is attributed to a stronger climatic gradient and the high ruggedness of the terrain, with steep gorge-like valleys.

With the exception of the temperature regime, which, at a regional scale, is fairly similar, the two areas have very contrasting moisture regimes, terrain and soil characteristics, as well as land cover patterns. The kinds of human influence are also different, with terracing the main land-shaping factor in the Hafe area, and de-stoning the main land intervention in the Sweida area.

Both study areas still contain 30-40% of the land with a very high biodiversity rating and conservation value. The challenges to their biodiversity are, however, different. The de-stoning operations in the Sweida area continue to transform natural rangelands into agricultural lands on a substantial scale and, at first glance, this appears a major trend that needs careful regulation in order to safeguard the few remaining biodiversity havens.

In the Hafe area the comparison of satellite images between 1990 and 1999 does not show much deforestation, if any. With the exception of isolated quarry operations, no major changes in land use/land cover patterns could be detected, which in one way is positive and in another way misleading. Within the agricultural areas much land has converted from field crops to fruit tree crops, but this cannot be assessed from the Landsat except through a detailed (and expensive) study. Probably the main but stealthy threat in the Hafe area is the extension of sub-urbanization and natural growth of village as a result of high population growth in the coastal plains. This natural growth is likely to entail the fragmentation of the remaining natural habitats through new road and housing construction. Zoning regulations are vital to prevent this encroachment into the remaining habitats.

1. INTRODUCTION

1.1. Background

The West Asia region is considered one of the major centers of plant diversity and endemism in the world. It encompasses an area of mega-diversity for major food crops and pastures species and contains wild relatives including those of wheat, barley, lentils and many fruit trees. The diversity of many of these species and their wild relatives is seriously decreasing due to rapid degradation of their natural habitats, intensification and expansion of cultivation and overgrazing and replacement of local varieties by imported ones.

Aware of the importance of the agro-biodiversity for present and future generations, the Global Environmental Facility (GEF), managed by UNDP, has funded a regional project aiming at the promotion of in-situ and on-farm conservation and sustainable use of the landraces and wild relatives of cereals, food and feed legumes, Allium and fruit trees species originating from Jordan, Lebanon, the Palestinian Authority and Syria. The activities are mostly concentrated in project sites that cover the diversity of ecosystems and predominant farming systems, ranging from highly degraded rangelands to intensive farming. In each country the project is executed by an organization representing a national agricultural research system. In Syria the General Commission for Scientific Agricultural Research (GCSAR) implements the project.

As part of its activities aimed towards the strengthening of the scientific basis for in-situ conservation of agro-biodiversity in Syria, the GCSAR has requested ICARDA to undertake a land resources inventory study of the designated agro-biodiversity conservation areas in Hafe and Sweida.

This report provides an overview of the land resources and land use for both study areas. By bringing together information sources from both areas and processing them with GIS technology, this report aims to promote the process of data integration and the use of GIS applications for the Syrian Component of the GEF Agro-Biodiversity Project. In addition, by explaining the environmental diversity in the selected study areas, it hopes to link up with the other national components and make a regional comparison possible. As such it will be of value for future biodiversity management, habitat conservation, land use planning and public awareness at national and regional level.

1.2. Deliverables

The aim of the project was to create a land resource information system at the level of the target areas. The spatial data created for both areas include a digital elevation model (at 30-m resolution for Hafe, at 1000 m resolution for Sweida), a slope map, a terrain map, a soil map, a land cover map at Corine Level 2, a land cover/use map at Corine Level 3, a biodiversity rating map, a similarity map for terrain and soil characteristics, the human intervention spots for the period 1990-1999, and a layer with the location of the monitoring sites and the location of the soil profiles. Both the soil map and the land cover Level 3 map were linked with a spatial database that contains more extended information on soil and land cover/use.
Also included are climatic maps of the study areas and surroundings and climate diagrams for representative locations.

2. OVERVIEW

2.1. Location of the study areas

The Hafe study area covers about 73 km² on the western slopes of the coastal mountains in Northwest Syria. In the target area six monitoring areas, Wadi Kars, Rabya, Bereen, Zankoufeh, Tishreen and Sharifa, were selected to carry out more detailed collection of wild relatives of the target species (wheat, barley, lentil, vetch, medics, clover, and fruit trees such as wild olive, almond, fig, pear, apricot, peach, pistachio etc.) , as well as detailed botanical and resource surveys, and research on land use dynamics and socio-economic aspects.

The Sweida study area is located in the south of Syria, on the slopes of the Jebel El Arab, close to the Jordan frontier. With an area of about 768 km² it is much larger than the Hafe study area. The monitoring areas selected in the target area are Selim, Sayegh, Huyur el Loz, Rashida, Mushannaf, Sahwet Khudur and Sahwet Balata.

2.2. General approach used for the study

The study started on 1 September 2002 and was completed six months later. Fieldwork was necessary to gather information on land cover/use CORINE III level as well as to create a regional soil map. The Laboratory of Soil and Plant Analysis at ICARDA undertook chemical soil analysis. The GIS software used during the project was IDRISI 32 for Windows and ArcView 3.2.

The first step in the land resource assessment was the acquisition and preparation of the digital database. Existing 1:50,000 topographical maps and soil maps were scanned and georeferenced in order to serve as primary terrain and soil data layers in the GIS. ASTER-DEM images (resolution 30 m) were acquired for Hafe. An ASTER-derived DEM could not be obtained for the Sweida area from the NASA. Landsat and ASTER images were acquired and preprocessed to create land cover maps for the areas.

For the characterization of the land resources, field surveys were carried out. Transects were used for soil auger and profile observations and sampling for analysis in the Soil and Water Laboratory at ICARDA. Physical and chemical characteristics, such as texture, organic carbon, pH, EC, CaCO3 content etc., were determined.

During the fieldwork ground truth information on soils characteristics, land cover, land use and degradation processes was collected. Internationally accepted methods for environmental data classification (CORINE for land cover mapping and the FAO soil classification system for soil mapping) were used to ensure compatibility with other data sets in the other country projects.

3. GEOLOGY

The Hafe study area has two major geological formations, with a clear boundary dividing the study area in two parts. In the eastern part occur the oldest deposits: the Cenomanian and Turonian limestones formed in the Cretaceous period. In the western part more recent marine marls were deposited during the Pliocene period. The fault line that separates both geological deposits passes through the Zankufe monitoring site. Some parts in the south of the study area also contain marl deposits, which, however, date from the Cretaceous period and are therefore older than the Pliocene marls in the western part of the study area.

The geology of the area around Hafe is shown in Figure 7[1].

The Sweida study area was exposed to a lot of volcanic activity in the Neogene period. The area is located on a huge basaltic mountain plateau (Jebel El Arab) and its western hill slopes, and is characterized by the occurrence of stony basaltic flows and volcanic cones, which are composed of volcanic tuff. This volcanic past had a major impact on the soil formation in the region.
The geology of the area around Sweida is shown in Figure 8[2].
Information on the geology of both study area can be found in the database that is connected to the soil maps (Tables 4 and 6).

4. TERRAIN

4.1. Methodology

DEM information for the Hafe area was obtained through ASTER satellite imagery, processed by NASA. However, for the Sweida area no ASTER-derived DEM could be obtained and the less detailed information from the digital DEM of the world (GTOPO30) had to be used to delimit terrain characteristics. The spatial resolution for the Aster DEM is 30 m, whereas for the GTOPO30 global DEM the resolution is 1000 m. Before any calculation was done to retrieve topographic information, a georeferencing process was done. From the DEMs the slope was calculated to create for both areas a slope map.

For Hafe the DEM's resolution was adequate to calculate the actual slope in degrees. For Sweida, using the Range filter script in ArcView, the 'relative elevation difference' was used rather than a real degree slope, which is meaningless at a 1-km resolution, to obtain a reasonable approximation of the dissection of the terrain. Both parameters altitude and slope were classified, and combined into a terrain map. 15 types of terrain were defined for the Hafe study area, whereas for the Sweida area 8 types of terrain were defined. All the GIS operations necessary for the terrain characterization were done with the software IDRISI 32 for Windows (Eastman, 2001).

4.2. Results

4.2.1. Digital Elevation Model, slope and terrain map for study area Hafe

Altitude
From about 150 m in the west the altitude increases to a maximum altitude of about 1000 m in the east. The study area can be divided into three distinct altitude classes (see Hafe Map 2). The first altitude class ranges from 0 to 300 m and contains mainly the hilly area of marl deposits around the town Hafe. The second altitude class ranges from 300 to 600 m and includes mainly the lower western part of the limestone area, as well as the valley floors of the bigger wadi structures (Wadi Kars and Wadi Kasis). The highest altitude class ranges from 600 to 1000 m and contains the eastern part of the limestone area as well as the area with the marl deposits of the Cretaceous period in the south.

[1] Adapted from Technoexport, 1967.
[2] Adapted from Technoexport, 1967.

Slopes
Five slope classes were differentiated from the DEM: 0-10; 10-18; 18-30; 30-45; > 45 degrees (see Hafe Map 3). The steepest slopes (18-45 degrees) occur along the two main wadi structures, Wadi Kars and Wadi Kasis. In these wadis some small areas have slopes of more than 45 degrees and have a canyon appearance. The western marl area around Hafe has slopes in the range 0-18 degrees. This is also the case for the limestone plateaus between the wadis.

Terrain
The terrain map of Hafe (see Hafe Map 4) combines the three altitude classes with the five slope classes and subdivides the study area into a limited number of homogeneous terrain units with similar elevation and level of dissection. The map shows a terrain that is smoothly increasing in altitude from the west to the east, cut through by two deep transversal wadi structures.

4.2.2. Digital Elevation Model, slope and terrain map for study area Sweida

Altitude
The altitude varies between 600m and 1900m (see Sweida Map 2). The Sweida study area can be divided into four distinct altitude classes. The first altitude class ranges from 600 to 1000 m and is situated west of the city Sweida. The second class ranges from 1000 to 1400 m and includes mainly the western hill slope of the basaltic mountain Jebel Arab (local name Jebel Druz). The third altitude class is defined between 1400 and 1600 m and contains the highest parts of the western and eastern hill slopes of the Jebel Arab as well as the higher plateau located in the east of the study area. The fourth class varies between 1600 and 2000 m and contains the highest part of the mountain Jebel Arab, this area is located in the center of the study area.

Slopes
The slope map contains only two slope classes (see Sweida Map 3). The first class is the flat to low hill slope class, which includes the western part of the study area close to the city Sweida, the eastern high plateau where the monitoring sites Rashida and Mushannaf are situated and the flat area in the north where the monitoring site Sahwet Khudur is situated. Those flat areas are, if they are not too stony, characterized by their intensive agriculture use. The second class defines the steep hilly regions, which are located at the western and eastern hill slopes, as well as the highest part of the Jebel Arab. It's the slope class, which is most abundant in the Sweida study area.

Terrain
Because the resolution of the DEM of Sweida is too coarse (1 kilometer pixel size) to detect topographical variations at meso-scale, the volcanic cones, which are such an obvious feature of the landscape, could not be displayed on the terrain map.
The terrain map of Sweida combines the four altitude classes with the two slope classes (see Sweida Map 4). The terrain map shows a low flat area in the west and a higher plateau in the eastern part of the study area, whereas the steepest parts are located in the central part of the study area. Especially the western slopes of the Jebel Arab have a long continuous sloping structure and are covering a big part of the study area. It is also in this sloping area that the monitoring sites Selim, Sahwet Balata, Huyur el Loz and Sayegh are located.

5. SOILS

5.1. Methodology

For both study areas representative soil profiles were dug, described, sampled and analyzed at the monitoring sites and in some other areas of interest. For the Hafe study area 9 soil profiles were described, for Sweida ten. The full soil profile description was done according to the FAO Guidelines for soil profile description (FAO, 1990). Soil samples from these profiles were analyzed for the principal characteristics (texture, pH, CaCO3, organic carbon). The classification was done according to the FAO revised [redacted] classification system (FAO, 1988).

The site-specific information from the soil profiles, together with already existing local soil maps made it possible to create new soil maps for both study areas, at scale 1:65.0000 for Hafe and scale 1:175.000 for Sweida. The reason to use two different scales was because the study areas are quite different in size, with the Sweida about 10 times larger than the Hafe study area.

The soil maps are actually represented as maps of *soil associations*. Soil association maps show *patterns* of soil occurrence, instead of the location of individual soils. Individual soils could not be located due to to the scale of the study and the short duration of the project. Soil associations are characterized by the recurrence of a limited number of specific soil types within particular land systems, but in different proportions. A land system is defined by a homogenous landscape with the same geological background, similar topographic characteristics and a specific soil association. The land system units were delineated by combining field observations, local soil maps and satellite image interpretations.

Each soil map is linked to a spatial soil database (see Annex 1). From these soil databases users can derive information of the soil characteristics for the different land systems. The reference on the maps to the soil database is by means of a number, which represents the first column (the polygon ID) in each soil database.

5.2.Results of the soil survey

5.2.1. Study area Hafe

The geological parent material has strongly influenced the soil formation. Two main types of soil can be distinguished in the Hafe study area, one formed on the Pliocene marl deposits (in the west) and the other formed on the limestone (in the east).

The soils formed on the marl deposits are light colored, have a clay loam texture and little soil formation has taken place. They are also characterized by huge amounts of $CaCO_3$ (>45 %) content all over the profile. The soils in the monitoring sites Sjarifa (Hsoil3), Rabya (Hsoil6) and part of the Zankoefeh (Hsoil5) site are all formed on these marl deposits. The soils could be classified as Haplic Calsisols (Hsoil3) or Calcaric Cambisols (Hsoil5 and Hsoil6).

For the soils formed on the limestone deposits of the Cretaceous period, three types of soils can be differentiated. The first soil type occurs on the plateaus between the wadis (mainly between the Wadi Kars and northern lying Wadi Kasis). The second soil type occurs on the steep slopes of the wadis and the third soil type occurs at the bottom of the wadis.

The first soil type consists of deep, dark brown to red colored soils, characterized by some degree of alteration, with signs of clay transport in the profile, low $CaCO_3$ content in the upper part of the profile and a dark brown to red color. Typical soil profiles with these characteristics are Hsoil1 (Haplic Luvisol), located on the flat upper plateau of the Wadi Kars valley, and the profile Hsoil7 (Haplic Luvisol), located in the Bereen monitoring site.

The second soil type, located on the hill slopes of the wadis, is characterized by high stoniness, shallow depth and little soil formation. The soil profiles located at the Wadi Kars hill slope, Hsoil2 (Calcaric Regosol) and Hsoil10 (Eutric Leptosol), are typical examples of these wadi hillslopes.

The third soil type, located at the bottom of the wadis, is subjected to flooding conditions in the wintertime. They can be very different in morphology, depending on the local sedimentation pattern, but are in general dark colored and have little soil formation. Hsoil8 (Calcaric Fluvisol), taken at the Wadi Kars monitoring site, is a representative soil profile for the valley floor of the Wadis.

The soil map (Hafe Map 5) shows a more uniform region in the west, with only one land form unit, corresponding with Landform Unit 1 (Hafe Map 4). For the limestone district in the eastern part of the study area, one can clearly relate the landforms to specific soil patterns. The wadi valley floor, corresponding with Landform Unit 4 (Hafe Map 4), is characterized by Calcaric Fluvisols. The Leptosols and Calcaric Regosols occur on the steep hillslopes of the wadis, corresponding with Landform Unit 3, and the Haplic Luvisols are located at the plateaus between the Wadis, corresponding with Landform Unit 2. Information on human intervention by the use of terraces is marked upon the soil map by horizontal stripes. One can see that especially in the marl area, a lot of human intervention has occurred in the past by the construction of terraces.

From the soil database that is linked to the soil map (Annex 1, Tables 4-7), one can derive information of the soil characteristics for the different Landform Units.

The soils formed on marl (landform 1) have limitations for agricultural use by their structure (weak), organic matter (less than < 3%), huge amounts of $CaCO_3$ (> 40 %), and by their sensitivity towards erosion (10-25 % of the area is affected). On the other hand, the stoniness conditions and depth of these soils are good. The Luvisols, which are formed on the limestone plateaus (= landform 2[3]), are the best soils for agricultural purposes. Their texture, organic material content, $CaCO_3$ content and structure are excellent, but stoniness (15-40 %) and depth (50-100 cm) are limiting factors. The soils formed on the wadi hillslope (landform 3) and the flat to sloping stony landform 6, both situated in the limestone area, have very severe limitations for agricultural use by their stoniness and shallowness.

5.2.2. Study area Sweida

The Sweida study area is formed by past volcanic activity. The area lies actually on a huge basaltic shield volcano, complete with stony basalt flows and volcanic cones formed on volcanic tuff. This volcanic past had also its influence on the soil formation.

Most of the monitoring sites, like Selim (Ssoil2), Mushannaf (Ssoil10), Sayegh (Ssoil4) and Sahwet Balata (Ssoil 11) are located on the slowly inclining hill slopes of the basaltic plateau and are characterized by high stoniness (between 30 and 70 % of basaltic stones), shallow soils and limited soil formation. These soil profiles were mainly classified as Chromic Cambisols (Ssoil2), Eutric Cambisols (Ssoil4), Eutric Regosols and Eutric Leptosols (Ssoil10 and Ssoil11).

The monitoring sites Rashida (Ssoil3) and Mushannaf herbaceous are located on flatter areas (e.g. the upper plateau at elevation 1500 meter) and are also very stony. However, they also show clear vertic properties, like the occurrence of cracks, slickensides, and wedge-shaped structural aggregates. Therefore they could be classified as Eutric Vertisols. The monitoring site Sahwet Khudur (altitude 1400 m) has a similar flat topography, but is located on a basaltic stone flow and is for this reason more stony than the

[3] See Annex 1, Tables 4-5

upper plateau. The soils are showing some but not all of the vertic properties and could be classified as Vertic Cambisols.

The soils that are formed on the volcanic tuff cones, which are scattered throughout the study area, are yellowish red colored, have a clay loam texture and show weak structure. In view of their very limited soil development they were classified as Eutric Regosols.

An area where no monitoring sites are located but which covers also a huge part of the study area is the area situated at the lower slope west and south of the town Sweida. The soils formed in this area are heavily textured soils with vertic properties (cracks, slickensides, wedge-shaped-aggregates) and were classified as Eutric Vertisols. They differ from the Vertisols in the upper plateau only by containing more $CaCO_3$, having even sometimes a calcareous horizon (Bk), and being less stony.

The soil map shows us the different types of landform with their soil associations for the study area. The Vertisols of the higher plateau (=landform 2), together with the Vertisols located at the lowest part of the western hill slope (=landform 7) and the Eutric Cambisols at the transversal east-west valleys (= landform 8) are the best suited soils for agricultural purposes. They are deep (> 100 cm) and have a good texture and structure. Their only limitation factor is the organic matter content, which in the case of the Vertisols is less then 1 %. The soils types associated with the other Landform Units are more limiting for agricultural activities because of their stoniness and their shallowness.

The soil database (Annex 1, Tables 6-7) summarizes the information on the soil composition and characteristics for the different Landform Units.

6. CLIMATE

6.1.Methodology

In this report the climatic conditions at both sites are assessed through climate diagrams and climatic maps.

The climate diagrams summarize precipitation, temperature, growing period and waterbalance conditions at a location representative for each study area. The representative location for the Hafe area is Bereen herbaceous, and for Sweida area it is Sweida itself. Climatic data for Sweida were obtained from the FAOCLIM2 database (FAO, 2001). For Bereen the climatic data were extracted from the climate surfaces for Syria (De Pauw et al., 2001) using the Point-Profiler extension of ArcView (Ibiyemi, 2002), and imported into the CLIMCHART software (De Pauw and Pertziger, 2001) for generation of climate diagrams.

The climatic maps were created through ‘topography-guided’ spatial interpolation (Hutchinson, 1995), using the GTOPO30 global digital elevation model (Gesch and Larson, 1996) extracted for Syria, in combination with a database of point climatic data, extracted from FAOCLIM2, through the software ANUSPLIN 4.1 (Hutchinson, 2000). The Map of Agroclimatic Zones is created by combination of individual layers for annual precipitation, potential evapotranspiration, maximum and minimum temperature according to the UNESCO classification system (UNESCO, 1979).

6.2.Results

6.2.1. Study area Hafe

The climatic data for Sjarifa and Bereen are summarized in Annex 3, Tables 10-12). Since the two stations represent the range of climatic conditions in the study area, other sites have conditions that are intermediate.

The climate according to the Köppen classification system (Köppen and Geiger, 1928) is a 'warm temperate rainy climate with summer drought and hot summers'. Essentially there is not much difference in climatic conditions between the two sites, although they have an elevation difference of about 500 m. Both sites have among the highest precipitation levels in Syria. Bereen, being closer to the Slenfeh escarpment, traps more precipitation from the West and receives per year about 300 mm more than Sjarifa. Sjarifa, on the other hand, is somewhat warmer, as evidenced by about 7% more heat units[4] than in Bereen.

The climate diagram for Bereen (Annex 3, Figure 1) shows the distribution of precipitation and temperature across the year. Unusual is the maritime influence from late summer to autumn, leading to raised minimum temperatures, whereas in winter and spring the continental influence is stronger, as evidenced by a higher range between the maximum and minimum temperatures.

The length-of-growing-period (LGP) diagram (Annex 3, Figure 2) shows a long growing season between mid-September and mid-June, during which moisture and temperature conditions can be considered non-limiting for vegetative growth.

The waterbalance diagram (Annex 3, Figure 3) confirms the favourable hydrological conditions and high runoff potential in the area, with a surplus[5] between December and April.

The regional context of climatic conditions in the study area is shown through the maps of Agroclimatic Zones (Annex 4, Figure 7), annual precipitation (Annex 4, Figure 12), mean temperature of the coldest (Annex 4, Figure 14) and of the warmest month (Annex 4, Figure 16). The Agroclimatic Zones Map shows that the study area, notwithstanding its small size, contains three agroclimatic zones:

SH-C-W: sub-humid, cool winter, warm summer
H-C-W: humid, cool winter, warm summer
PH-C-W: per-humid, cool winter, warm summer

These divisions are, as pointed out earlier, related to the strong precipitation gradient in the area.

6.2.2. Study area Sweida

The climatic data for Sweida are summarized in Annex 3, Table 12.

The climate according to the Köppen classification system (Köppen and Geiger, 1928) is, as in Sjarifa and Bereen, a 'warm temperate rainy climate with summer drought and hot summers'. Nevertheless, although the temperature regime is comparable to the Hafe study area, the climate data and diagram for Sweida (Annex 3, Figure 4) shows a much lower precipitation in Sweida. This demonstrates the limited value of interpreting a climate classification designed for global applications. The map of Agroclimatic Zones (Annex 4, Figure 10) shows that the study area contains the following agroclimatic zones:

A-C-W: arid, cool winter, warm summer
SA-C-W: semi-arid, cool winter, warm summer

These climatic divisions capture better the different moisture regimes, especially in comparison to the Hafe study area, than the Köppen classification. The map of annual precipitation (Annex 4, Figure 13) confirms the much drier conditions in the Sweida study area.

[4] Heat units are accumulated temperatures above 0°C per month and per year and are expressed in degree°C.days

[5] 'Surplus' is herewith defined as the amount of water that can not be stored in the soil after making allowance for potential evapotranspiration and is therefore lost through deep percolation or surface runoff.

The length-of-growing-period (LGP) diagram (Annex 3, Figure 15) shows a much shorter growing season, essentially between mid-November and end-April. The fact that in winter the mean temperature curve comes closer to the threshold of vegetative growth, indicates a weaker growth potential in winter.
The waterbalance diagram (Annex 3, Figure 17) confirms less favourable hydrological conditions and limited runoff potential in the area: there is virtually no surplus, and water deficits[6] appear at the beginning and end of the growing season.

7. LAND COVER/LAND USE

7.1.Methodology

7.1.1. General land cover analysis (CORINE II)

A general analysis of the land cover was conducted through a supervised classification on Landsat imagery[7], using the Corine Level 2 classification. Spectral information from different 'training sites' was used to define the land cover/use types. Six types of land cover/use could be separated statistically for the Hafe region, whereas in Sweida eight types of land cover/use could be distinguished.

Because the supervised classification method is an automatic classification process, which uses only ground truth information from the training sites, the CORINE II land cover map is less accurate than the CORINE III land cover map, which was carried out completely by fieldwork. Nevertheless because the CORINE II maps are processed for an area bigger than the study area boundaries, they could give us also an idea of the land cover/use in the area surrounding the Hafe and Sweida study areas and allow situating the study areas in a wider context. The software used for classification of the satellite images was IDRISI 32. The nomenclature and source of the CORINE land cover classification system is given in Appendix 5.

7.1.2. Detailed land cover analysis (CORINE III) and human intervention spots

The land cover/use CORINE III maps were created with the GIS ArcView software and are in vector format. Using this software any kind of query can be done to get information of the spatial land cover/use database.
The full database is to be found in Annex 6.

<u>Land cover/land use</u>
A more detailed survey, based on intensive fieldwork, was done to obtain a land cover/use map at CORINE III level for both study areas. The polygon map is linked with a spatial database, which contains for every mapping unit information on land cover/use (with a maximum combination of three kinds of land cover/use for every mapping unit), their coverage (in percent) , the occurrence of small landscape elements:

(h=hedges, t=terraces, w= wadi, tr= big trees, reclam= land reclamation)

and a biodiversity rating which depends on the amount and the kind of natural vegetation present.

[6] 'Deficit' is herewith defined as the amount of water needed to meet potential evapotranspiration after all available soil moisture has been used.
[7] Landsat image for Hafe dated 24/09/1999, image for Sweida dated 28/08/2000

Biodiversity rating

The biodiversity rating is a tool to evaluate the importance of biological diversity for the mapping units. The following scale was used (Table 1):

1= none, 2 = very low, 3 = low, 4 = medium, 5 = high, 6 = very high biological diversity.

Table 1: Relationship between Land cover/use types (CORINE Level 3) and biological ratings.

Land cover/use (CORINEIII)	**Identifier in spatial Land cover database**	**Biological rate (1 = low to 6 = very high)**
Continuous urban fabric	1	1
Discontinuous urban fabric	2	1
Industrial or commercial units	3	1
Road and rail networks and associated land	4	1
Airports	5	1
Mineral extraction site	6	1
Construction site	7	1
Green urban areas	8	2
Sport and leisure facilities	9	1
Non-irrigated arable land	10	1
Permanently irrigated land	11	1
Vineyards	12	1
Fruit trees and berry plantations	13	1
Olive groves	14	1
Pastures	15	1
Annual crops associated with permanent crops	16	2
Complex cultivation pattern	17	1
Land principally occupied by agriculture with significant areas of natural vegetation	18	4
Agro-forestry areas	19	4
Broad-leaved forest	20	6
Coniferous forest	21	4
Mixed forest	22	6
Natural grassland	23	6
Maquis (high shrub)	24	6
Garrigue (low shrub)	25	6
Transitional woodland scrub	26	5
Bare rock	27	2
Sparsely vegetated areas	28	2
Burnt areas	29	1
Inland marshes	30	6
Salt marshes	31	6
Salines	32	3
Water courses	33	1
Water bodies	34	1
Mixture fruit + vines in equal quantities	35	1
Mixture fruit + olive in equal quantities	36	1

Human intervention

For the human intervention maps (Hafe Map 10 and Sweida Map 10), Landsat images from 1990 were compared with the more recent Landsat images from 1999 (Hafe) and 2000 (Sweida) to detect changes. The changes were marked with spots. By using this method, only major changes in land cover or land use could be detected. To detect changes in cropping patterns at field scale, high-resolution satellite images like IKONOS and more detailed ground truth information from the 1990 images would be needed. However, such information does not exist.

7.2.Results

7.2.1. General land cover/use map (CORINE II), detailed land cover/use map (CORINE III), biodiversity rating map and human intervention spots for Hafe.

The CORINE II map (Hafe Map 7) shows that the Hafe study area has a near equal proportion of areas without vegetation, areas in agricultural use, and areas with natural high shrub/forested vegetation (each class in the range 4,000-6,000 hectares).The western part of the study area with its soils formed on marl has less natural vegetation left. Most of the fruit plantations occur in this region as well.

The more detailed CORINE III map (Hafe Map 8) shows the dominant types of land cover/use, which were observed by fieldwork. In total 16 classes of dominant land cover/use could be distinguished. It is to be noted that only the dominant land cover/use types can be shown on the map, because the number of possible combinations is very large.

The map shows that the only remnants of broad-leaved forest remain at the bottom of the bigger wadis , like Wadi Kars and Wadi Kasis. On the plateau between both wadis there still exist some small patches of degraded oak forest, which were classified as transitional woodland. Extensive areas of high shrub (maquis) vegetation still remain in the eastern limestone area, mainly located on the hillslopes of the wadis. Non-irrigated arable land can be found specifically on the plateaus between the wadis in the limestone area, whereas most of the fruit plantations and olive groves are located in the western marl area.

The Biodiversity Rating Map (Hafe Map 9) shows that still 40 % of the Hafe study area has a very high biological rating value, whereas 16 % has a low biodiversity rating (Table 1). The map shows clearly that the western marl area is less interesting in terms of biodiversity than the eastern limestone area, where vast areas of maquis shrub and forest still remains. Most of the marl area is already deforested and the terrain is used for agricultural purposes.

From the Map with Hot Spots of Human Intervention (Hafe Map 10), it appears that major changes in land cover occurred between 1990 and 1999. The deforestation rate is low, only a few small spots of deforestation could be detected, especially south of the Wadi Kars valley. The major threats to the natural habitat appear to be quarrying activities. The location of the new quarries is indicated on the map.

7.2.2. General land cover map (CORINE II), detailed land cover map (CORINE III), biodiversity rating map and human intervention spots for Sweida.

The CORINE II map (Sweida Map 7) shows that the central part of the Sweida study area is the greenest part, with vast areas of permanent crops (especially fruit trees and vines) and maquis shrub vegetation. Making allowance for the inherent lack of accuracy of supervised classification techniques, it is estimated that between 10,000 and 15,000 hectares of natural high shrub or maquis vegetation still remain. This is a lot more that the actually protected

area of forest and shrub vegetation, which is no more than 1,000 hectares[8]. It can therefore be concluded that efforts should be taken to protect better the last patches of natural forest and shrub vegetation in the Sweida study area.

The more detailed CORINE III map (Sweida Map 8) shows the dominant types of land cover/use, as observed by combining fieldwork and visual interpretation of Landsat imagery. In total 14 classes of dominant land cover/use could be distinguished. As in the case of Hafe, it is to be noted that these combinations summarize a very complex land cover/land use pattern. The map shows that particularly the central part of the study area, located on the western slope of the basaltic plateau, has a complex pattern of different types of land cover/use. The western and eastern edges of the study area, which are located on flat land with deep soils (Vertisols), are more homogeneous. The central part contains most of the areas fruit cultivation and vineyards as well as the last remnants of high shrub (maquis) vegetation. The more homogeneous western area and eastern higher plateau have non-irrigated arable land and natural grassland as principal land cover/use type. With the exception of the Vertisols west of Sweida, the study area is very stony. This is why even within areas with mainly maquis vegetation or natural grassland 10-20 % of rocks are registered (Table 2).

The Biodiversity Rating Map of Sweida (Sweida Map 9) indicates that 30 % of the study area has a very high biodiversity rating and is mainly covered by natural vegetation like high shrub (maquis) and natural grassland. Almost 30 % of the study area has the lowest biodiversity rating (Table 1). These areas are the vast areas of intensive agriculture and fruit plantations. The volcanic cones, which are scattered throughout the study area, are showing a lot of difference in biodiversity. From the 24 identified volcanic cones, 16 have a very high biodiversity rating and are mainly covered by natural grassland and some patches of maquis, whereas three volcanoes score high (=5) for biodiversity rating. Five volcanoes have a low (=3) biodiversity rating, mainly because they are almost completely occupied by fruit plantations and vineyards and little natural vegetation remains.

The map of Hot Spots of Human Intervention (Sweida Map 10) shows that the only area where deforestation could be detected occurs in the north of Sweida, along the road to the village Qanawat. Land reclamation, where stones were removed from natural grasslands for agricultural development could be detected at some places in the basaltic stone flows west of Al Kafr. However, it needs to be noted that de-stoning is an age-old operation, going back for generations, and has affected most of the agricultural areas. In this respect the information obtained from the comparison of two satellite images is by necessity limited given the short time frame.

[8] information kindly provided by the Ministry of Agriculture Office in Sweida

Table 2: Summary of terrain and soil information for the different monitoring sites

Monitoring site	**Land cover/use (CORINE III)**	**Biodiv. rating**	**Soil (FAO, 1990 classification)**	**Altitude class** (m)	**Slope class** (degrees)	**X-UTM**	**Y-UTM**
Hafe							
Bereen	fruit 80%, urban 20%	1	Haplic Luvisol	600-1000 m	0-10	239862	3943227
Bereen herbacious	grassland 70%, rock 20%, fruit 10%	6	Haplic Luvisol	600-1000 m	0-10	240461	3942799
Wadi Kars	forest 80%, high shrub 20%	6	Calcic Fluvisol (valley floor)	300-600 m	0-10	239928	3941417
Rabya	fruit+olive 80%, low shrub 20%	1, 3	Calcaric Cambisol	300-600 m	0-10	231664	3942698
Zankoufeh	fruit+olive 60%, high shrub 30%	3	Calcaric Cambisol	300-600 m	10-18	232067	3943226
Tishreen	fruit+olive 80%, low shrub 20%	3		0-300 m	0-10	229725	3941036
Sjarifa	fruit+olive 80%, low shrub 20%	3	Haplic Calcisol	0-300 m	0-10	231335	3947153
Sweida					(category)		
Sahwet Khudur	grassland 100%	6	Vertic Cambisol	1000-1400 m	flat-low hills	286473	3603969
Sahwet Balata	high shrub 70%, rock 20%, grassland 10%	6	Eutric Regosol	1000-1400 m	steep hills	276021	3614998
Rashida	grassland 60%, arable land 20%, rock 20%	6	Eutric Vertisol	1400-1600 m	flat-low hills	293479	3614917
Mushannaf herbacious	grassland 60%, arable land 20%, rock 20%	6	Eutric Vertisol	1400-1600 m	flat-low hills	293004	3621787
Mushannaf trees	grassland 60%, arable land 20%, rock 20%	6	Eutric Regosol & Eutric Leptosol	1400-1600 m	flat-low hills	291551	3623835
Mushannaf waterharvest.	grassland 60%, arable land 20%, rock 20%	6	Eutric Regosol & Eutric Leptosol	1400-1600 m	flat-low hills	290917	3623814
Huyur El Loz	fruit+vines 60%, high shrub 20%, rock 20%	3		1000-1400 m	steep hills	277480	3622551
Sayegh (Qanawat)	grassland 50%, fruit 40%, rock 10%	5	Eutric Cambisol	1000-1400 m	steep hills	280973	3624734
Selim	high shrub 70%, fruit 20%, grassland 10%	6	Chromic Cambisol	1000-1400 m	steep hills	275778	3627124

8. SIMILARITY ANALYSIS FOR EDAPHIC (TERRAIN +SOIL) CHARACTERISTICS OF THE MONITORING SITES.

8.1.Background and approach

At the monitoring sites of the Hafe and Sweida study areas the UNDP/GEF project staff carried out a detailed plant species inventory. Each monitoring site has its specific characteristics in relation to altitude, slope and soil type, and it can be safely assumed that these factors are to some extent related to the distribution of plant species in the area. By combining the information of the terrain and soil characteristics of the monitoring sites a first approximation can be obtained about the edaphic conditions the inventoried plants are growing in. A summary of terrain and soil information at the monitoring sites is given in Table 2.

Through GIS overlaying procedures (point in polygon operation) it is relatively simple to predict where in the study area similar edaphic conditions can be found like the ones in the monitoring sites. From this analysis it can be deducted which monitoring site is best representing the edaphic conditions of the study area, or, alternatively, which monitoring site habitat is very unique and has only a very low occurrence in the study area. The exercise could also be done outside the study area, for example for the whole of Syria, in which case also climate information needs to be incorporated.

8.2.Results

8.2.1. Study area Hafe

The Map of Similarity in Edaphic Conditions (Hafe Map 6) indicates that 33 % of the study area is very similar to the edaphic conditions of one of the monitoring sites, while 67 % has different edaphic characteristics. The monitoring site located at the valley floor of Wadi Kars has the lowest area with similar characteristics in the study area (only 41 hectares) whereas the monitoring sites Tishreen and Sjarifa, who were already classified in the same edaphic 'niche', are having 1,172 hectares of the study area with similar characteristics.

Looking at the two different geological regions in the Hafe study area, it appears that the monitoring sites Zankufe, Rabia, Sjarifa and Tisjreen are representing better the edaphic conditions of the marl area than the Wadi Kars and Bereen monitoring sites do for the limestone area. Most of the area in the marl region has similar edaphic characteristics as in one of the monitoring sites, whereas this is not the case for the limestone plateau. The characteristics of Bereen and Wadi Kars are not representing the variation of edaphic conditions that exists in that region.

It can therefore be concluded that the marl area is better monitored than the limestone area and that efforts should be made to improve the monitoring of the limestone area in the future, possibly by adding monitoring sites.

8.2.2. Study area Sweida

The Map of Similarity in Edaphic Conditions (Sweida Map 6) shows that the edaphic conditions at the Rashida and Mushannaf herbaceous monitoring sites are well present in the eastern part of the study area. Also the edaphic conditions of the western hillslope of the Jebel el Arab are well represented by those at the monitoring sites Selim, Sayegh, Huyur el loz and Sahwet Balata. The Sahwet Khudur and Mushannaf trees+waterharvesting monitoring sites, however, do not find many areas with similar conditions in the study area.

Especially the flat area in the western part of the study area and the central part, which contains the highest part of the Jebel Arab are not monitored well by any monitoring site. These areas have edaphic conditions that are not represented and therefore require additional monitoring sites.

9. COMPARISON BETWEEN HAFE AND SWEIDA

Table 3 summarizes the major similarities and differences between the two study areas. Although the Hafe study area is much smaller, its ecological diversity is larger than in the Sweida area. This is attributed to a stronger climatic gradient and the high ruggedness of the terrain, with steep gorge-like valleys.

With the exception of the temperature regime, which, at a regional scale, is fairly similar, the two areas have very contrasting moisture regimes, terrain and soil characteristics, as well as land cover patterns. The kinds of human influence are also different, with terracing the main land-shaping factor in the Hafe area, and de-stoning the main land intervention in the Sweida area.

Table 3: Comparison between Hafe and Sweida study area

Characteristics	Hafe	Sweida
Size study area	73 km^2	768 km^2
Parent material	Marl (west) & limestone (east)	Basalt rock
Altitude	200-1000 m	600-2000 m
Slope	mainly very steep slopes, very dissected by wadis	mainly steep slopes and plateaus
Zonal Soils	Luvisols	Vertisols
Climate	Per-humid to sub-humid, cool winter, warm summer	Semi-arid to arid, cool winter, warm summer
Land use and human interventions	small-scale plots, frequent use of terraces	large-scale plots, frequent stone removal
Land cover	mainly high shrub, olive and fruit orchards	natural grassland, arable land and fruit orchards
Biodiversity rating	40% of study area with very high rating	30% of study area with very high rating

10. CONCLUSIONS

Both study areas still contain 30-40% of the land with a very high biodiversity rating and conservation value. The challenges to their biodiversity are, however, different. The de-stoning operations in the Sweida area continue to transform natural rangelands into agricultural lands on a substantial scale and, at first glance, this appears a major trend that needs careful regulation in order to safeguard the few remaining biodiversity havens.

In the Hafe area the comparison of satellite images between 1990 and 1999 does not show much deforestation, if any. With the exception of isolated quarry operations, no major

changes in land use/land cover patterns could be detected, which in one way is positive and in another way misleading. Within the agricultural areas much land has converted from field crops to fruit tree crops, but this cannot be assessed from the Landsat except through a detailed (and expensive) study. Probably the main but stealthy threat in the Hafe area is the extension of sub-urbanization and natural growth of village as a result of high population growth in the coastal plains. This natural growth is likely to entail the fragmentation of the remaining natural habitats through new road and housing construction. Zoning regulations are vital to prevent this encroachment into the remaining habitats.

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ANNEX 1. SOIL DATABASE

HAFE

Table 4. Hafe Study Area. Composition of the soil associations

Polygon ID	Landform Class	Landform description	Geology	Soil unit 1	%	Soil unit 2	%
1	10	urban			0		0
2	12	mine			0		0
3	12	mine			0		0
4	11	water			0		0
5	2	plateau to sloping land	limestone cretaceous	rock + Leptosol	60	Haplic Luvisol	40
6	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
7	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
8	4	wadi valley floor	limestone cretaceous	calcar. Fluvisol	60	Calcaric Regosol	40
9	4	wadi valley floor	limestone cretaceous	calcar. Fluvisol	60	Calcaric Regosol	40
10	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
11	2	plateau to sloping land	limestone cretaceous	rock + Leptosol	60	Haplic Luvisol	40
12	4	wadi valley floor	limestone cretaceous	calcar. Fluvisol	60	Calcaric Regosol	40
13	6	plateau to sloping land	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
14	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
15	2	plateau to sloping land	limestone cretaceous	rock + Leptosol	60	Haplic Luvisol	40
16	6	plateau to sloping land	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
17	6	plateau to sloping land	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
18	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20
19	1	medium gradient hills	marl neogene	calcar. Cambisol	70	Haplic Calcisol	30
20	1	medium gradient hills	marl creataceous	calcar. Cambisol	70	Haplic Calcisol	30
21	3	steep hillslope of wadi valley	limestone cretaceous	rock + Leptosol	80	Calcaric Regosol	20

Table 5. Hafe study area: Soil properties

Poly-gon ID	Landform class	Soil depth	Organic matter	Structure	Stoniness	Soil color	CaCO3	Texture	Rill+Gully erosion	Reference profiles
1	10									
2	12									
3	12									
4	11									
5	2	50-100 cm	> 4 %	strong	15-40 %	dark brown	< 10 %	clay	none	Hsoil1, Hsoil7
6	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
7	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
8	4	50-100 cm	> 5 %	weak	40-60%	dark brown	40-50 %	clay	none	Hsoil8
9	4	50-100 cm	> 5 %	weak	40-60%	dark brown	40-50 %	clay	none	Hsoil8
10	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
11	2	50-100 cm	> 4 %	strong	15-40 %	dark brown	< 10 %	clay	none	Hsoil1, Hsoil7
12	4	50-100 cm	> 5 %	weak	40-60%	dark brown	40-50 %	clay	none	Hsoil8
13	6	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
14	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
15	2	50-100 cm	> 4 %	strong	15-40 %	dark brown	< 10 %	clay	none	Hsoil1, Hsoil7
16	6	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
17	6	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
18	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10
19	1	> 100 cm	< 3 %	weak	5-15 %	light gray	40-50 %	clay loam	10- 25 % area affected	Hsoil3, Hsoil5, Hsoil6
20	1	> 100 cm	< 3 %	weak	5-15 %	light gray	40-50 %	clay loam	10-25 % area affected	Hsoil3, Hsoil5, Hsoil6
21	3	< 50 cm	> 4 %	moderate	15-40 %	reddish brown	40-50 %	clay loam	none	Hsoil2, Hsoil10

SWEIDA

Table 6. Composition of the soil associations

Poly-gon ID	Landform class	Landform	Soil unit 1	%	Soil unit 2	%	Soil unit 3	%
1	9	urban		0		0		0
2	9	urban		0		0		0
3	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
4	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
5	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
6	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
7	9	urban		0		0		0
8	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
9	9	urban		0		0		0
10	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
11	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
12	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
13	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
14	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
15	9	urban		0		0		0
16	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
17	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
18	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
19	9	urban		0		0		0
20	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
21	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
22	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
23	9	urban		0		0		0
24	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
25	9	urban		0		0		0
26	9	urban		0		0		0
27	9	urban		0		0		0
28	9	urban		0		0		0
29	9	urban		0		0		0
30	9	urban		0		0		0
31	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
32	9	urban		0		0		0
33	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
34	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
35	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
36	9	urban		0		0		0
37	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
38	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
39	9	urban		0		0		0
40	9	urban		0		0		0
41	9	urban		0		0		0
42	1	volcanic tuff cone	Eutric Regosol	80	rock + Leptosol	20		0
43	2	high plateau	Eutric Vertisol	40	rock + Leptosol	60		0

44	5	stony plateau	Vertic Cambisol	30	rock + Leptosol	70		0
45	9	urban		0		0		0
46	6	stone flow	rock + Leptosol	90	Eutric+Vertic Cambisol	10		0
47	9	urban		0		0		0
48	6	stone flow	rock + Leptosol	90	Eutric+Vertic Cambisol	10		0
49	3	western hillslope + top	Eutric+Chromic Cambisol	40	Eutric Regosol	30	rock + Leptosol	30
50	7	flat lowest part western slope	Eutric Vertisol	90	rock + Leptosol	10		0
51	3	western hillslope + top	Eutric+Chromic Cambisol	40	Eutric Regosol	30	rock + Leptosol	30
52	4	eastern hillslope	Eutric Regosol	50	rock + Leptosol	40	Eutric Cambisol	10
53	6	stoneflow	rock + Leptosol	90	Eutric+Vertic Cambisol	10		0
54	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0
55	10	transversal east-west ridges	rock + Leptosol	80	Eutric Cambisol	20		0
56	10	transversal east-west ridges	Eutric Cambisol (valley)	80	Eutric Cambisol	20		0
57	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0
58	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0
59	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0
60	10	transversal east-west ridges	Eutric Cambisol (valley)	80	Eutric Cambisol	20		0
61	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0
62	10	transversal east-west ridges	Eutric Cambisol (valley)	80	Eutric Cambisol	20		0
63	8	transversal east-west valleys	Eutric Cambisol	80	rock + Leptosol	20		0

Table 7. Sweida Study Area. Soil properties

Poly-gon ID	Landform class	Depth	Organic matter (%)	Structure	Stoniness	Color	CaCO3	Texture	Rill + gully erosion	Reference soil profile
1										
2	9									
3	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
4	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
5	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
6	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
7	9									
8	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
9	9									
10	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
11	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
12	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
13	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
14	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
15	9									
16	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
17	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
18	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
19	9									
20	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
21	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
22	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
23	9									
24	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
25	9									
26	9									
27	9									

28	9									
29	9									
30	9									
31	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
32	9									
33	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
34	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
35	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
36	9									
37	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
38	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
39	9									
40	9									
41	9									
42	1	<50 cm	< 3 %	weak	15-40 %	yellowish red	< 10 %	clay loam	5-10 % affected area	ssoil5
43	2	> 100 cm	< 1 %	strong	60 %	dark brown	< 10 %	clay	none	ssoil3
44	5	< 50 cm	< 1 %	moderate	70 %	dark brown	< 10 %	clay	none	ssoil12
45	9									
46	6	< 50 cm	< 3 %	moderate	80 %	brown	< 10 %	clay	none	
47	9									
48	6	< 50 cm	< 3 %	moderate	80 %	brown	< 10 %	clay	none	
49	3	< 50 & > 100 cm	<3 %	moderate	15-70 %	dark red brown	< 10 %	clay	0-5 % affected area	ssoil1,ssoil2,ssoil11
50	7	>100 cm	< 1 %	strong	< 10 %	dark brown	10-20 %	clay	none	ssoil6
51	3	< 50 & > 100 cm	<3 %	moderate	15-70 %	dark(red) brown	< 10 %	clay	0-5 % affected area	ssoil1,ssoil2,ssoil11
52	4	<50 cm	< 3 %	moderate	15- 70 %	dark brown	< 10 %	clay	0-5 % affected area	ssoil10
53	6	< 50 cm	< 3 %	moderate	80 %	brown	< 10 %	clay	none	
54	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4
55	10	< 50 cm	< 3 %	moderate	40 %	v.darkgray brown	< 10 %	clay	5-10 % affected area	ssoil4(2)
56	10	< 50 cm	< 3 %	moderate	40 %	v.darkgray brown	< 10 %	clay	5-10 % affected area	ssoil4(2)
57	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4
58	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4

59	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4
60	10	< 50 cm	< 3 %	moderate	40 %	v.darkgray brown	< 10 %	clay	5-10 % affected area	ssoil4(2)
61	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4
62	10	< 50 cm	< 3 %	moderate	40 %	v.darkgray brown	< 10 %	clay	5-10 % affected area	ssoil4(2)
63	8	> 100 cm	< 3 %	strong	5 %	v.darkgray brown	< 10 %	clay	none	ssoil4

ANNEX 2. SOIL PROFILE DESCRIPTIONS AND ANALYTICAL DATA

1. SOIL DESCRIPTIONS SWEIDA

Ssoil1

Classification: Eutric Leptosol
Location: Xutm37: 273903 m Yutm37: 3624776 m
Altitude: 1076 m

Physiography: western slope of basaltic mountain range of Sweida
Topography: plains of moderate relief with wide drainage spacing (1500-3000 m) undulating (2-10 %).
Landscape profile: rectilinear slope form
Surface: common rock outcrops (5-15 %) at a distance of > 50 m; abundant coarse gravel to large boulders, no surface sealing, no surface cracks.
Erosion: none
Drainage: well drained
Moisture status: dry
Vegetation: natural grassland (degraded)
Parent material: basalt
Land use: some cereals and olive trees

Ah: 0-25 cm

Brown (10 YR 4/3) dry, and very dark grayish brown (10YR 3/2) moist, clay, 15-40 % weathered sub-rounded basalt fragments of 6-20 cm size, weak fine granular structure, consistency hard when dry, very friable when moist, sticky and slightly plastic when wet, many very fine pores, non-calcareous, no cutans, few fine roots, common biological activity, gradual wavy boundary.

R: > 25 cm

Ssoil2 (representative for monitoring site Selim)

Classification: Chromic Cambisol
Location: Xutm37: 275076 m Yutm37: 3624844
Altitude: 1179 m

Physiography: western slope of basaltic mountain range of Sweida.
Topography: plains of moderate relief with moderate drainage spacing (400-1500 m), moderately steep slope (10-18 %)
Landscape profile: rectilinear-concave slope form
Surface: common rock outcrops (5-15 %) at a distance of > 50 m; Many coarse gravel to large boulders, no surface sealing, no surface cracks.
Erosion: none
Drainage: well drained
Moisture status: dry
Vegetation: natural high scrub vegetation
Parent material: basalt
Land use: protected area

Ah: 0-20 cm

Dark reddish brown (2.5 YR 3/3) moist, clay, 35 % strongly weathered sub-rounded basalt fragments of 0.6- 6 cm size, moderate coarse crumby structure, consistence hard when dry, very friable when moist, very sticky and plastic when wet, many very fine pores, non-calcareous, no cutans, many roots, common biological activity, clear wavy boundary.

Bw: 20-45 cm

Dark reddish brown (2.5 YR 3/4) moist, clay, 45 % strongly weathered sub-rounded basalt fragments of 2- 20 cm size, moderate coarse granular structure, consistence hard when dry, very friable when moist, sticky and very plastic when wet, many very fine pores, non-calcareous, no cutans, very few fine roots, few biological activity, clear wavy boundary.

R: > 45 cm

Ssoil3 (monitoring site Rashida and representative for monitoring site Mushannaf herbaceous)

Classification: Eutric Vertisol
Location: Xutm37: 293753 m Yutm37: 3615117 m
Altitude: 1530 m

Physiography: top of basaltic high plateau
Topography: plains of low relief with very wide drainage spacing (> 3000 m) flat or almost flat (0- 2 %)
Landscape profile: flat rectilinear
Surface: no rock outcrops; **abundant (60 %) boulders to large boulders**, no surface sealing, **very wide, moderately wide spaced surface cracks**.
Erosion: none
Drainage: poorly drained in winter times, saturated up to 30 days/year
Moisture status: dry
Vegetation: natural grassland
Parent material: basalt
Land use: grassland
Remarks: reforestation project with pine

Ah: 0-40 cm

Dark brown (7.5 YR 3/3) dry, very dark brown (7.5 YR 2.5/3) moist, clay, <2 % weathered sub-rounded basalt fragments of 0.6- 2 cm size, strong coarse angular blocky structure (0-5 cm granular mulch), consistence extremely hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, non-calcareous, **many slickensides**, very few .5-2 mm roots, common biological activity, diffuse wavy boundary.

B1: 40-60 cm

Dark brown (7.5 YR 3/3) dry, clay, <2 % weathered sub-rounded basalt fragments of 0.6-2 cm size, **moderate coarse wedge-shaped aggregates**, consistence very hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, non-calcareous, **many slickensides,** very few fine roots, few biological activity, gradual wavy boundary.

B2: 60-80 cm

Dark brown (7.5 YR 3/3) dry, clay, <2 % weathered sub-rounded basalt fragments of 0.6-2 cm size**, moderate coarse wedge-shaped aggregates**, consistence very hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, non-calcareous, **many slickensides**, very few fine roots, few biological activity, **3 % lime concretions nodules**.

Ssoil4 (representative for valley soil of monitoring site Sayegh)

Classification: Eutric Cambisol
Location: Xutm37: 278161 m Yutm37: 3624791 m
Altitude: 1294 m

Physiography: valley floor from small wadi valley on the western hill slope of the basaltic mountain range of Sweida.
Topography: hills with drainage spacing close (100-400 m), valley bottom flat or almost flat (0-2 %), valley hill slopes (= ssoil 4 (2)) steep (18-30 %).
Landscape profile: rectilinear-concave
Surface: no rock outcrops; few (5 %) coarse gravel to stones, no surface sealing, no cracks.
Erosion: none
Drainage: well drained
Moisture status: dry
Vegetation: agriculture
Parent material: basalt
Land use: agriculture
Remarks: **presence of human artifacts like fragments of pottery**

Ap: 0-25 cm

Very dark grayish brown (10 YR 3/2) dry, clay, 5 % weathered sub-rounded basalt and pottery fragments of 2-6 cm size, strong medium sub-angular blocky structure, consistence very hard when dry, friable when moist, sticky and plastic when wet, many very fine pores, non-calcareous, many roots, common biological activity, gradual wavy boundary.

Bw: 25-45 cm

Very dark brown (10 YR 2/2) dry, clay, <2 % weathered sub-rounded basalt and pottery fragments of 0.6-6 cm size, **moderate medium to coarse prismatic structure**, consistence extremely hard when dry, friable when moist, very sticky and plastic when wet, many very fine pores, non-calcareous, few fine roots, few biological activity, gradual wavy boundary.

BC: 45-80 cm

Very dark brown (10 YR 2/2) dry, clay, <2 % weathered sub-rounded basalt and pottery fragments of 0.6-2 cm size, **no to weak structure**, consistence extremely hard when dry, friable when moist, very sticky and plastic when wet, many very fine pores, non-calcareous, very few fine roots, few biological activity.

Ssoil4 (2) (representative for valley hill slope of monitoring site Sayegh)

Classification: Eutric Cambisol
Location: Xutm37: 278161 m Yutm37: 3624791 m
Altitude: 1294 m

Physiography: southern slope of a wadi valley on the western hill slope of the basaltic mountain range of Sweida.
Topography: hills with drainage spacing close (100-400 m), valley bottom flat or almost flat (0-2 %), valley hill slopes (= ssoil 4 (2)) very steep (30-45 %).
Landscape profile: rectilinear-concave
Surface: no rock outcrops; many (40 %) coarse gravel to boulders, no surface sealing, no cracks.
Moisture status: dry
Vegetation: fruit trees on terraces
Parent material: basalt
Land use: agriculture

Ah: 0-30 cm

Very dark grayish brown (10 YR 3/2) dry, clay, **40 % weathered sub-rounded basalt fragments of 2-60 cm size**, no information on structure, non-calcareous, many roots, common biological activity, gradual wavy boundary.

B: 30-90 cm

Very dark grayish brown (10 YR 3/2) dry, clay, 40 % weathered sub-rounded basalt fragments of 2-60 cm size, no information on structure, non-calcareous, many roots, common biological activity.

Ssoil5 (Volcanic soil)

Classification: Eutric Regosol
Location: Xutm37: 276422 m Yutm37: 3624791 m
Altitude: 1286 m

Physiography: cone of volcano
Topography: hill with close drainage spacing (100-400 m), very steep (30-40%).
Landscape profile: steep volcano cone
Surface: few rock outcrops (lava channels); many (15-40 %) medium gravel to boulders, no surface sealing, no cracks.
Erosion: slight rill and gully erosion (5 –10 % affected area)
Drainage: well drained
Moisture status: dry
Vegetation: fruit plantations and natural grassland
Parent material: volcanic tuff
Land use: agriculture and natural grassland
Remarks: mine exploitation to collect the volcanic tuff

Ah: 0-35 cm

Yellowish red (5 YR 4/6) dry, **clay loam**, 15-40 % strongly weathered rounded lava tuff of 0.6-2 cm size, **weak fine crumby structure**, **consistence soft when dry**, very friable when moist, very sticky and slightly plastic when wet, many very fine pores, non-calcareous, common roots <0.5 mm, common biological activity (burrows), clear wavy boundary.

C: 35-90 cm

Compacted strongly weathered lava tuff, non-calcareous.

Ssoil6 (Vertisol in lower lying flat land close to Sweida)

Classification: Eutric Vertisol (Calcic Vertisol)[9]
Location: Xutm37: 272589 m Yutm37: 3612971 m
Altitude: 1062 m

Physiography: lower part of western hill slope of basalt mountain range of Sweida
Topography: plains of low relief with wide drainage spacing (1500-3000 m) flat or almost flat (0- 2 %)
Landscape profile: flat rectilinear
Surface: no rock outcrops; **common (5-15 %) stones to boulders**, no surface sealing, **very wide, moderately wide spaced surface cracks**.
Erosion: none
Drainage: well drained
Moisture status: dry
Vegetation: agriculture, cereals and olive tree plantations
Parent material: basalt
Land use: agriculture

Ah: 0-40 cm

Dark brown (7.5 YR 3/4) dry, clay, 5 % weathered sub-rounded basalt fragments of 2 – 20 cm size, strong coarse angular blocky structure (0-5 cm granular mulch), consistence extremely hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, **slightly calcareous**, **many slickensides**, very few .5-2 mm roots, common biological activity, diffuse wavy boundary.

B1: 40-90 cm

Dark brown (7.5 YR 3/3) dry, clay, 5 % weathered sub-rounded basalt fragments of 2 -20 cm size, **moderate coarse wedge-shaped aggregates**, consistence very hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, non-calcareous, **many slickensides,** very few fine roots, few biological activity, diffuse wavy boundary.

B2: 90-120 cm

Dark brown (7.5 YR 3/3) dry, clay, <2 % weathered sub-rounded basalt fragments of 0.6-2 cm size**, moderate coarse wedge-shaped aggregates,** consistence very hard when dry, friable when moist, slightly sticky and very plastic when wet, many very fine pores, **slightly calcareous**, **many slickensides**, very few fine roots, no biological activity, diffuse wavy boundary.

Bk: 120- 140 cm

Dark brown (7.5 YR 3/3) dry, clay, <2 % weathered sub-rounded basalt fragments of 0.6-2 cm size**, moderate coarse wedge-shaped aggregates,** consistence very hard when dry,

[9] In other places in the same area calcic horizons were detected within 125 cm of the surface, therefore the soils could be classified as Calcic Vertisols.

friable when moist, slightly sticky and very plastic when wet, many very fine pores, **slightly calcareous**, **many slickensides**, very few fine roots, no biological activity, **5-10 % lime concretions nodules**, diffuse wavy boundary.

C: >140 cm

Dark brown (7.5 YR 3/3) dry, clay, <2 % weathered sub-rounded basalt fragments of 0.6-2 cm size**, weak coarse wedge-shaped aggregates,** consistence very hard when dry, friable when moist, slightly sticky- and very plastic when wet, many very fine pores, **slightly calcareous**, **slickensides**, very few fine roots, no biological activity.

Ssoil10 (monitoring site Mushannaf water harvesting)

Classification: Eutric Regosol (Eutric Leptosol)[10]
Location: Xutm37: 290882 m Yutm37: 3623849 m
Altitude: 1560 m

Physiography: slope close to the highest point of the basaltic plateau of Sweida, very long and slowly declining slope towards northern direction
Topography: plains of moderate relief with moderate drainage spacing (400- 1500 m), undulating (2-10%).
Landscape profile: rectilinear - concave
Surface: very few rock outcrops; abundant (70 %) coarse gravel to large boulders, no surface sealing, no cracks.
Erosion: slight rill erosion (0 –5 % affected area)
Drainage: well drained
Moisture status: dry
Vegetation: natural grassland
Parent material: basalt
Land use: grazing
Remarks: water harvesting using small dikes along the slope has started

Ah: 0-30 cm

Clay, **Abundant (70 %) coarse gravel to large boulders**, moderate medium crumby structure, consistence hard when dry, common very fine pores, non-calcareous, no cutans, common roots <0.5 mm, common biological activity, diffuse wavy boundary.

R: >30 cm

[10] In this particular profile the depth is just too deep to be classified as Leptosol. In other places in the same area soils are shallower and qualify as Leptosols.

Ssoil11 (monitoring site Sahwet Balata)

Classification: Eutric Regosol
Location: Xutm37: 276021 m Yutm37: 3614998 m
Altitude: 1217 m

Physiography: western slope of basaltic plateau
Topography: hills with small drainage patterns with drainage spacing close (100-400 m), undulating (2-10%).
Landscape profile: rectilinear - concave
Surface: very few rock outcrops; abundant (70- 80 %) coarse gravel to large boulders, no surface sealing, no cracks.
Erosion: slight rill erosion (0 –5 % affected area)
Drainage: well drained
Moisture status: dry
Vegetation: natural high shrub vegetation
Parent material: basalt
Land use: forest area

Ah: 0-35 cm

Dark reddish brown (2.5 YR 3/3) dry, clay, **abundant (70- 80 %) coarse gravel to large boulders**, moderate medium sub-angular blocky structure, consistence hard when dry, common very fine pores, non-calcareous, no cutans, common roots <0.5 mm, common biological activity, diffuse wavy boundary.

R: >35 cm

Ssoil12 (monitoring site Sahwet Khudur)

Classification: Vertic Cambisol
Location: Xutm37: 286456 m Yutm37: 3603971 m
Altitude: 1418 m

Physiography: just next to the base of a lava-tuff composed volcanic cone, on a plateau formed on basaltic material south of Sweida.
Topography: plains of low relief with wide spacing (1500-3000 m), almost flat (0-2 %).
Landscape profile: rectilinear
Surface: very few rock outcrops; abundant (70 %) coarse gravel to large boulders, no surface sealing, **occurrence of cracks (especially in reclaimed stone-free fields)**.
Erosion: none
Drainage: not known
Moisture status: dry
Vegetation: natural grassland
Parent material: basalt
Land use: grazing
Remarks: land reclamation by removing the stones

A/Bw: 0-30 cm

Brown (10 YR 4/3) dry, and very dark grayish brown (10YR 3/2) moist, clay, abundant (70 %) coarse gravel to large boulders of weathered sub-rounded basalt fragments, upper part moderate medium crumby to granular mulch structure, under part moderate medium angular blocky structure, consistence very hard when dry, slightly sticky and plastic when wet, many very fine pores, slightly calcareous, **few slickensides,** few fine roots, common biological activity, gradual wavy boundary.

R: > 30 cm (deeper with removed large boulders in reclaimed agriculture areas)

SOIL DESCRIPTIONS HAFE

Hsoil1 (monitoring site Wadi Kars, top of plateau)

Classification: Haplic Luvisol
Location: Xutm37: 237777 m Yutm37: 3943087 m
Altitude: 687 m

Physiography: upper part of Wadi Kars valley, flat limestone plateau.
Topography: mountainous with moderate drainage spacing (400-1500 m), on plateau undulating (2-10 %).
Landscape profile: convex - rectilinear slope form
Surface: common rock outcrops at a distance of 2-5 m; abundant coarse gravel to stones, no surface sealing, no surface cracks.
Erosion: none
Drainage: well drained
Moisture status: dry
Vegetation: natural scrub vegetation (degraded)
Parent material: limestone
Land use: grazing in other parts fields of cereals and fruit tree plantations

Ah: 0-30 cm

Dark brown (7.5 YR 3/4) moist, and brown (7.5 YR 4/4) dry, clay, 40 % weathered angular limestone fragments of 2-6 cm size, moderate to strong medium crumby structure, consistence hard when dry, friable when moist, sticky and plastic when wet, many very fine pores, non-calcareous, no cutans, no nodules, very few fine roots, common biological activity, diffuse wavy boundary.

Bt: 30-80 cm

Dark brown (7.5 YR 4/4) dry, **heavy clay**, 60 % fresh angular to sub-rounded limestone fragments of 2 -6 cm and > 60cm size, moderate to strong coarse angular blocky structure, consistence very hard when dry, firm when moist, sticky and very plastic when wet, many very fine pores, slightly calcareous, **continuous moderately thick clay cutans,** no nodules, no roots.

R: > 80 cm (> 80 % large boulders of limestone)

Hsoil2 (monitoring site Wadi Kars, on northern slope of Wadi Kars valley)

Classification: Calcaric Regosol
Location: Xutm37: 237273 m Yutm37: 3942745 m
Altitude: 610 m

Physiography: northern slope of Wadi Kars valley
Topography: mountainous with moderate drainage spacing (400-1500 m), very steep (30-45%) slopes.
Landscape profile: convex - rectilinear slope form
Surface: many rock outcrops at a distance of > 50 m; abundant stones to boulders, no surface sealing, no surface cracks.
Erosion: not specified
Drainage: well drained
Moisture status: dry
Vegetation: natural high scrub vegetation
Parent material: limestone
Land use: forest

Ah: 0-20 cm

Reddish brown (5 YR 4/4) dry, clay, 30 % weathered sub-rounded limestone fragments of 2-20 cm size, moderate medium crumby structure, many very fine pores, calcareous, no cutans, no nodules, very few fine roots, common biological activity, diffuse wavy boundary.

C: 20-80 cm

Clay, 70 % weathered sub-rounded limestone fragments of 2 -6 cm and 20-60 cm size, moderate coarse granular structure, many very fine pores, calcareous, few thin clay cutans, few fine roots.

Hsoil3 (monitoring site Sjarifa)

Classification: Haplic Calcisol
Location: Xutm37: 231335 m Yutm37: 3947153 m
Altitude: 400 m
Physiography: upper part of valley (canyon) in area with marl as parent material.
Topography: hills with moderate drainage spacing (400-1500 m), steep (18-30%) slopes.
Landscape profile: convex – concave, with lowest part of wadi canyon
Surface: no rock outcrops; few stones, no surface sealing, no surface cracks.
Erosion: moderate rill and gully erosion, 5-10 % area affected and moderate mass movement (landslides) for 10-25 % of the area.
Drainage: well drained
Moisture status: dry
Vegetation: olive plantation
Parent material: marl
Land use: agriculture

Ah: 0-15 cm

Grayish brown (2.5 Y 5/2) dry, clay, 2-5 % weathered sub-rounded limestone fragments of 0.6-6 cm size, moderate medium sub-angular blocky structure**, consistence very hard when dry, very friable when moist**, very sticky and slightly plastic when wet, many very fine pores, **strongly calcareous**, no cutans, no nodules, very few fine roots, common biological activity, gradual wavy boundary.

B1: 15-47 cm

clay, 2-5 % weathered sub-rounded limestone fragments of 0.6-6 cm size, moderate fine sub-angular blocky structure**, consistence very hard when dry, very friable when moist**, very sticky and slightly plastic when wet, many very fine pores, **strongly calcareous**, no cutans, no nodules, few fine roots, common biological activity, clear wavy boundary.
Bk: 47-60 cm

clay, 2-5 % weathered sub-rounded limestone fragments of 0.6-6 cm size, **weak structure**, **strongly calcareous**, no cutans, **CaCO3 nodules (>5 % of volume)**, very few fine roots, clear wavy boundary.

B2: 60-100 cm

clay, 2-5 % weathered sub-rounded limestone fragments of 0.6-6 cm size, moderate fine granular structure**, consistence very hard when dry, very friable when moist**, very sticky and slightly plastic when wet, many very fine pores, **strongly calcareous**, no cutans, yellow mottles (gley due to temporal hydromorphic conditions), few fine roots.

H**soil4 (monitoring site Zankufe)**

Classification: Chromic Luvisol (‘terra rossa’)
Location: Xutm37: 232067 m Yutm37: 3943226 m, altitude: 312 m
Physiography: upper part of small wadi valley close to Hafe having a clear **break line** dividing ‘terra rossa’ (Hsoil4) on lime parent material and light colored soils (Hsoil5) on marl deposits.
*Topography***: hills with very close drainage spacing (< 100 m)**, very steep (30-45 %).
Landscape profile: concave
Surface: upper part of the valley many rock outcrops at a distance of 5-20 m; many stones to boulders, no surface sealing, no surface cracks.
Erosion: **somewhat excessive rill and gully erosion, 10-25 % area affected and moderate mass movement (landslides) for 5-10 % of the area especially on the soils formed in marl deposits**.
Drainage: well drained
Moisture status: dry
Vegetation: natural shrub vegetation mixed with olive and fruit plantation
Parent material: limestone
Land use: natural vegetation and agriculture

Ah: 0-20 cm
Reddish brown (5 YR 4/4) dry, clay loam, 5-15 % weathered sub-rounded limestone fragments of 2-6 cm size, moderate fine crumby structure**,** consistence very hard when dry, very friable when moist, sticky and slightly plastic when wet, many very fine pores, **calcareous**, no cutans, no nodules, common fine roots, common biological activity, clear wavy boundary.

B1: 20-70 cm
Yellowish red (5 YR 5/8) dry, clay loam, 15-40 % weathered angular limestone fragments of 6 –20 cm size, moderate fine crumby structure**,** consistence very hard when dry, very friable when moist, sticky and slightly plastic when wet, many very fine pores, calcareous, no cutans, no nodules, common fine roots, common biological activity, clear wavy boundary.

Bt: 70-95 cm
Yellowish red (5 YR 4/6) dry, **clay**, 15-40 % weathered angular limestone fragments of 6 –20 cm size, moderate fine crumby structure**,** consistence very hard when dry, very friable when moist, sticky and slightly plastic when wet, many very fine pores, calcareous, patchy thin clay cutans, no nodules, few fine roots, few biological activity, clear wavy boundary.

C: 95-120 cm
Yellowish red (5 YR 5/6) dry, clay loam, 15-40 % weathered angular limestone fragments of 6 –20 cm size, **weak fine granular structure, consistence soft when dry**, very friable when moist, **very sticky** and slightly plastic when wet, many very fine pores, calcareous, no cutans, no nodules, no fine roots, no biological activity.

Hsoil5 (monitoring site Zankufe)

Classification: Calcaric Cambisol
Location: Xutm37: 232072 m Yutm37: 3943221 m, altitude: 312 m
Physiography: upper part of small wadi valley close to Hafe having a clear **break line** dividing 'terra rossa' (Hsoil4) on lime parent material and light colored soils (Hsoil5) on marl deposits.
*Topography***: hills with very close drainage spacing (< 100 m)**, very steep (30-45 %).
Landscape profile: concave
Surface: upper part of the valley many rock outcrops at a distance of 5-20 m; many stones to boulders, no surface sealing, no surface cracks.
Erosion: **somewhat excessive rill and gully erosion, 10-25 % area affected and moderate mass movement (landslides) for 5-10 % of the area especially on the soils formed in marl deposits**.
Drainage: well drained
Moisture status: dry
Vegetation: natural shrub vegetation mixed with olive and fruit plantation
Parent material: marl
Land use: natural vegetation and agriculture

Ah: 0-30 cm
Light gray (2.5 Y 7/2) dry, clay loam, 5-10 % weathered rounded stone fragments of 2-20 cm size, moderate fine crumby structure**, very sticky and non plastic when wet,** many very fine pores, **strongly calcareous**, no cutans, no nodules, common fine roots, common biological activity, clear wavy boundary.

Bw: 30-75 cm
Pale yellow (2.5 YR 8/4) dry, clay loam, 5-10 % weathered rounded stone fragments of 2-20 cm size, moderate fine angular blocky structure**, very sticky and non plastic when wet,** many very fine pores**, strongly calcareous**, no cutans, no nodules, few fine roots, few biological activity, clear wavy boundary.

C: 75-130 cm
Pale yellow (2.5 YR 8/4) to yellow (2.5 Y 8/8) dry, clay loam, 5-10 % weathered rounded stone fragments of 2 –20 cm size, **weak structure, very sticky and non plastic when wet**, many very fine pores, **strongly calcareous**, no cutans, **yellow mottles** (gley due to temporal hydromorphic conditions), broken stripes of CaCO3, no roots, no biological activity.

C: 95-120 cm
Yellowish red (5 YR 5/6) dry, clay loam, 15-40 % weathered angular limestone fragments of 6 –20 cm size, **weak fine granular structure, consistence soft when dry**, very friable when moist, **very sticky** and slightly plastic when wet, many very fine pores, calcareous, no cutans, no nodules, no fine roots, no biological activity.

Hsoil6 (monitoring site Rabya)

Classification: Calcaric Cambisol
Location: Xutm37: 231346 m Yutm37: 3942957 m
Altitude: 551 m

Physiography: on slowly westwards declining slope in wadi valley.
Topography: hills with close drainage spacing (100-400 m), moderately steep (10-18 %) slopes, terrace structure; normal valley relief.
Landscape profile: terrace structure (slope 2 –4 % on terraces, 40-50 % between terraces)
Surface: no rock outcrops; common coarse gravel to stones, no surface sealing, no surface cracks.
Erosion: no erosion due to terrace structure.
Drainage: well drained
Moisture status: dry
Vegetation: fruit plantation
Parent material: marl
Land use: agriculture, fruit plantation

Ah: 0-15 cm

Light gray (2.5 Y 7/2) dry**, clay loam**, 5-15 % weathered sub-rounded limestone fragments of 2-20 cm size, moderate medium sub-angular blocky structure**,** consistence hard when dry, very friable when moist, **very sticky and non plastic when wet,** many fine pores, **strongly calcareous**, no cutans, no nodules, common fine roots, few biological activity, gradual wavy boundary.

Bw1: 15-50 cm

Light gray (2.5 Y 7/2) dry, clay loam, 5-10 % weathered rounded stone fragments of 2-20 cm size, moderate medium sub-angular blocky structure, consistence hard when dry, very friable when moist, very sticky and non plastic when wet**,** many fine pores, strongly calcareous, no cutans**, few CACO3 nodules**, few fine roots, few biological activity, gradual wavy boundary.

Bw2: 50-100 cm

Light gray (2.5 Y 7/2) dry, clay loam, 5-10 % weathered rounded stone fragments of 2-20 cm size, **weak medium sub-angular** blocky structure, consistence hard when dry, very friable when moist, very sticky and non plastic when wet, many fine pores, strongly calcareous, no cutans, few CACO3 nodules, few fine roots, few biological activity.

Hsoil7 (monitoring site Bireen)

Classification: Haplic Luvisol
Location: Xutm37: 239862 m Yutm37: 3943227 m, altitude: 834 m
Physiography: on plateau north of Wadi Kars valley.
Topography: hills with moderate drainage spacing (400-1500 m), flat or almost flat (0-2%)
Landscape profile: upper plateau, flat.
Surface: no rock outcrops; many coarse gravel to stones, no surface sealing, no surface cracks.
Erosion: no erosion, flat.
Drainage: well drained
Moisture status: dry
Vegetation: fruit plantation
Parent material: limestone
Land use: agriculture, fruit plantation

Ah: 0-30 cm

Very dark grayish brown (10YR 3/2) wet, clay, 15-40 % weathered sub-rounded limestone fragments of 2-20 cm size, strong medium sub-angular blocky structure (**fine granular for upper 5 cm**)**,** consistence very hard when dry, friable when moist, slightly sticky and slightly plastic when wet, many very fine pores, **non calcareous**, no cutans, no nodules, common fine roots, common biological activity, gradual wavy boundary.

Bt: 30-60 cm

Dark brown (7.5 YR 3/4) dry**, clay,** 15-40 % weathered sub-rounded limestone fragments of 2-20 cm size, moderate medium sub-angular blocky structure, consistence hard when dry, friable when moist, slightly sticky and slightly plastic when wet, many very fine pores, non calcareous, **continuous moderately thick clay coatings**, no nodules, very few fine roots, few biological activity, gradual wavy boundary.

BC: 60-90 cm

Dark brown (7.5 YR 3/4) dry, **clay,** 15-40 % weathered sub-rounded limestone fragments of **6-60 cm size**, **weak medium sub-angular blocky structure**, consistence hard when dry, friable when moist, slightly sticky and slightly plastic when wet, many very fine pores, non calcareous, **broken moderately thick clay coatings**, no nodules, very few fine roots, few biological activity.

Hsoil8 (monitoring site Wadi Kars, lowest part, valley floor)

Classification: Calcaric Fluvisol
Location: Xutm37: 239787 m Yutm37: 3941328 m
Altitude: 514 m

Physiography: valley floor of the Wadi Kars valley.
Topography: Mountainous with moderate drainage spacing (400-1500 m), very steep (30-45 %) slope, normal valley relief.
Landscape profile: convex (upper part) – rectilinear (hillsides) – concave (valley floor), soil profile pit on one of the terraces (300 m² max) along the river.
Surface: very few rock outcrops; many coarse gravel to stones, no surface sealing, no surface cracks.
Erosion: no erosion, flat.
Drainage: well drained, **occasionally flooded during the wintertime.**
Moisture status: dry
Vegetation: agriculture: cereals, tobacco
Parent material: limestone
Land use: agriculture

Ah: 0-20 cm

Dark brown (10 YR 3/3) dry**, clay**, 40-60 % weathered sub-rounded limestone fragments of 6-20 cm size, **weak** fine sub-angular blocky to medium crumby structure**,** consistence hard when dry, friable when moist, sticky and slightly plastic when wet, many very fine pores, **calcareous**, no cutans, no nodules, common big to fine roots, common biological activity, gradual wavy boundary.

C: 20-100 cm

Dark brown (7.5 YR 3/2) dry, **clay, 70 % weathered sub-rounded limestone fragments** of 6-20 cm size, **weak** medium sub-angular blocky to crumby structure, consistence hard when dry, friable when moist, sticky and slightly plastic when wet, many very fine pores**, slightly calcareous**, no coatings, no nodules, few fine roots, few biological activity**, no clear stratification**.

Hsoil10 (monitoring site Wadi Kars, on northern hill slope of Wadi Kars valley)

Same location of Hsoil2, but shallow soil overlying immediately calcareous material (limestone). Only an Ah (0-20 cm) horizon is defined. **The organic material content is too low to give it rendzic properties**.

Classification: Eutric Leptosol

Table 8. Soil analytical data for the profiles of the Hafe study area

Location		Depth	Lab.	pH	E.C. (1:1)	O.M.	$CaCO_3$	Extr. K	Extr. Na	Extr. Ca	Extr. Mg	Total - P	Total - N		Particle Size Analysis	
HAFE		cm	No.	1:1	mS/cm	%	%	ppm		meq/L		ppm	ppm	Clay %	Silt %	Sand %
Hsoil 1	**Ah**	**00-30**	**1**	6.9	0.218	5.81	2.71	146.6	2.1	260.2	51.1	950.0	2824	51.5	31.4	17.0
	Bt	**30-80**	**2**	7.6	0.246	1.47	5.66	102.0	1.5	410.7	61.0			95.0	2.9	2.1
Hsoil 2	**Ah**	**00-20**	**3**	8.1	0.234	4.69	49.76	172.0	1.5	293.4	60.4	487.5	2010	36.6	30.9	32.5
	C	**20-100**	**4**	8.4	0.205	3.22	35.06	181.0	2.1	392.9	22.2			57.2	25.1	17.7
Hsoil 3	**A**	**00-15**	**5**	8.2	0.364	2.56	50.27	239.8	0.1	255.1	46.8	587.5	1483	35.5	27.2	37.3
	B1	**15-47**	**6**	8.3	0.180	2.03	50.52	77.1	0.1	239.8	42.0			35.5	23.3	41.2
	BK	**47-60**	**7**	8.4	0.158	0.70	50.27	31.3	0.1	156.9	31.8			27.1	44.4	28.5
	B2	**60-100**	**8**	8.1	0.245	1.05	50.27	66.0	1.5	244.9	51.1			53.9	28.6	17.5
Hsoil 4	**A**	**00-20**	**9**	8.0	0.359	3.05	49.76	115.9	0.5	265.3	46.0	712.5	1665	33.9	36.0	30.1
	B1	**20-70**	**10**	8.1	0.147	1.86	49.76	46.7	0.1	265.3	13.0			33.9	30.8	35.2
	Bt	**70-95**	**11**	8.3	0.155	1.40	49.76	51.2	0.5	308.1	11.2			41.1	27.5	31.4
	C	**95-120**	**12**	8.6	0.162	0.56	49.51	28.0	0.1	227.3	2.8			30.0	28.2	41.8
Hsoil 5	**A**	**00-30**	**13**	8.0	0.290	2.45	49.76	89.1	0.5	252.5	33.9	437.5	1184	37.9	30.9	31.2
	Bw	**30-75**	**14**	8.4	0.182	0.35	49.76	31.3	0.5	242.4	6.4			36.5	33.4	30.1
	C	**75-130**	**15**	8.5	0.138	0.14	49.76	38.5	0.1	197.0	14.3			29.7	30.5	39.7
Hsoil 6	**A**	**00-15**	**16**	8.1	0.372	2.49	49.76	190.2	0.5	252.5	24.5	862.5	1459	33.9	34.7	31.4
	Bw1	**15-50**	**17**	8.4	0.148	1.40	49.51	51.2	0.1	252.5	22.1			39.1	34.8	26.1
	Bw2	**50-100**	**18**	8.2	0.167	1.44	50.01	60.8	0.1	267.7	9.3			39.3	30.5	30.2
Hsoil 7	**A**	**00-30**	**19**	8.1	0.276	4.69	9.56	239.8	1.0	434.3	31.6	5775.0	2813	62.0	21.3	16.7
	Bt	**30-60**	**20**	7.8	0.152	2.31	6.66	95.4	1.0	464.7	18.9			69.8	16.1	14.1
	BC	**60-90**	**21**	7.6	0.120	2.03	6.66	123.2	1.5	505.1	4.3			74.8	13.5	11.8
Hsoil 8	**A**	**00-20**	**22**	8.0	0.343	5.53	43.41	356.7	0.5	311.2	23.7	1312.5	2577	45.6	24.8	29.6
	C	**20-100**	**23**	7.8	0.205	3.78	17.66	199.7	1.0	398.0	50.2			67.1	13.3	19.6
Hsoil 10	**Ah**	**00-20**	**24**	8.0	0.344	3.31	49.51	138.6	0.5	204.1	41.2	412.5	1462	26.4	41.9	31.7

Table 9. Soil analytical data for the profiles of the Sweida study area

Location		Depth	Lab.	pH	E.C. (1:1)	O.M.	$CaCO_3$	Extr. K	Extr. Na	Extr. Ca	Extr. Mg	Total - P	Total - N		Particle Size Analysis	
Sweida		cm	No.	1:1	mS/cm	%	%	ppm		meq/L		ppm	ppm	Clay %	Silt %	Sand %
Ssoil 1	Ah	00-25	25	7.7	0.153	1.40	6.16	172.0	3.4	274.2	116.0	1025.0	890	59.8	19.5	20.8
Ssoil 2	Ah	00-20	26	7.2	0.320	2.10	7.11	229.4	3.4	265.3	97.9	1575.0	1161	61.6	18.6	19.8
	Bw	20-90	27	7.2	0.133	0.46	6.41	130.8	8.9	267.9	142.5			58.7	12.2	29.1
Ssoil 3	A	00-40	28	7.6	0.169	0.63	5.66	283.7	2.7	464.3	120.6	700.0	535	78.0	14.8	7.2
	BW	40-60	29	7.9	0.177	0.67	6.16	138.6	3.4	457.9	114.0			80.8	12.5	6.7
	BK	60-80	30	8.0	0.190	0.67	9.56	115.9	3.4	469.4	106.1			81.7	9.7	8.5
Ssoil 4	A	00-25	31	7.5	0.089	1.16	5.16	115.9	1.5	214.3	92.3	2375.0	755	56.4	21.8	21.7
	B1	25-45	32	7.4	0.083	0.84	5.16	66.0	1.5	190.7	102.9			59.6	20.6	19.7
	BC	45-80	33	8.1	0.124	0.67	5.66	89.1	2.1	190.7	92.3			57.3	20.3	22.4
Ssoil 5	A	00-35	34A	7.5	0.135	2.00	7.11	576.5	3.4	304.1	63.8	1350.0	1137	37.2	24.3	38.5
	C	00-35	34R	8.0	0.080	0.25	14.51	319.1	8.9	371.1	75.8	600.0	202	33.8	9.5	56.6
Ssoil 6	A	00-40	35	8.2	0.231	0.84	12.51	396.4	6.8	463.9	84.4	712.5	494	78.3	12.4	9.3
	B1	40-90	36	7.8	0.213	0.70	6.66	181.0	10.0	458.8	107.3			83.1	9.7	7.2
	B2	90-120	37	7.7	0.285	0.60	8.11	146.6	12.4	427.8	133.5			87.8	5.8	6.3
	BK	120-140	38	7.8	0.306	0.42	12.51	146.6	12.4	417.5	115.5			83.8	10.0	6.2
	C	140-160	39	8.3	0.292	0.28	16.96	115.9	12.4	407.2	130.5			89.0	1.6	9.4
Ssoil 4 (2)	A	00-30	40	7.5	0.225	2.70	8.61	250.4	1.5	278.4	66.0	2675.0	1268	48.1	25.1	26.8
	B	30-90	41	6.8	0.276	0.89	8.61	172.0	2.7	257.7	91.3			48.6	19.0	32.5
Ssoil10	Ah	00-30	42	7.7	0.187	1.76	7.46	190.2	2.1	250.0	78.5	1662.5	1016	42.9	37.3	19.8
Ssoil11	Ah	00-30	43	7.7	0.129	1.55	2.49	396.4	1.0	137.8	38.5	1575.0	971	29.9	59.1	11.0
Ssoil12	Ah	00-30	44	7.8	0.127	0.72	0.5	190.2	2.1	137.8	38.5	850.0	583	48.0	39.8	12.2

ANNEX 3. CLIMATIC DATA FOR REPRESENTATIVE SITES

Table 10. Climatic profile for SJARIFA (Hafe study area)

CLIMATE SUMMARY

using average monthly data

Station information

Country: **SYRIA** Station ID: **00001** Station name: **SJARIFA**

Lat.: **35.38** Long.: **36.02** Alt.: **360**

Parameter	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Year
Maximum temperature (°C)	32.7	32.7	31.3	26.7	20.9	14.1	12.6	14.3	17.7	22.2	26.7	31.9	23.6
Minimum temperature (°C)	21.7	21.9	18.5	14.0	9.5	6.3	5.5	5.8	8.3	11.0	14.6	18.8	13.0
Mean temperature (°C)	27.2	27.3	24.9	20.3	15.2	10.2	9.0	10.0	13.0	16.6	20.6	25.3	18.3
Rainfall (mm)	2	4	31	64	100	237	183	162	124	60	36	9	1,013
Heat units	843	845	747	631	455	315	280	280	403	497	639	760	6,694
Heat units accumul. from JUL	843	1,688	2,435	3,065	3,520	3,835	4,115	4,396	4,799	5,295	5,935	6,694	
PET	128	113	86	73	63	51	52	52	67	77	90	109	960

Temperature

Intra-annual range of max. temp.:	**20.1**	°C
Intra-annual range of min. temp.:	**16.4**	°C
Mean temp. of the coldest month:	**9.0**	°C
Mean temp. of the warmest month:	**27.3**	°C

Rainfall

Total number of months that are

Dry: **5** *Intermediate:* **2** *Humid:* **5**

Winter rainfall:	**582.4**	mm	**57** %
Spring rainfall:	**220.3**	mm	**22** %
Summer rainfall:	**15.3**	mm	**2** %
Autumn rainfall:	**195.1**	mm	**19** %
Rainfall pattern:	**Winter-**		
Frequent fog:	FALSE		

Agroclimatic zone

Winter type:	**Cool**	
Summer type:	**Warm**	
Aridity index:	**1.05**	**Per-humid**
Agroclimatic region:	**6g**	**Per-humid, Cool winter, Warm summer**
Köppen climate:	**Csa**	**warm temperate rainy climate with summer drought and hot summers**

Table 11. Climatic profile for BEREEN Herbacious (Hafe study area)

CLIMATE SUMMARY

using average monthly data

Station information

Country:	SYRIA	Station ID:	00002	Station name:	BEREEN
Lat.:	35.36	Long.:	36.08	Alt.:	879

Parameter	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Year
Maximum temperature (°C)	31.9	26.7	22.2	17.7	14.3	12.6	14.1	20.9	26.7	31.3	32.7	32.7	23.6
Minimum temperature (°C)	18.9	19.4	16.4	12.7	8.6	4.2	2.6	3.2	5.5	8.4	12.1	16.1	10.7
Mean temperature (°C)	25.4	23.0	19.3	15.2	11.4	8.4	8.3	12.1	16.1	19.9	22.4	24.4	17.2
Rainfall (mm)	3	6	34	67	118	274	216	223	214	109	51	15	1,330
Heat units	788	713	579	471	342	260	257	338	498	596	694	732	6,270
Heat units accumul. from JUL	788	1,501	2,080	2,551	2,893	3,154	3,411	3,749	4,247	4,843	5,538	6,270	
PET	118	109	86	69	58	45	41	42	57	70	84	106	884

Temperature

Intra-annual range of max. temp.:	20.1	°C
Intra-annual range of min. temp.:	16.8	°C
Mean temp. of the coldest month:	8.3	°C
Mean temp. of the warmest month:	25.4	°C

Rainfall

Total number of months that are

Dry: 4 *Intermediate:* 2 *Humid:* 6

Winter rainfall:	713.1	mm	54	%
Spring rainfall:	373.6	mm	28	%
Summer rainfall:	24.3	mm	2	%
Autumn rainfall:	219.1	mm	16	%
Rainfall pattern:	Winter-Spring-			
Frequent fog:	FALSE			

Agroclimatic zone

Winter type:	Cool	
Summer type:	Warm	
Aridity index:	1.51	Per-humid
Agroclimatic region:	6g	Per-humid, Cool winter, Warm summer
Köppen climate:	Csa	warm temperate rainy climate with summer drought and hot summers

Table 12. Climatic profile for. SWEIDA (Sweida study area)

CLIMATE SUMMARY

using average monthly data

Station information

Country:	**SYRIA**	Station ID:	**SY26SWD0**	Station name:	**SWEIDA**
Lat.:	**32.42**	Long.:	**36.35**	Alt.:	**997**

Parameter	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Year
Maximum temperature (°C)	30.6	31.2	29.5	25.9	19.8	13.3	11.1	12.2	15.2	20.3	25.6	29.5	22.0
Minimum temperature (°C)	15.4	15.9	14.4	12.5	9.4	5.1	3.1	3.3	5.5	8.4	11.5	14.1	9.9
Mean temperature (°C)	23.0	23.6	22.0	19.2	14.6	9.2	7.1	7.8	10.4	14.4	18.6	21.8	16.0
Rainfall (mm)	0	0	2	9	30	59	78	82	68	28	8	0	364
Heat units	713	730	659	595	438	285	220	217	321	431	575	654	5,837
Heat units accumul. from JUL	713	1,443	2,102	2,697	3,135	3,420	3,640	3,857	4,178	4,608	5,183	5,837	
PET	175	157	125	92	52	31	29	42	71	102	157	170	1,203

Temperature

Intra-annual range of max. temp.:	**20.1**	°C
Intra-annual range of min. temp.:	**12.8**	°C
Mean temp. of the coldest month:	**7.1**	°C
Mean temp. of the warmest month:	**23.6**	°C

Rainfall

Total number of months that are

Dry: **7** *Intermediate:* **2** *Humid:* **3**

Winter rainfall:	**219.0**	mm	**60**	%
Spring rainfall:	**104.0**	mm	**29**	%
Summer rainfall:	**0.0**	mm	**0**	%
Autumn rainfall:	**41.0**	mm	**11**	%
Rainfall pattern:	**Winter-Spring-**			
Frequent fog:	FALSE			

Agroclimatic zone

Winter type:	**Cool**	
Summer type:	**Warm**	
Aridity index:	**0.30**	**Semi-arid**
Agroclimatic region:	**3g**	**Semi-arid, Cool winter, Warm summer**
Köppen climate:	**Csa**	**warm temperate rainy climate with summer drought and hot summers**

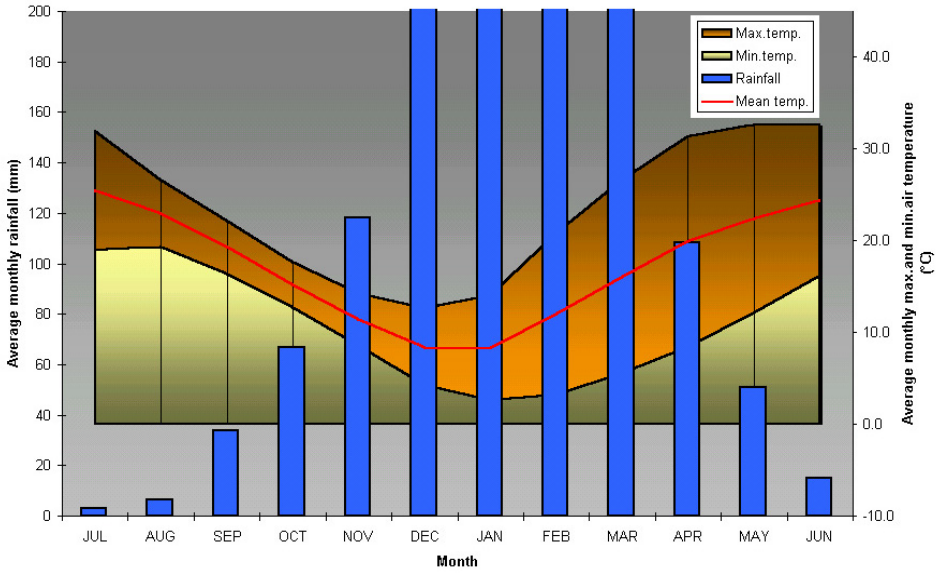


Figure 1. Climate diagram, Bereen

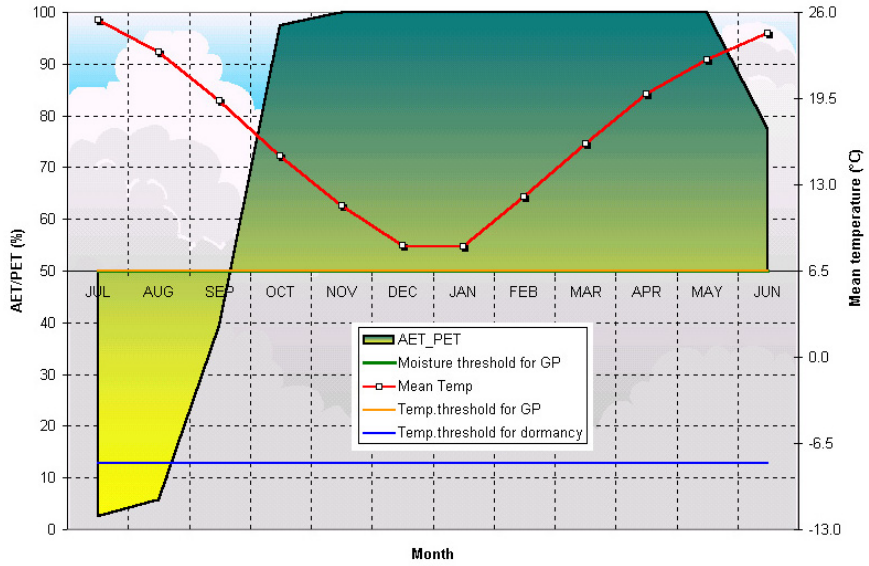


Figure 2. LGP-diagram, Bereen

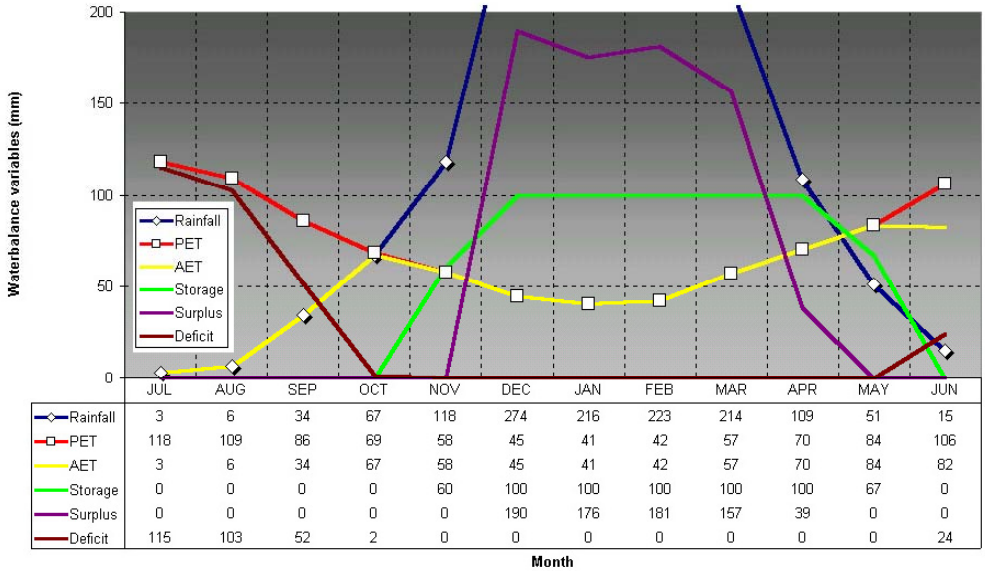


Figure 3. Water balance diagram, Bereen

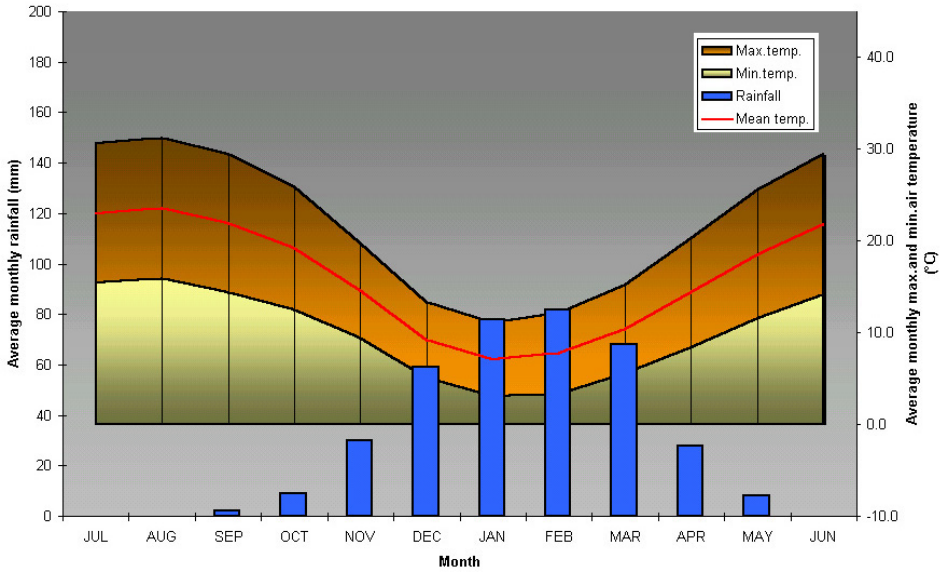


Figure 4. Climate diagram, Sweida

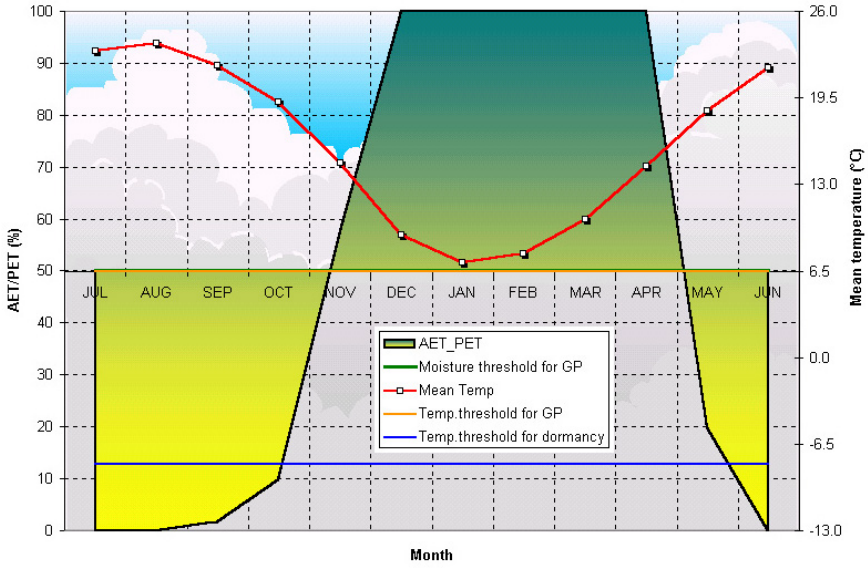


Figure 5. LGP-diagram, Sweida

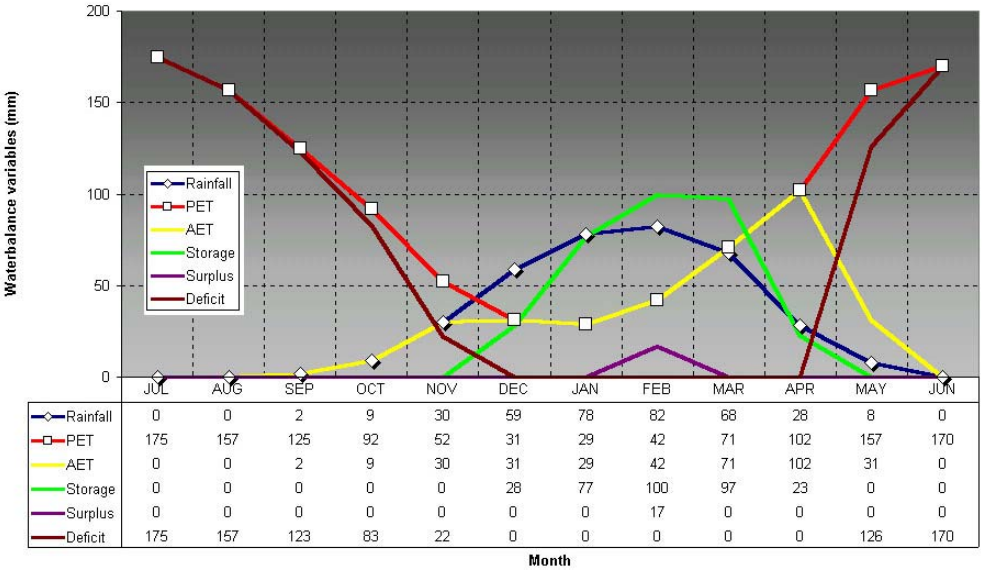
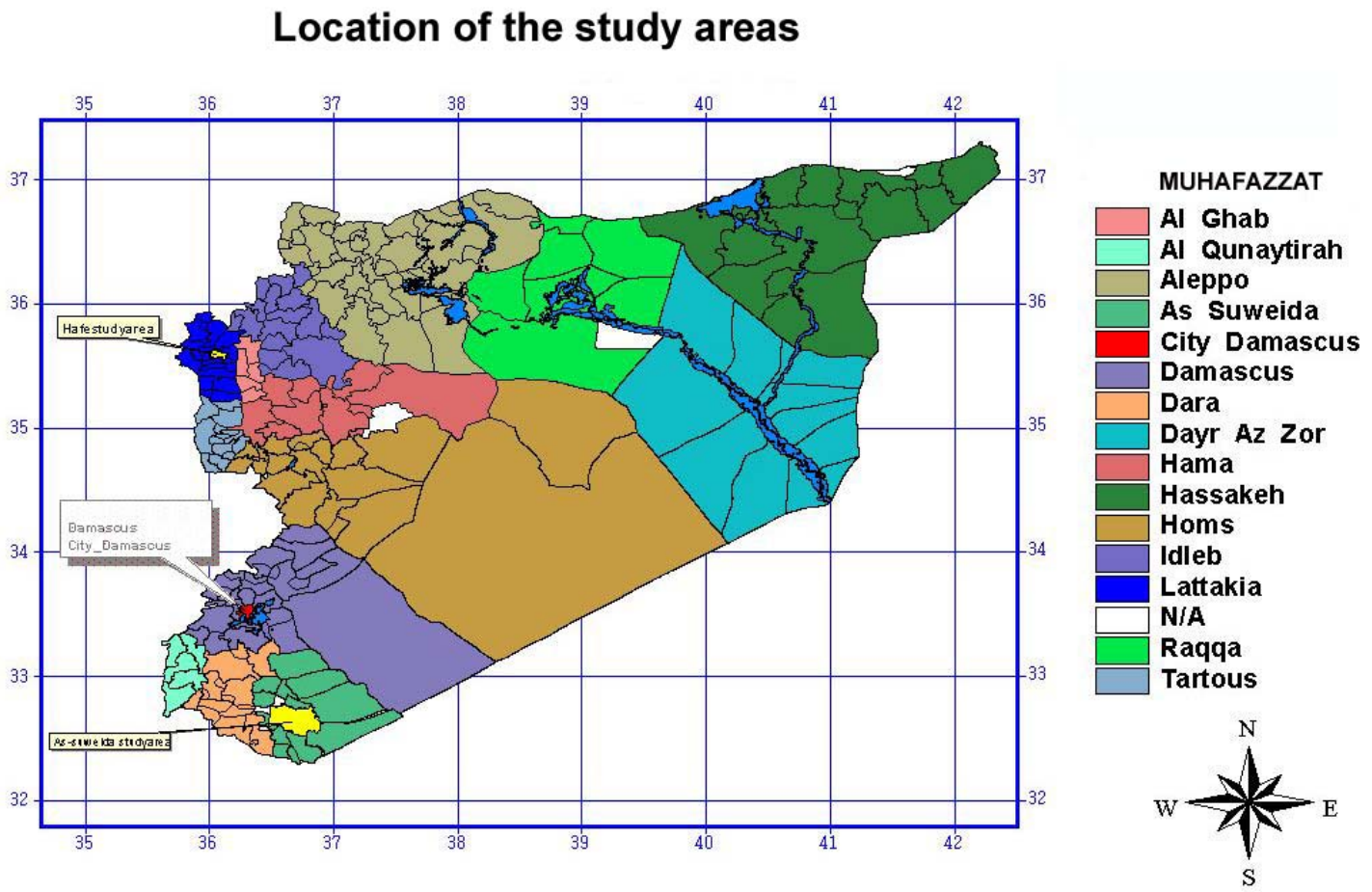


Figure 6. Water balance diagram, Sweida

ANNEX 4. MAPS FOR THE STUDY AREAS

LOCATION MAP OF THE STUDY AREAS



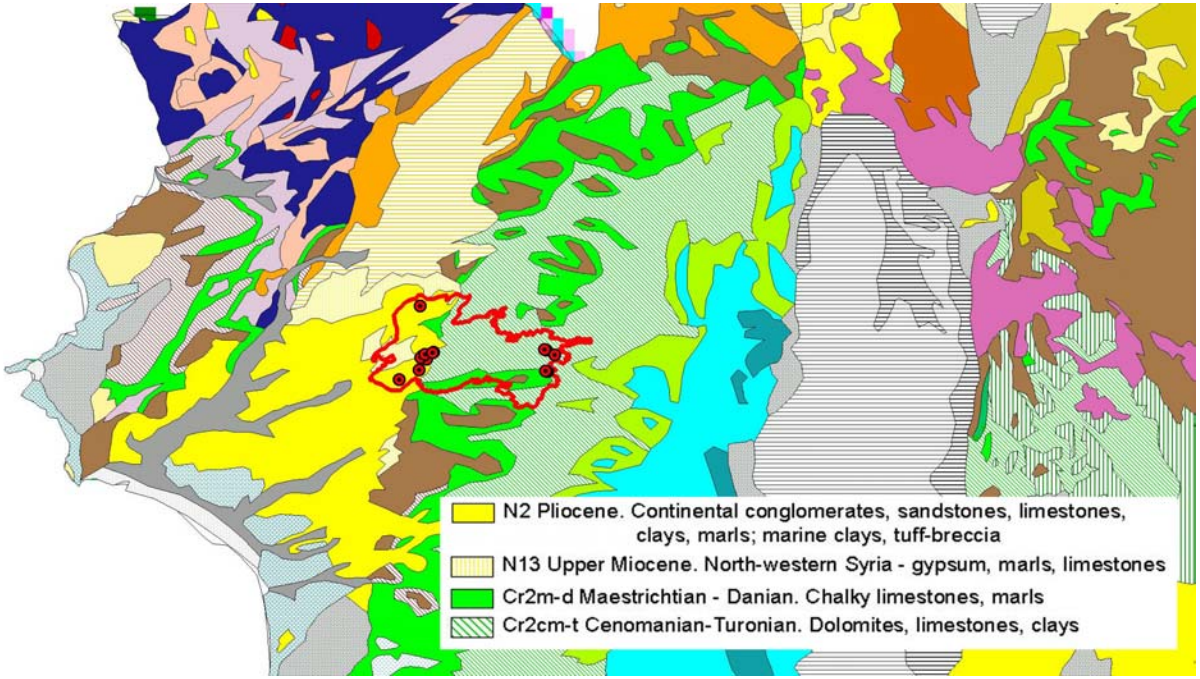


Figure 7. Hafe study area and surroundings: geology

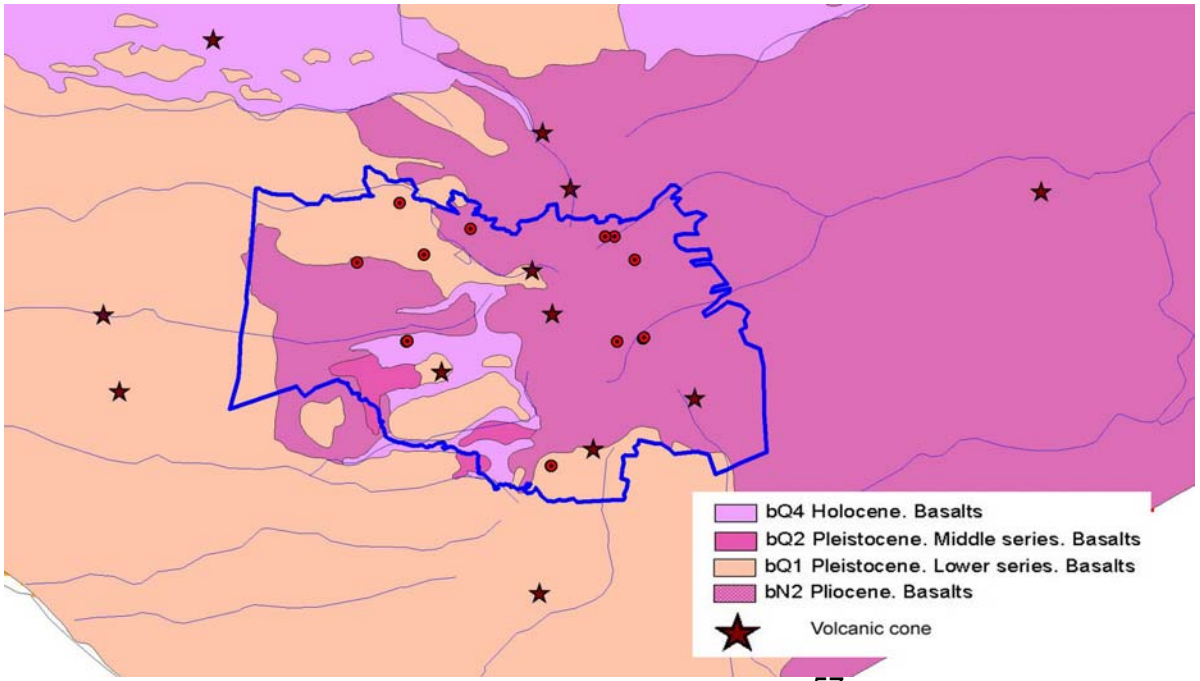


Figure 8. Sweida study area and surroundings: geology

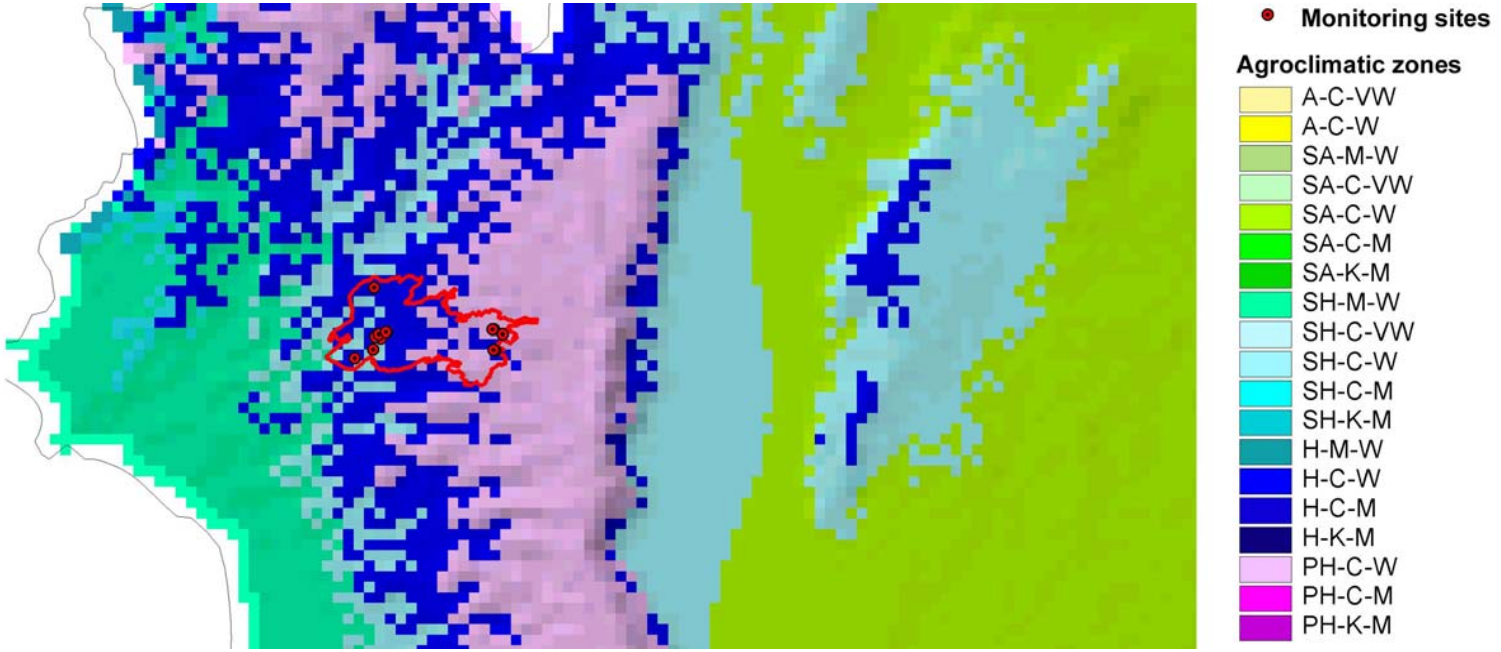


Figure 9. Hafe study area and surroundings: Agroclimatic zones

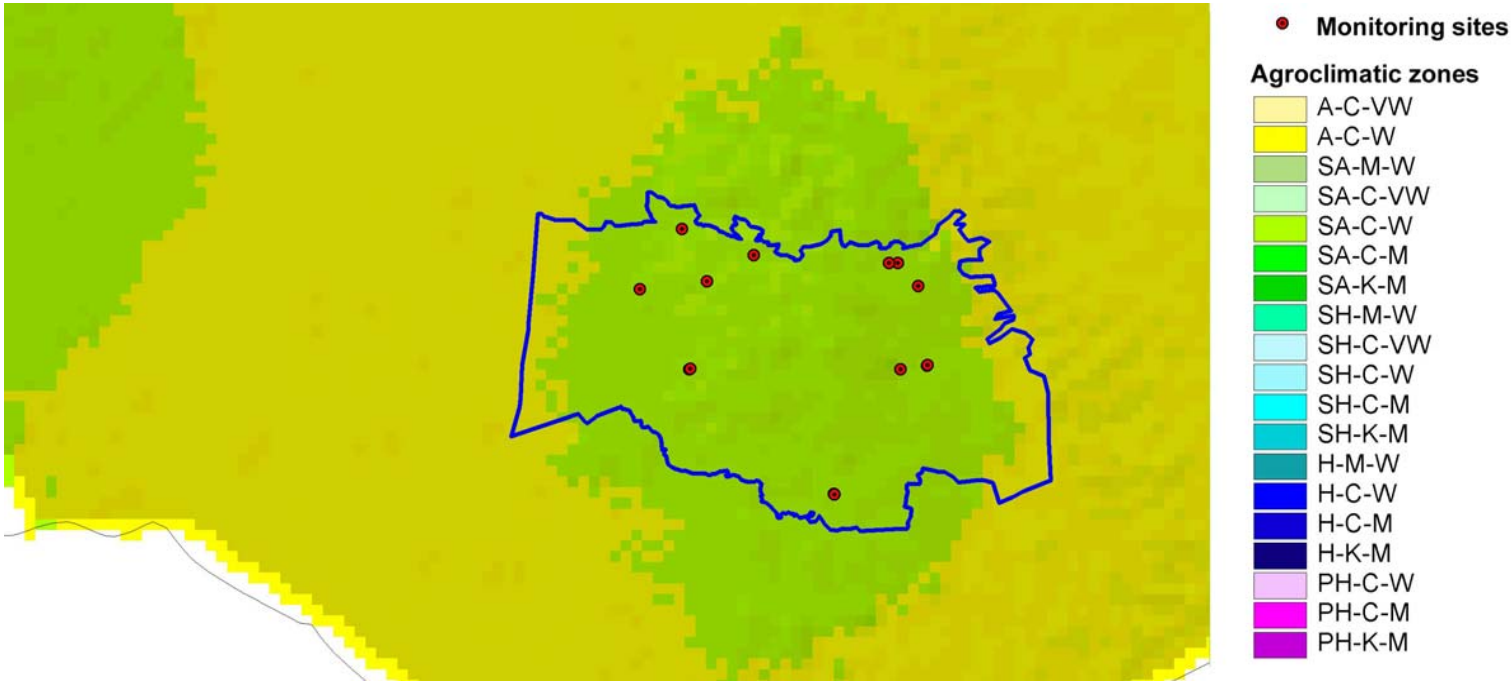


Figure 10. Sweida study area and surroundings: Agroclimatic zones

Agroclimatic Zone	Moisture regime	Aridity index	Winter temp.	Range_Win	Summer temp.	Range_Sum
A-C-VW	Arid	0.03 - 0.2	Cool	0° - 10°C	Very warm	> 30°C
A-C-W	Arid	0.03 - 0.2	Cool	0° - 10°C	Warm	20° - 30°C
SA-M-W	Semi-arid	0.2 - 0.5	Mild	10° - 20°C	Warm	20° - 30°C
SA-C-VW	Semi-arid	0.2 - 0.5	Cool	0° - 10°C	Very warm	> 30°C
SA-C-W	Semi-arid	0.2 - 0.5	Cool	0° - 10°C	Warm	20° - 30°C
SA-C-M	Semi-arid	0.2 - 0.5	Cool	0° - 10°C	Mild	10° - 20°C
SA-K-M	Semi-arid	0.2 - 0.5	Cold	<= 0°C	Mild	10° - 20°C
SH-M-W	Sub-humid	0.5 - 0.75	Mild	10° - 20°C	Warm	20° - 30°C
SH-C-VW	Sub-humid	0.5 - 0.75	Cool	0° - 10°C	Very warm	> 30°C
SH-C-W	Sub-humid	0.5 - 0.75	Cool	0° - 10°C	Warm	20° - 30°C
SH-C-M	Sub-humid	0.5 - 0.75	Cool	0° - 10°C	Mild	10° - 20°C
SH-K-M	Sub-humid	0.5 - 0.75	Cold	<= 0°C	Mild	10° - 20°C
H-M-W	Humid	0.75 - 1	Mild	10° - 20°C	Warm	20° - 30°C
H-C-W	Humid	0.75 - 1	Cool	0° - 10°C	Warm	20° - 30°C
H-C-M	Humid	0.75 - 1	Cool	0° - 10°C	Mild	10° - 20°C
H-K-M	Humid	0.75 - 1	Cold	<= 0°C	Mild	10° - 20°C
PH-C-W	Per-humid	> 1	Cool	0° - 10°C	Warm	20° - 30°C
PH-C-M	Per-humid	> 1	Cool	0° - 10°C	Mild	10° - 20°C
PH-K-M	Per-humid	> 1	Cold	<= 0°C	Mild	10° - 20°C

Figure 11. Full Legend Agroclimatic zones in Syria

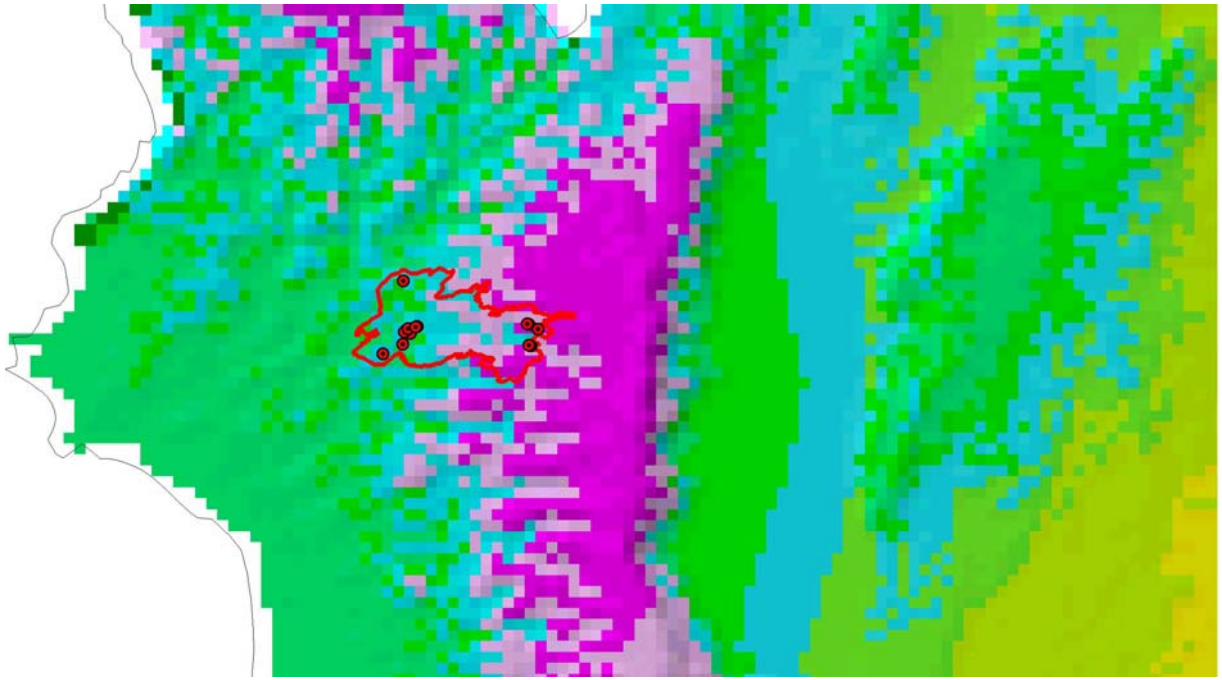


Figure 12. Hafe study area and surroundings: Annual precipitation

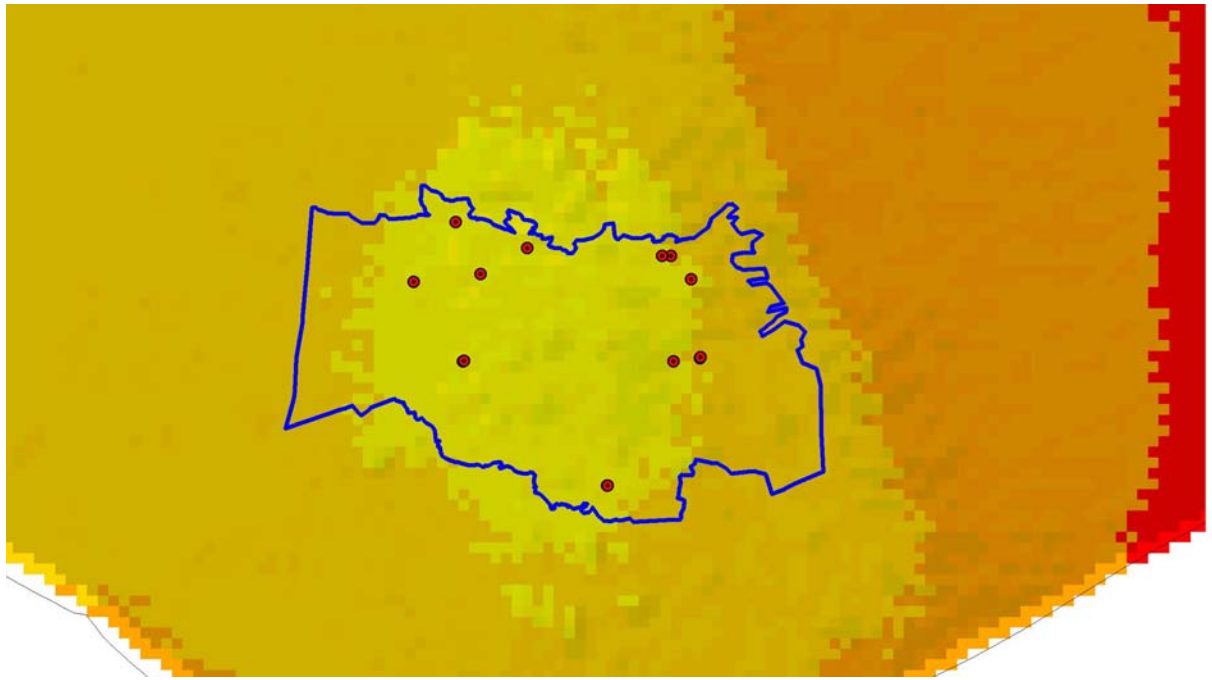


Figure 13. Sweida study area and surroundings: Annual precipitation

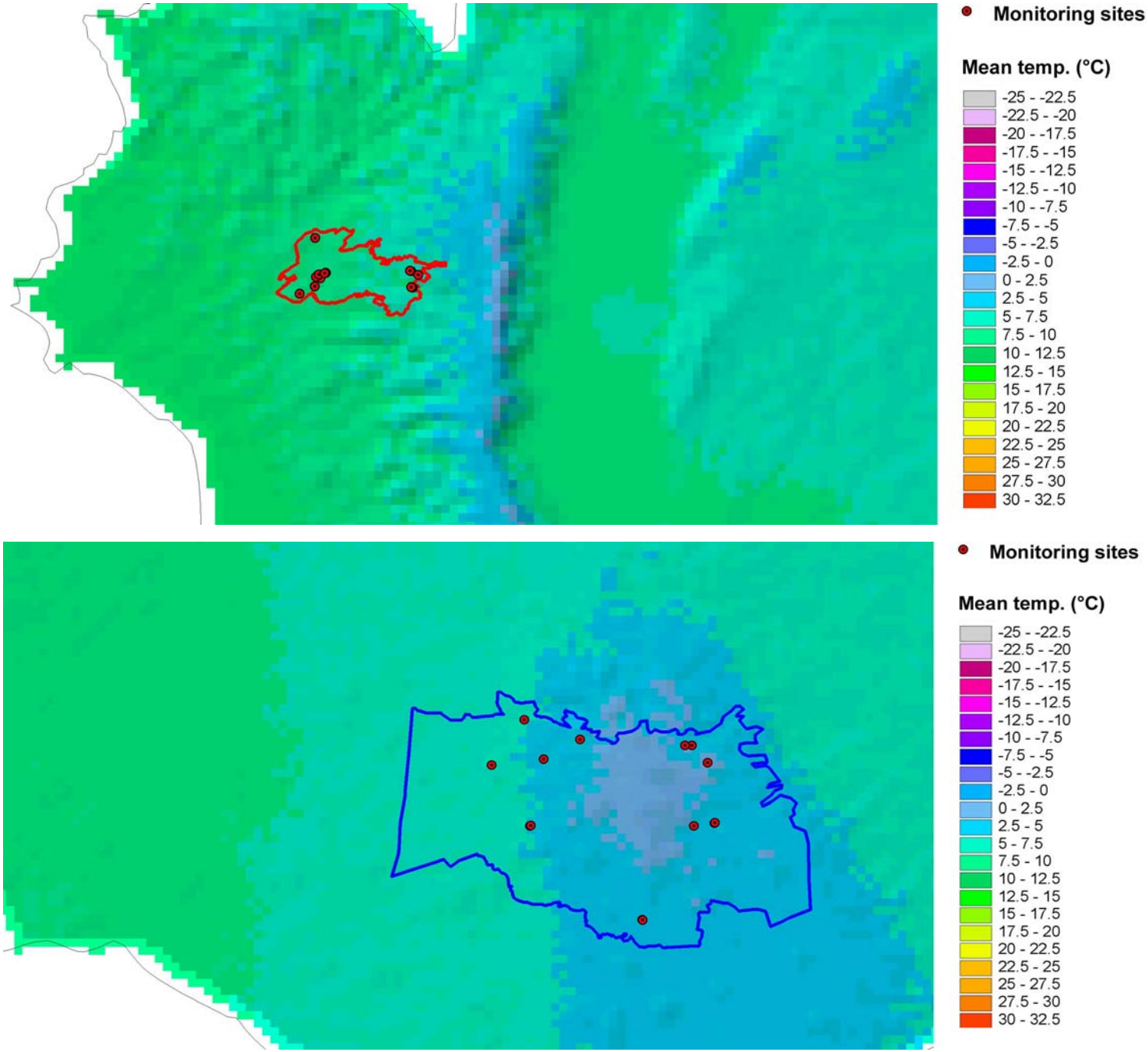


Figure 14. Hafe study area and surroundings: Mean temperature coldest month

Figure 15. Sweida study area and surroundings: Mean temperature coldest month

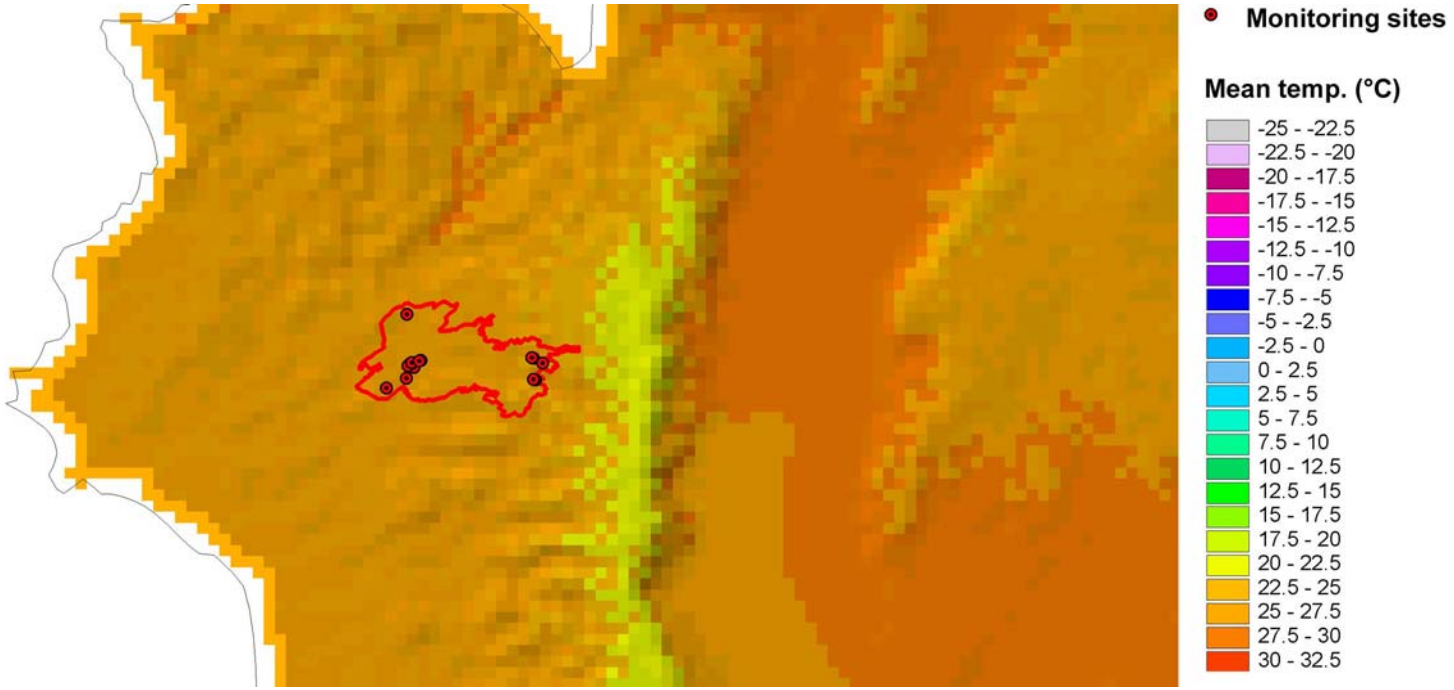


Figure 16. Hafe study area and surroundings: Mean temperature warmest month

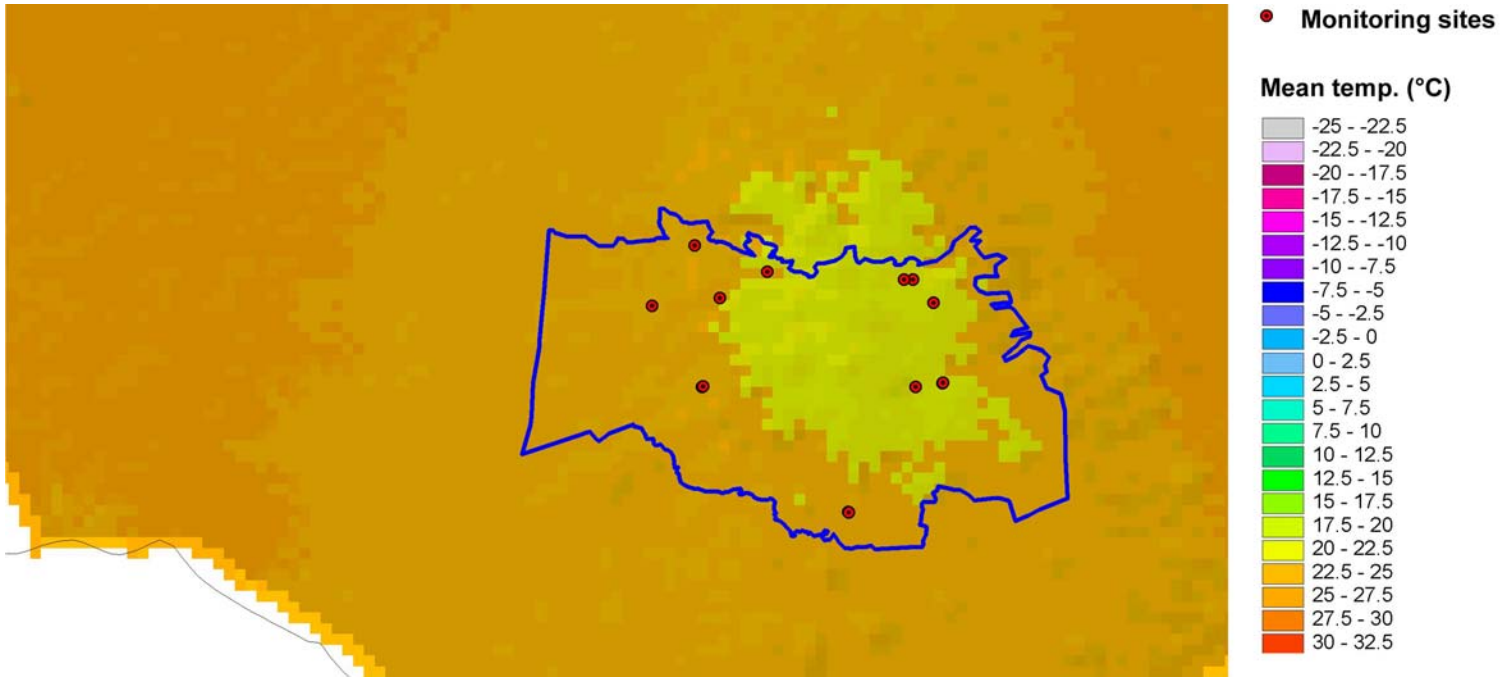
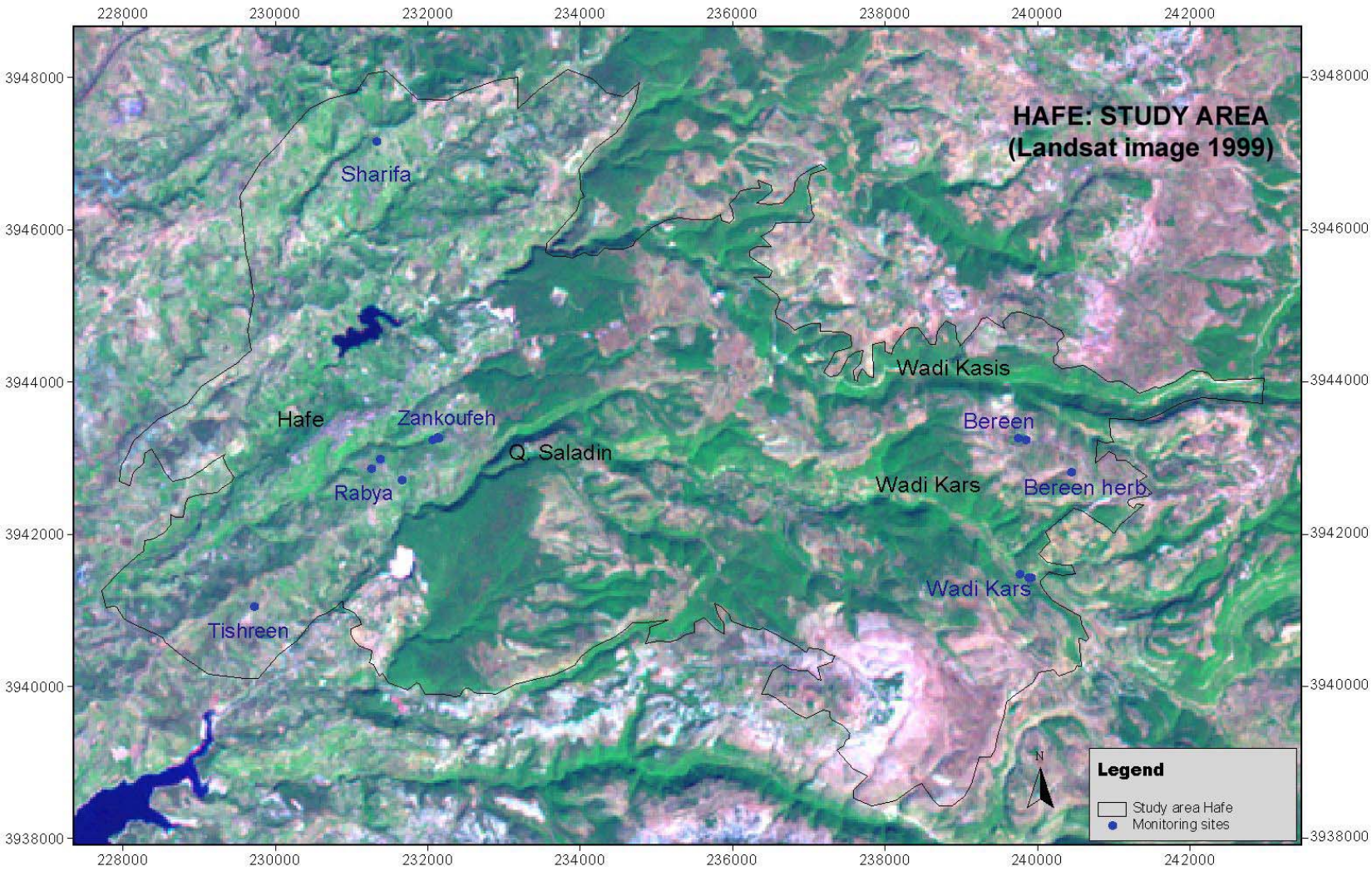
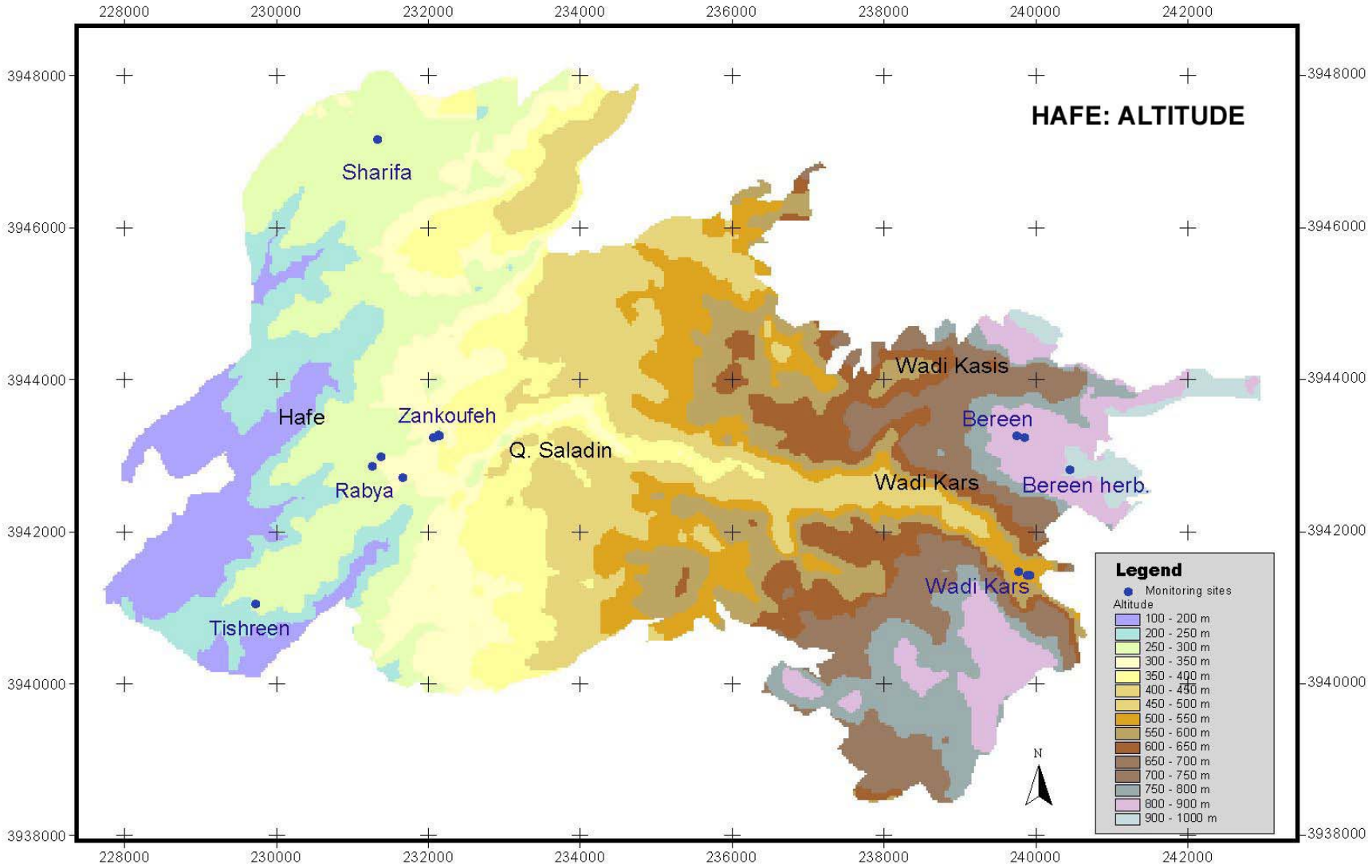


Figure 17. Sweida study area and surroundings: Mean temperature warmest month

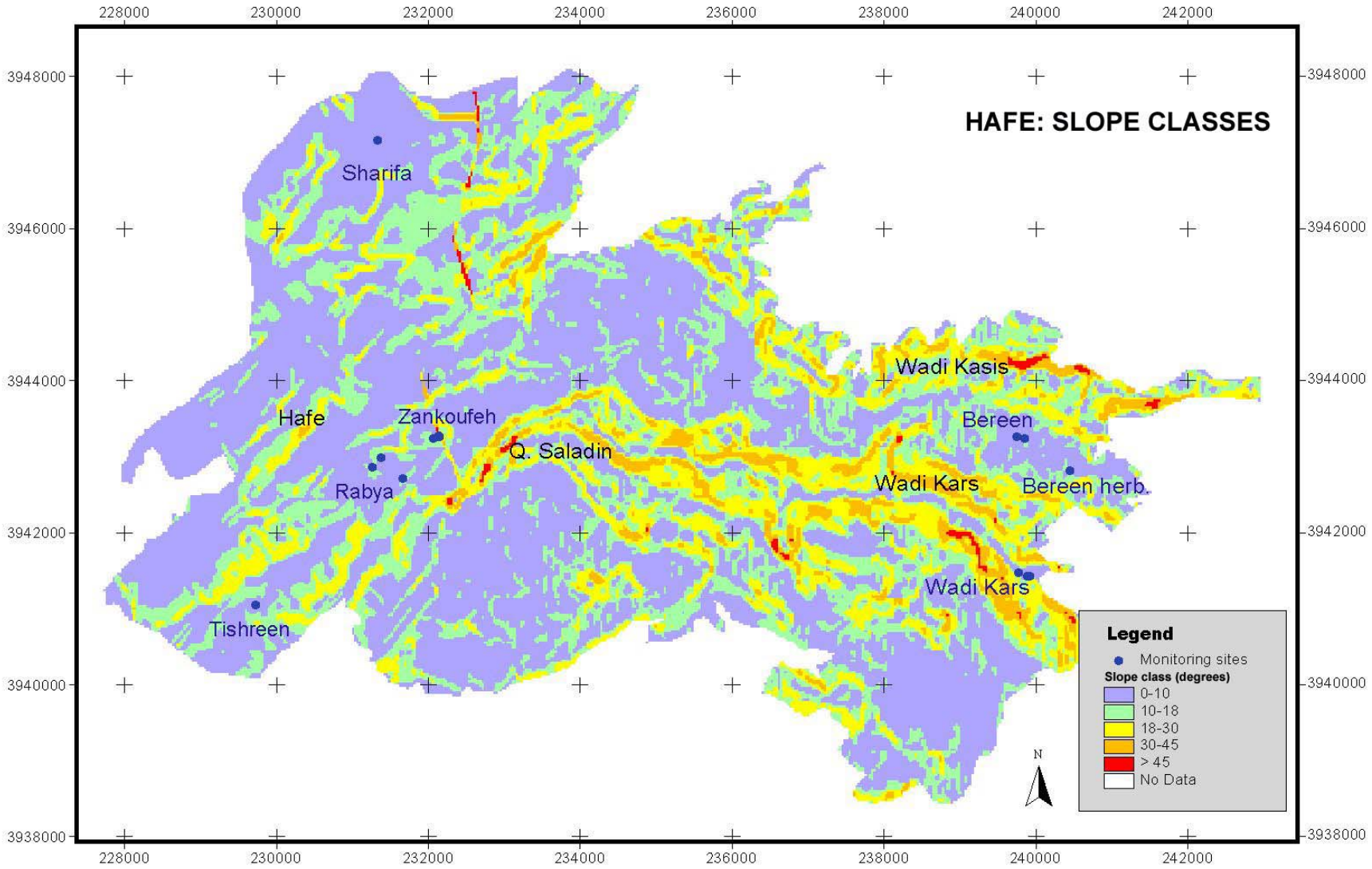
HAFE MAP 1. OVERVIEW OF THE STUDY AREA 1999



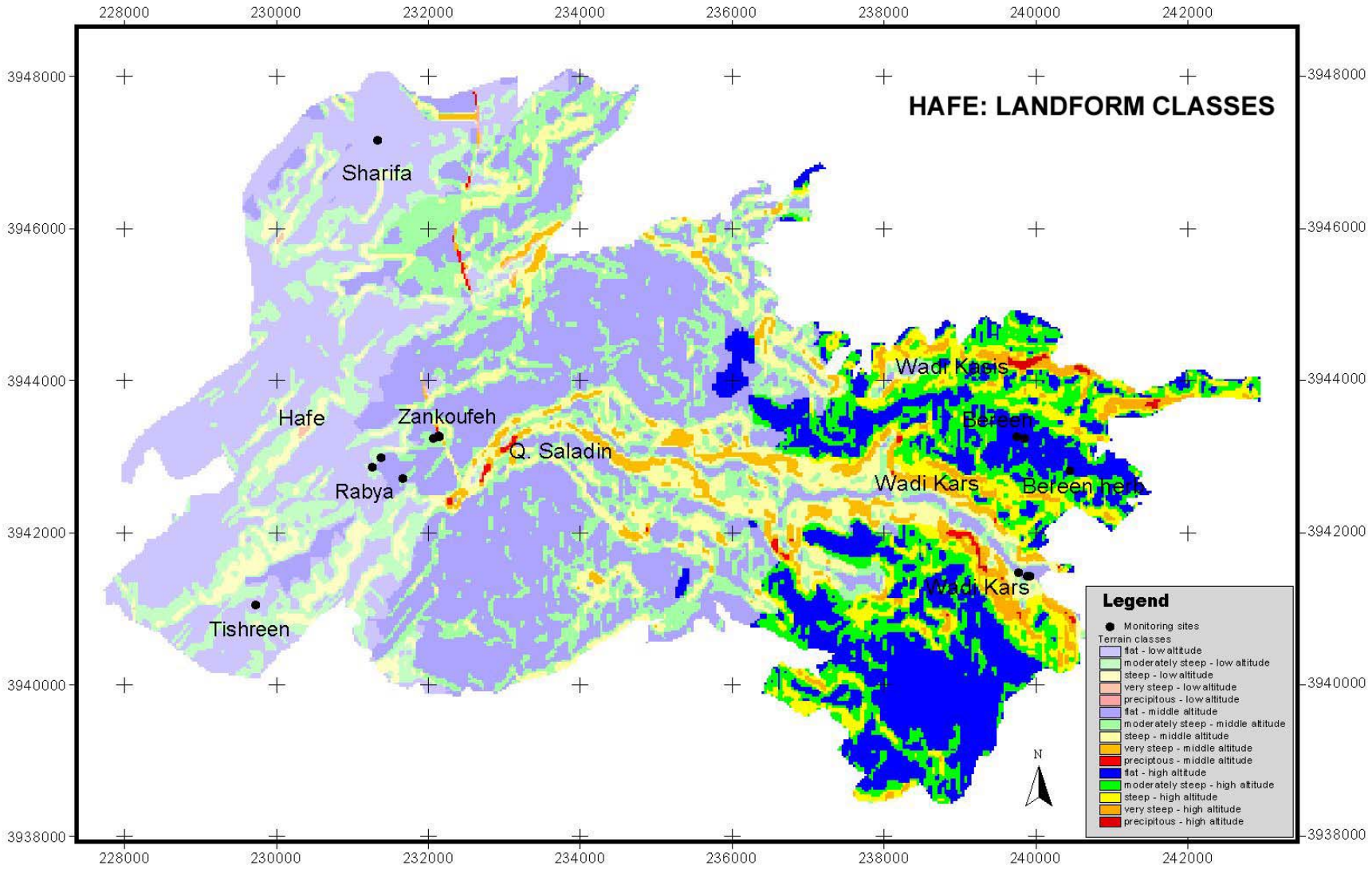
HAFE MAP 2. ALTITUDE



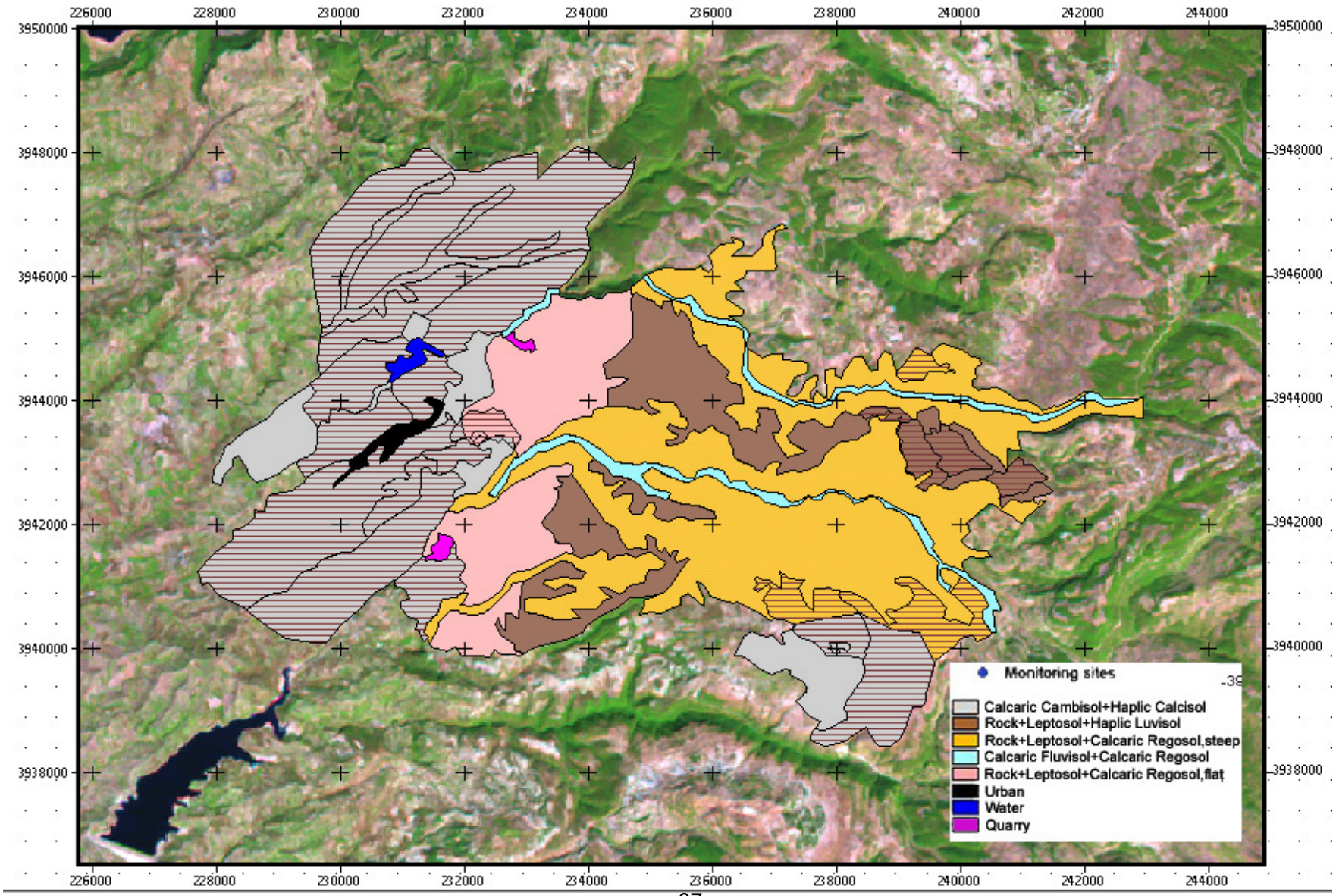
HAFE MAP 3. SLOPES



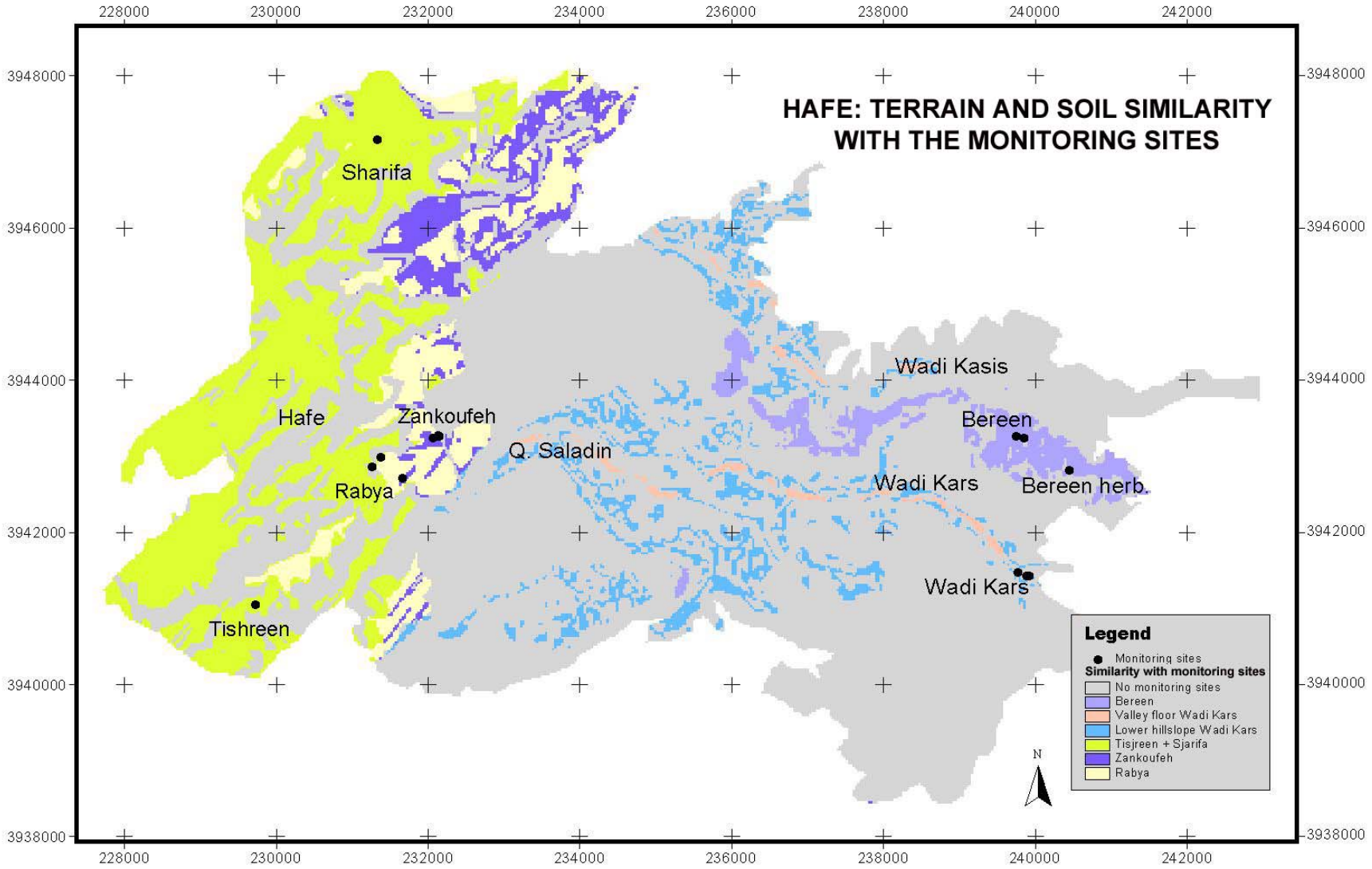
HAFE MAP 4. LANDFORMS



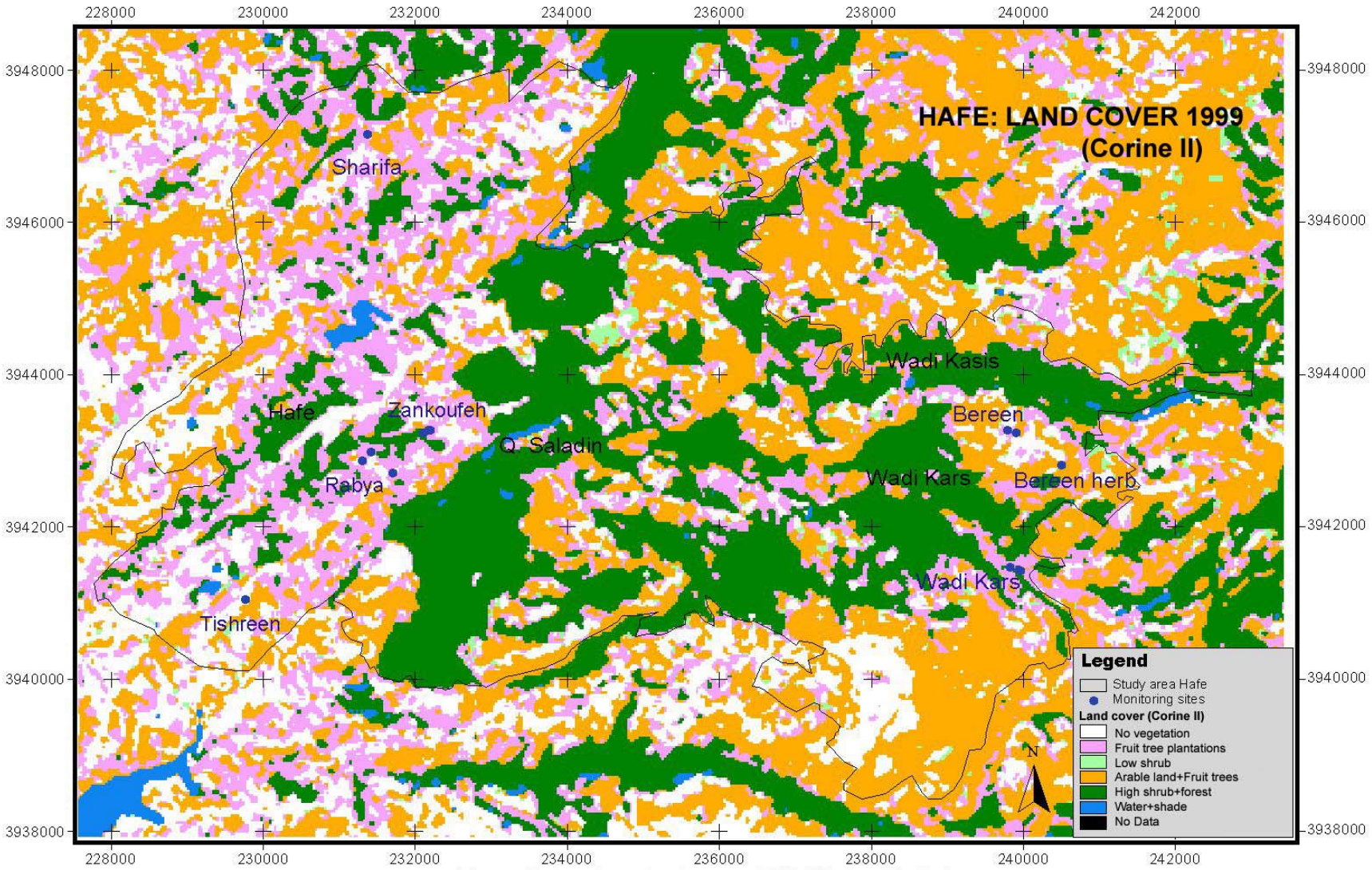
HAFE MAP 5. SOILS



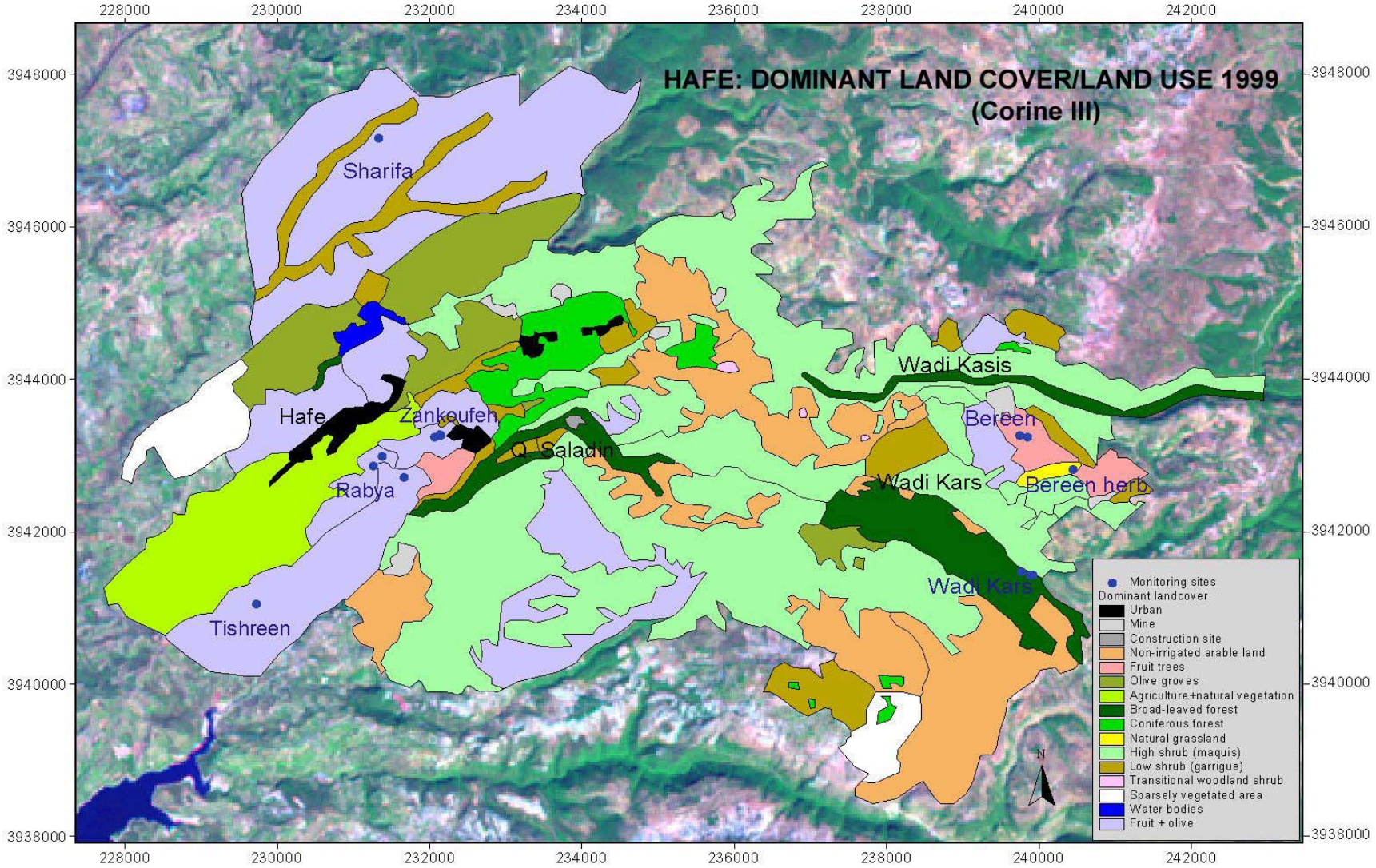
HAFE MAP 6. SIMILARITY IN EDAPHIC CONDITIONS WITH THE MONITORING SITES



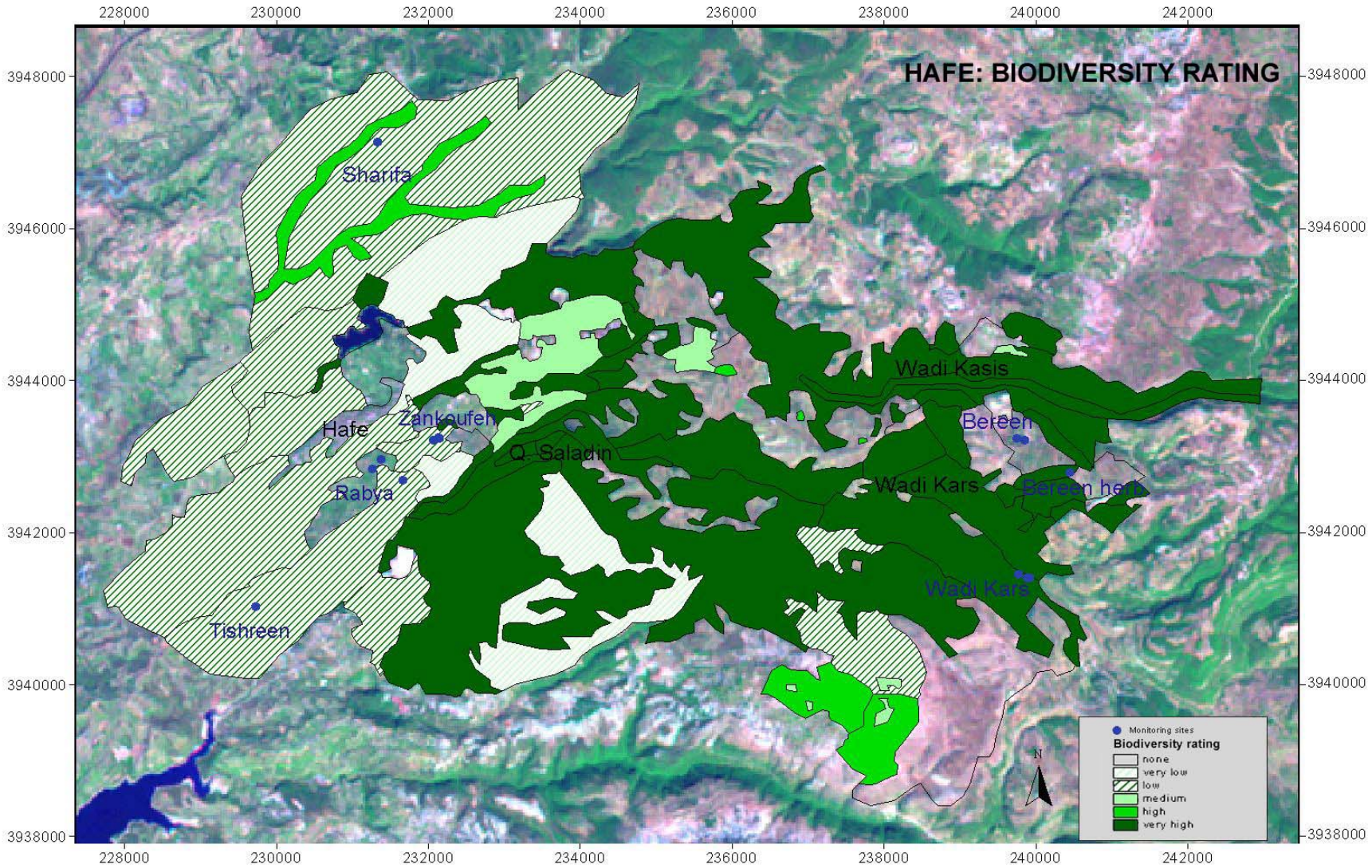
HAFE MAP 7. LAND COVER 1999 (CORINE 2)



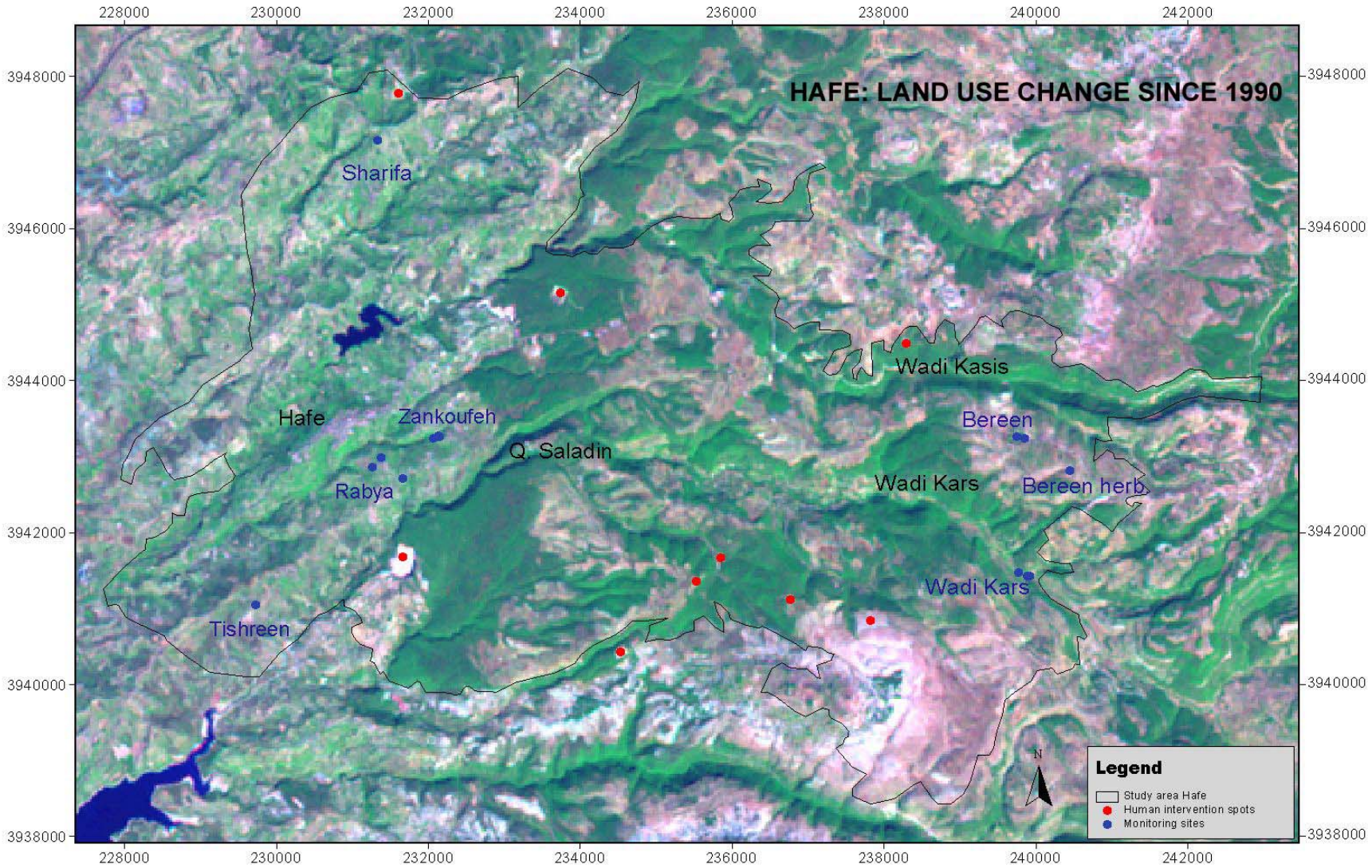
HAFE MAP 8. DOMINANT LAND USE/LAND COVER (CORINE 3)



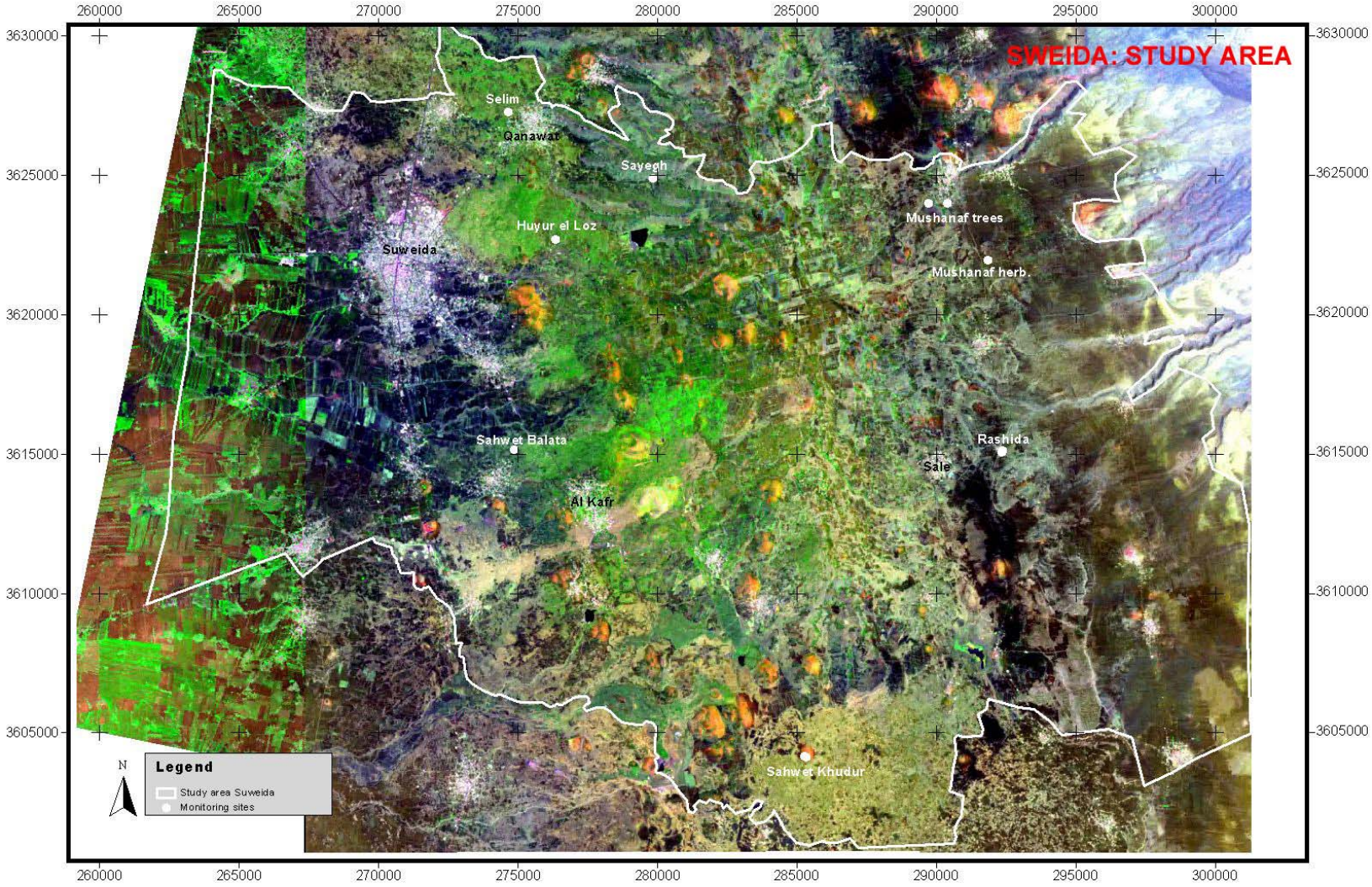
HAFE MAP 9. BIODIVERSITY RATING



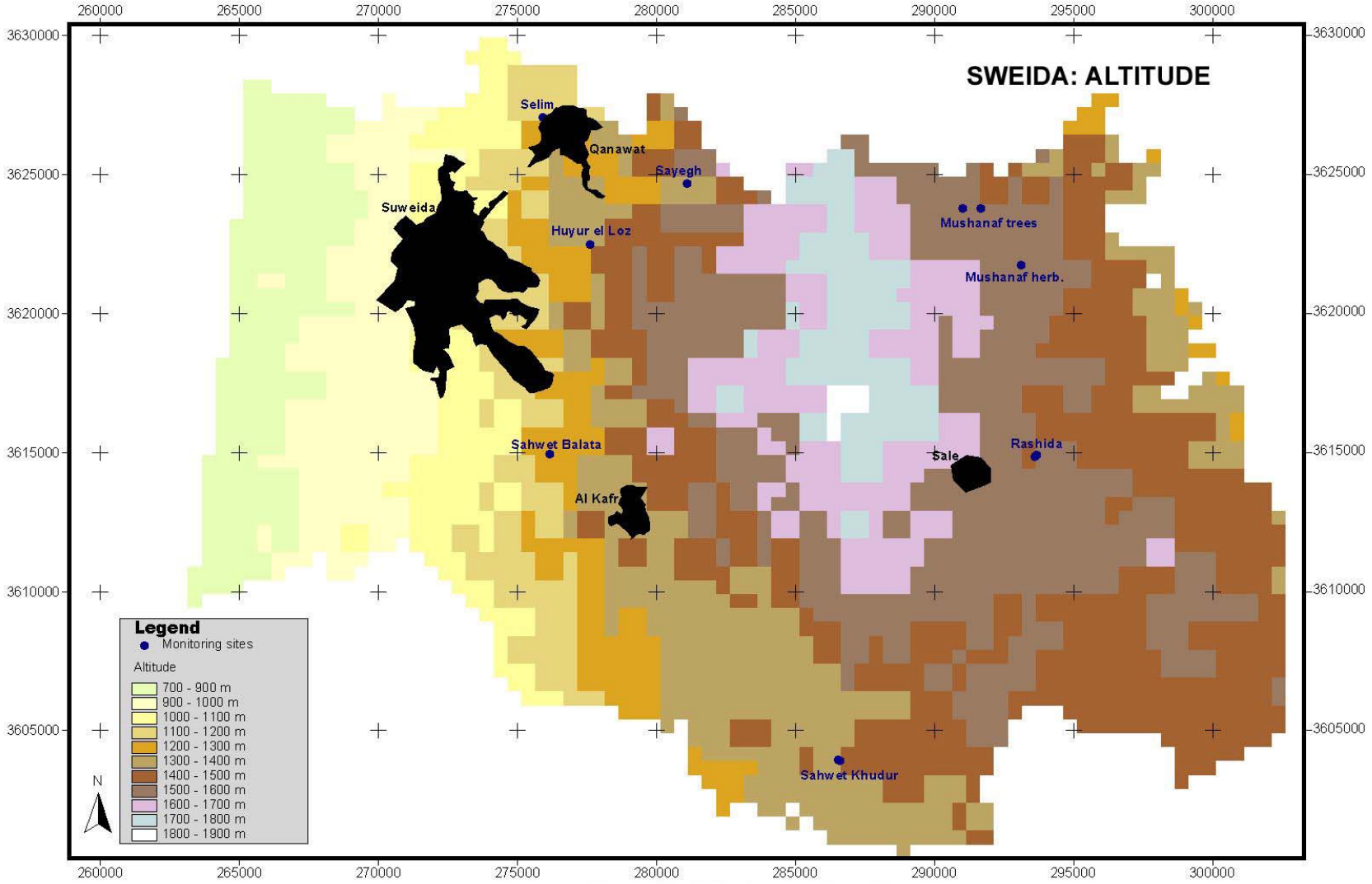
HAFE MAP 10. LAND USE CHANGES SINCE 1990



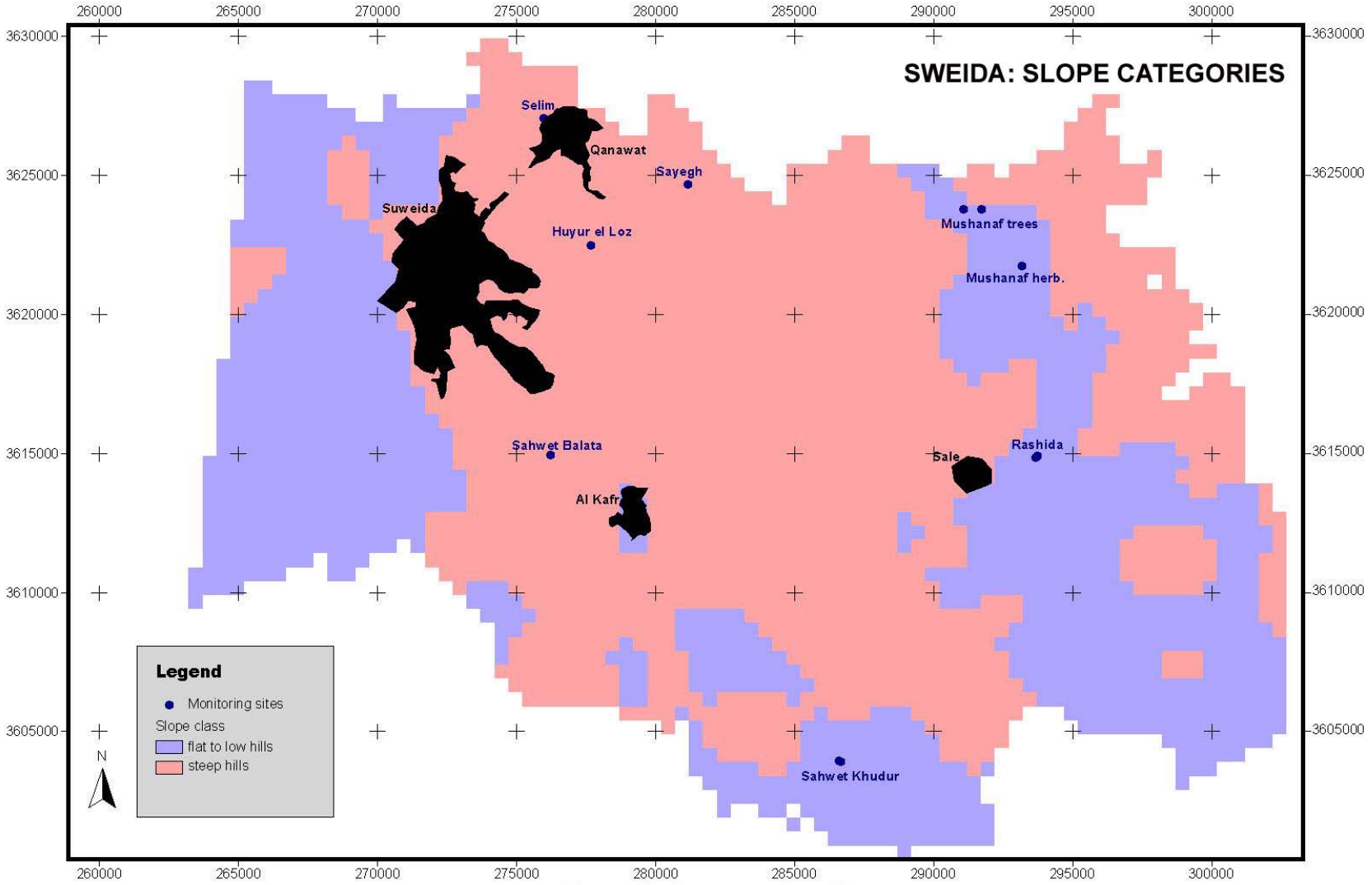
SWEIDA MAP 1. OVERVIEW OF THE STUDY AREA 2000



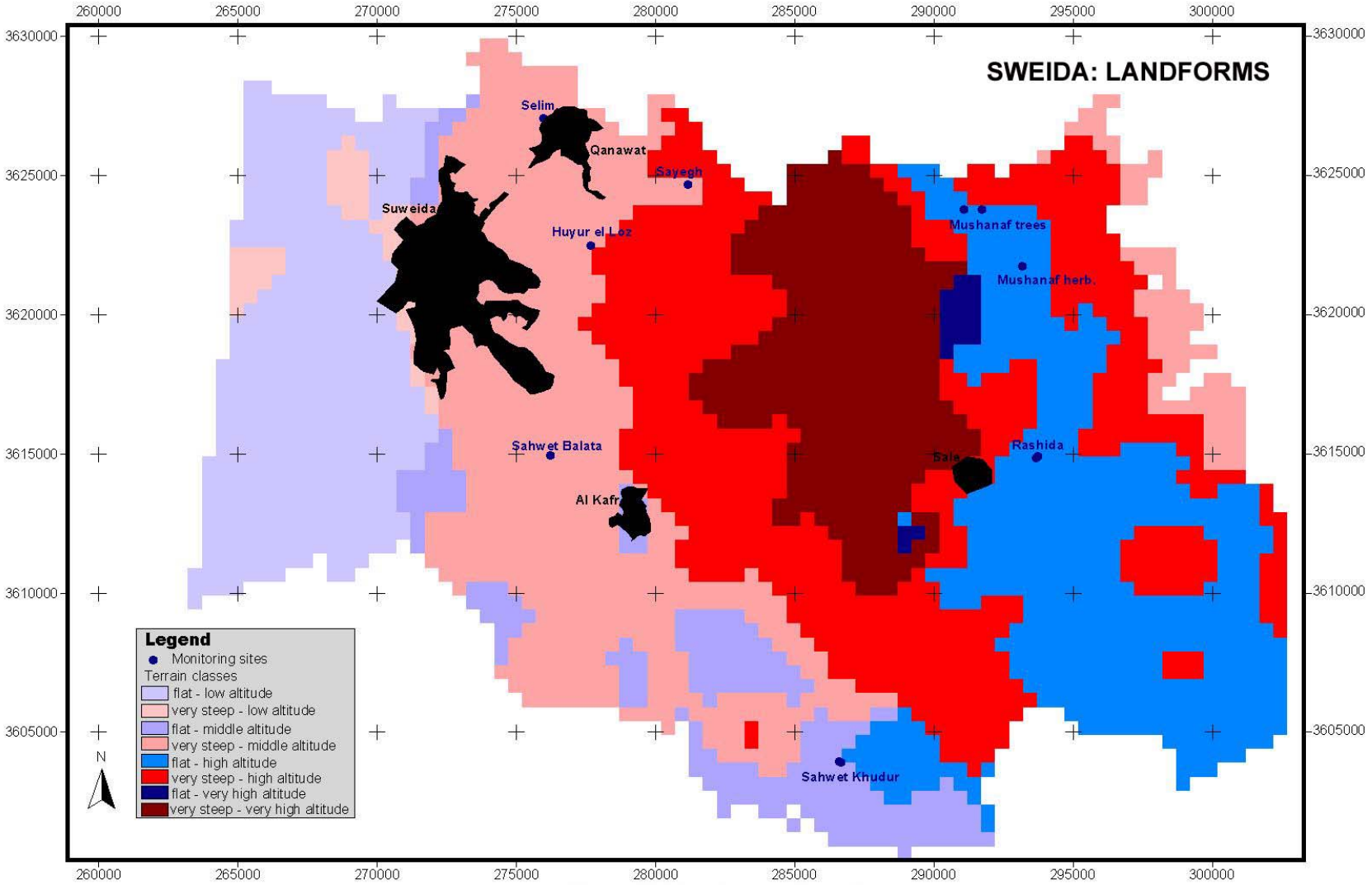
SWEIDA MAP 2. ALTITUDE



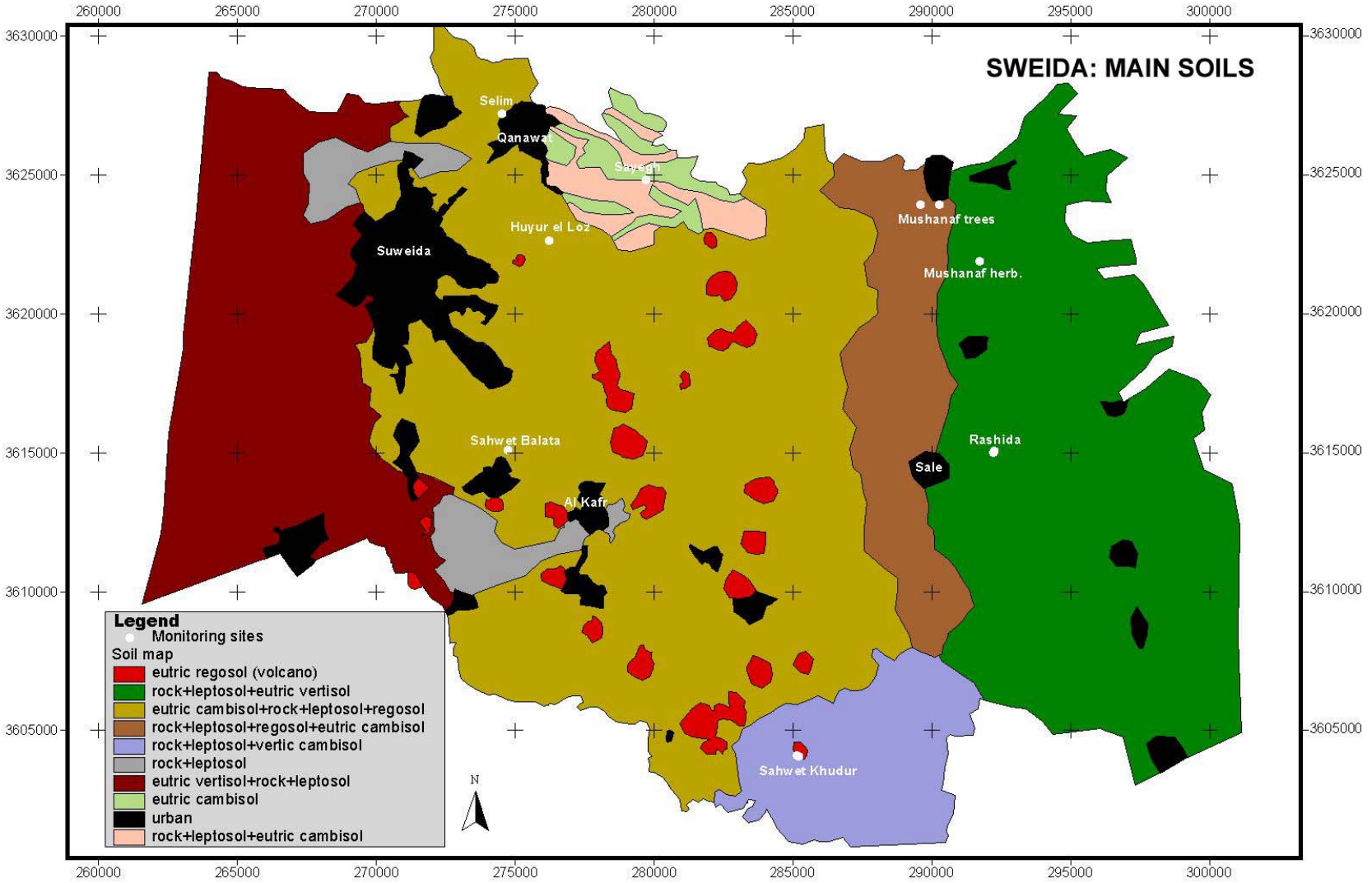
SWEIDA MAP 3. SLOPES



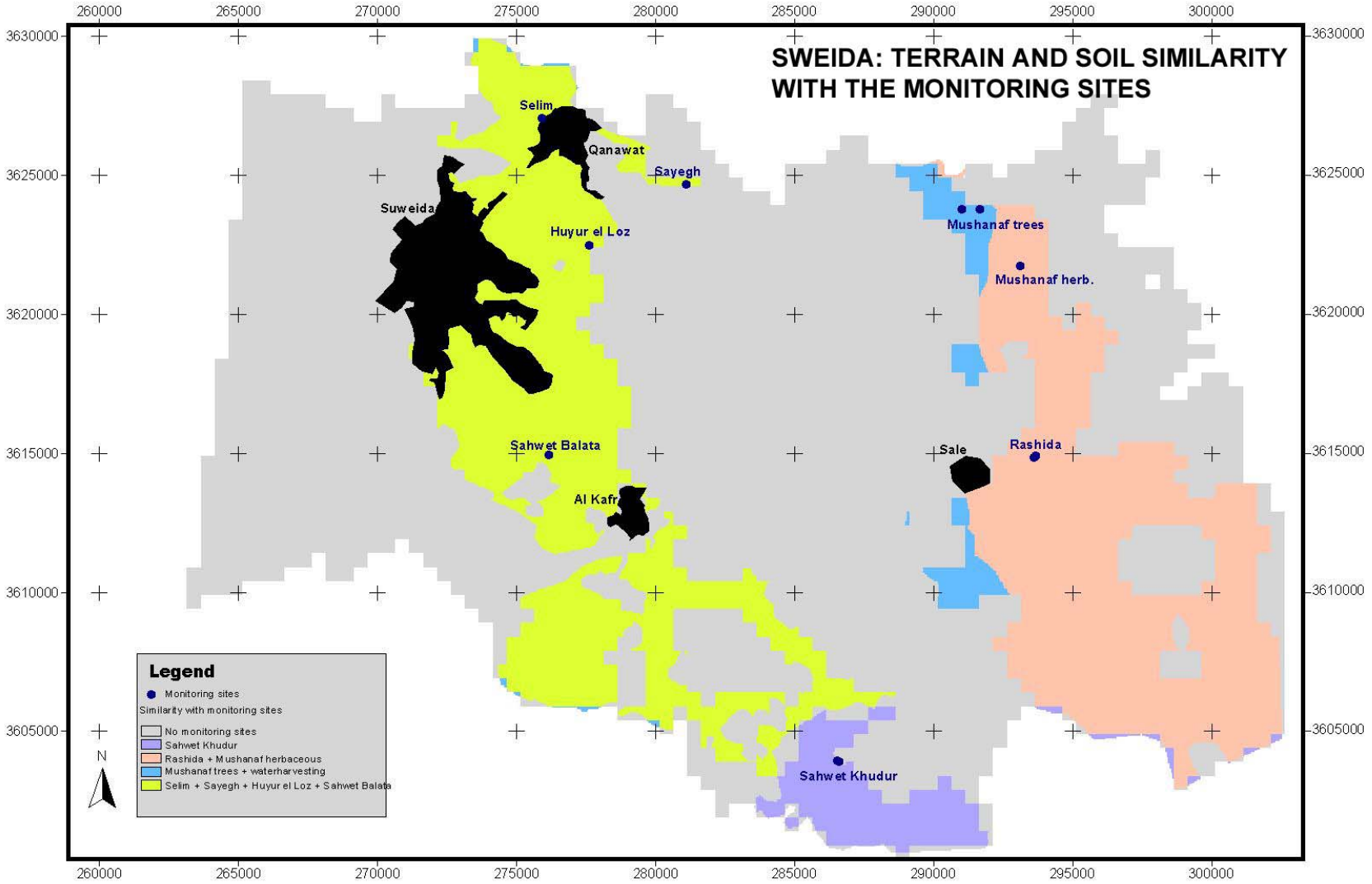
SWEIDA MAP 4. LANDFORMS



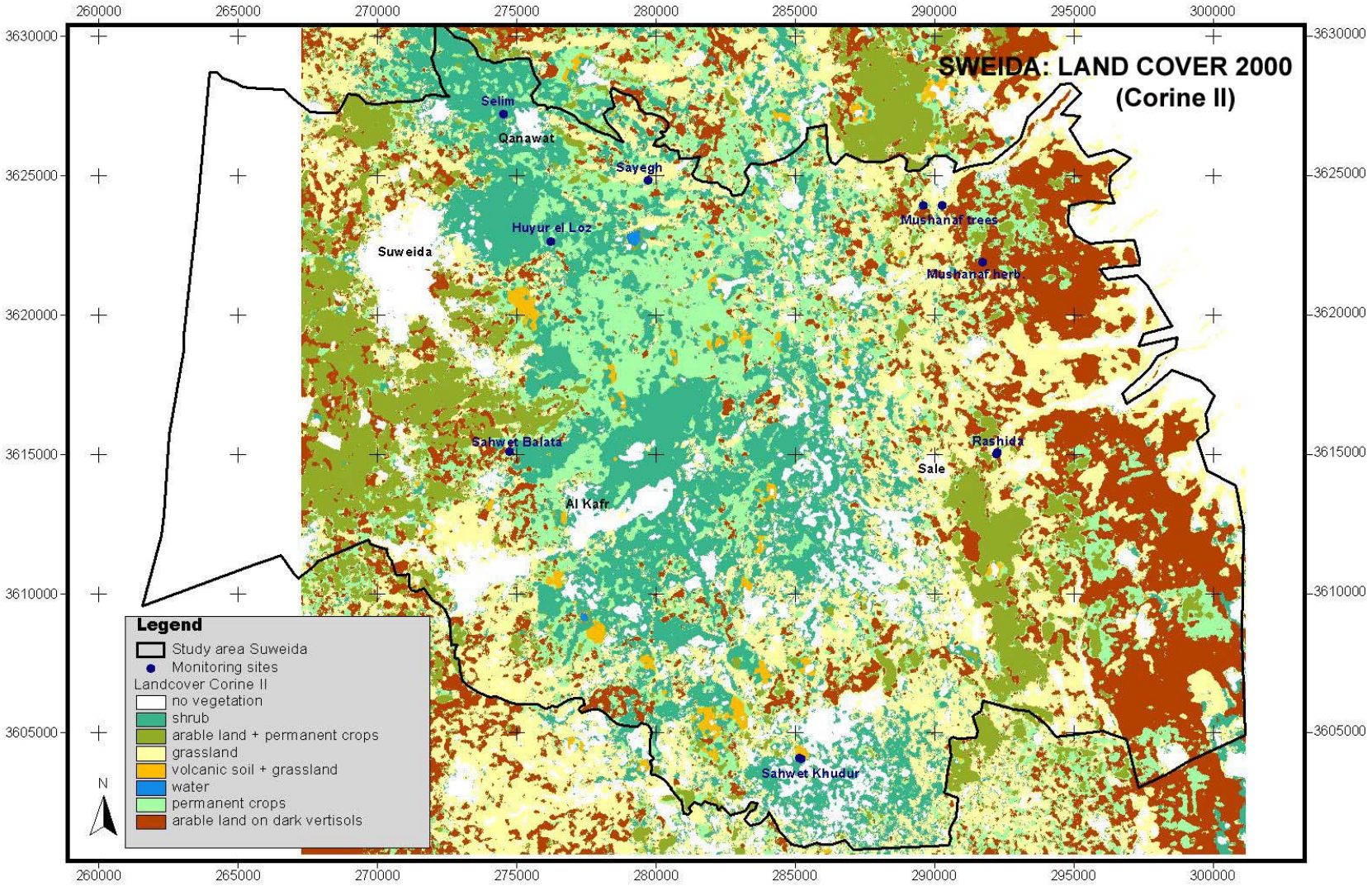
SWEIDA MAP 5. SOILS



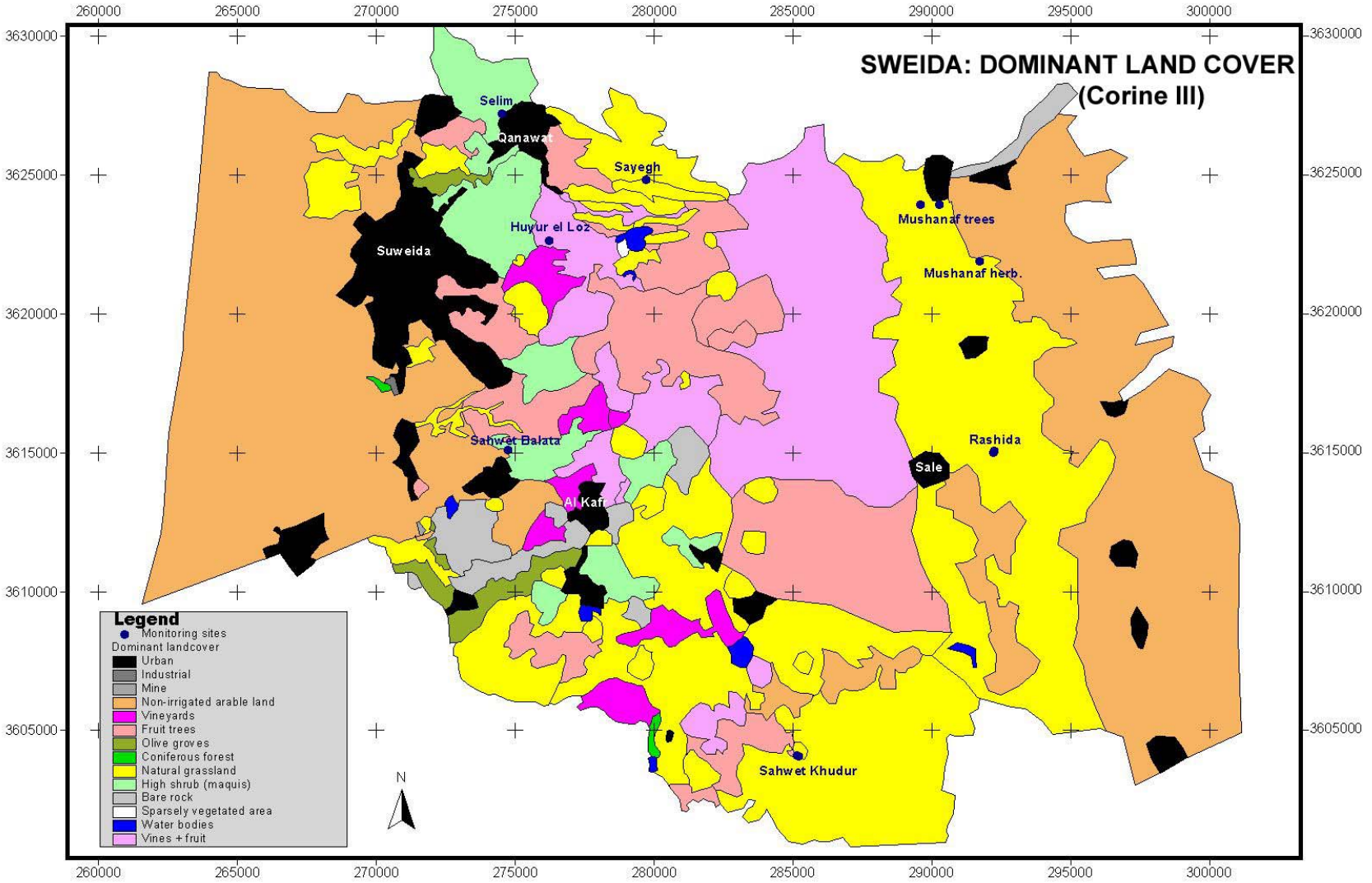
SWEIDA MAP 6. SIMILARITY IN EDAPHIC CONDITIONS WITH THE MONITORING SITES



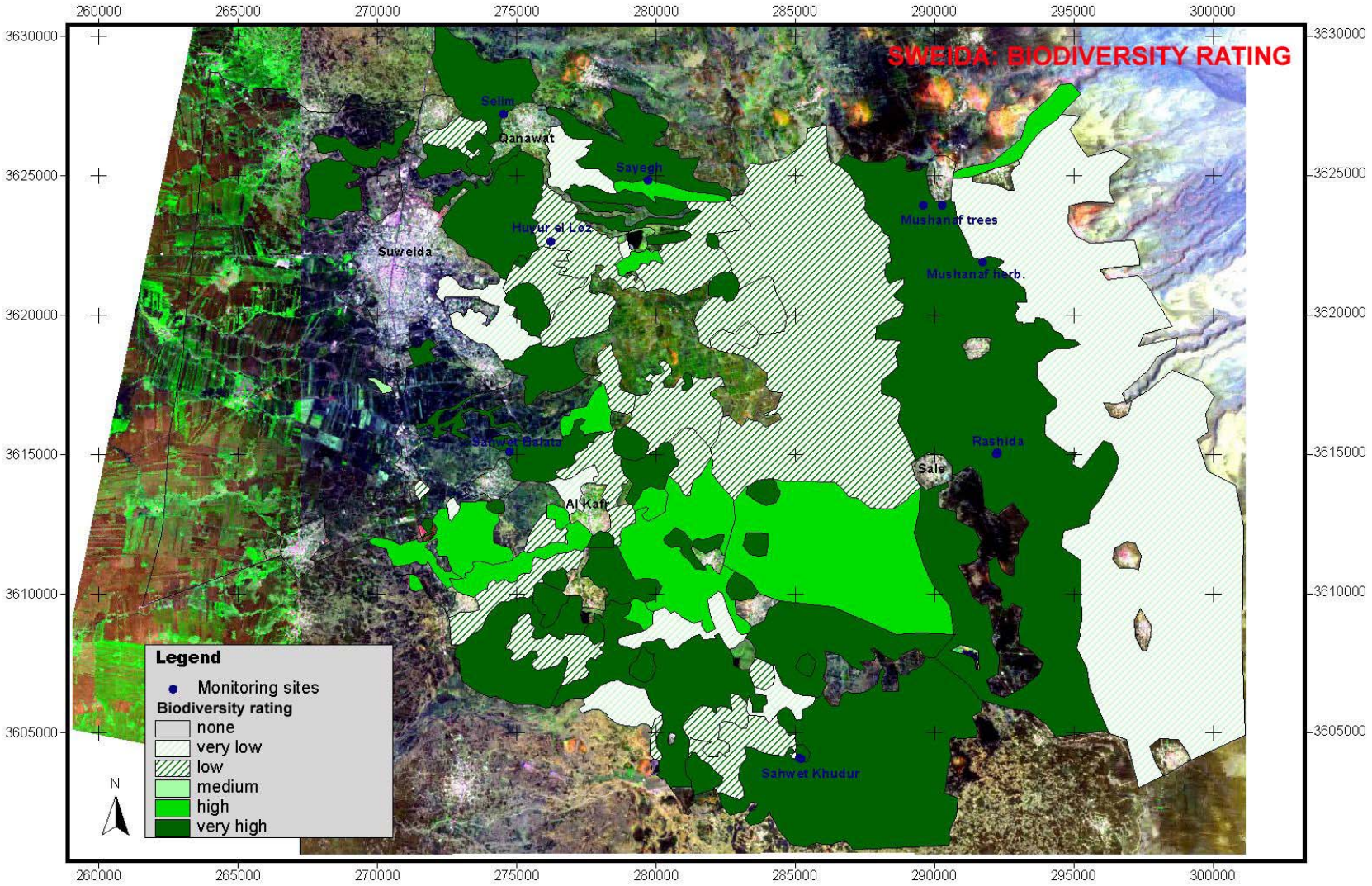
SWEIDA MAP 7. LAND COVER 2000 (CORINE 2)



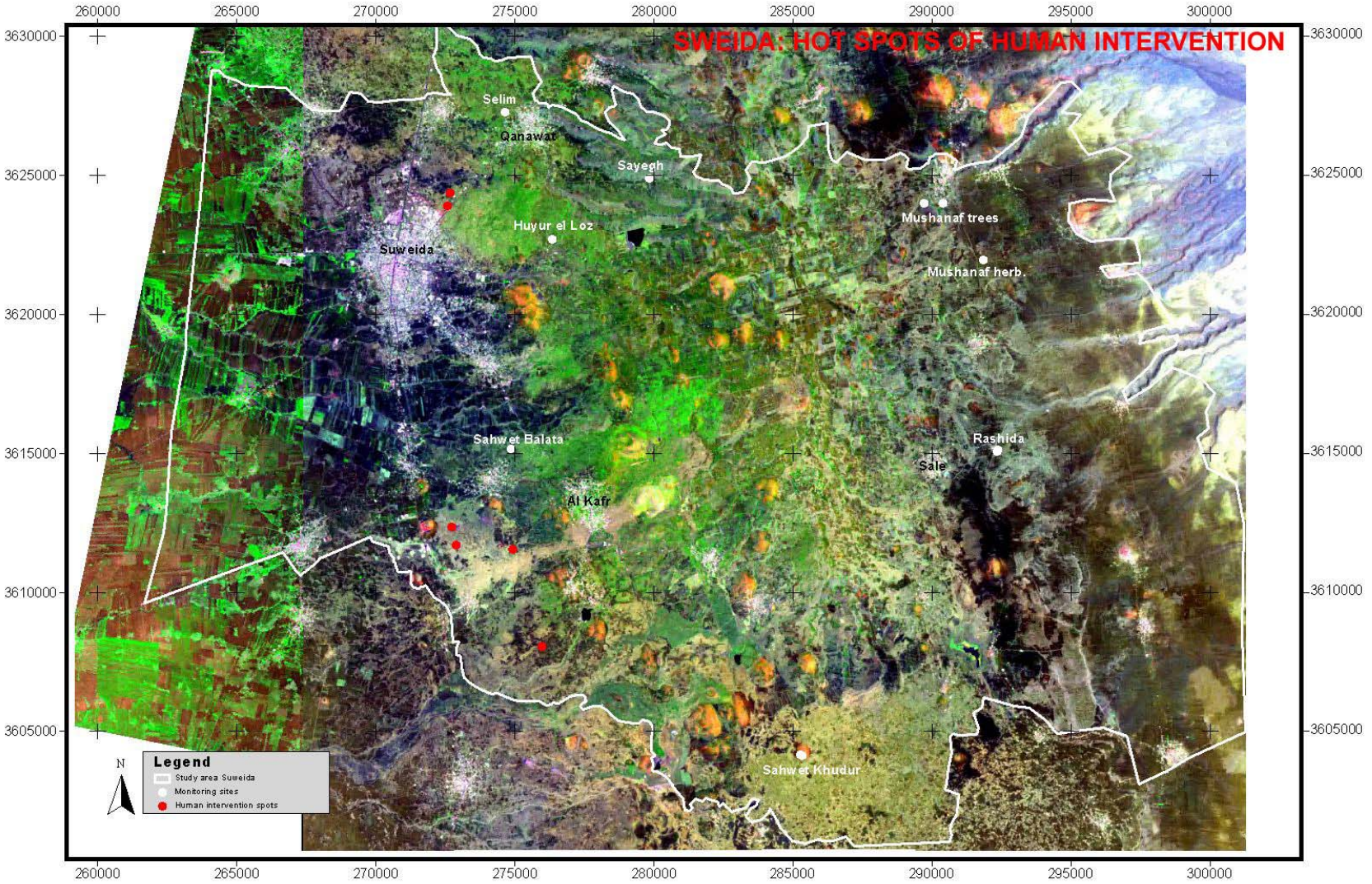
SWEIDA MAP 8. DOMINANT LAND USE/LAND COVER (CORINE 3)



SWEIDA MAP 9. BIODIVERSITY RATING



SWEIDA MAP 10. LAND USE CHANGES SINCE 1990



ANNEX 5. CORINE LAND COVER CLASSIFICATION

Table 13. Corine land cover classification

Level 1	Level 2	Level 3
1. Artificial surfaces	1.1. Urban fabric	1.1.1. Continuous urban fabric
		1.1.2. Discontinuous urban fabric
	1.2. Industrial, commercial and transport units	1.2.1. Industrial or commercial units
		1.2.2. Road and rail networks and associated land
		1.2.3. Port areas
		1.2.4. Airports
	1.3. Mine, dump and construction sites	1.3.1. Mineral extraction sites
		1.3.2. Dump sites
		1.3.3. Construction sites
	1.4. Artificial non-agricultural vegetated areas	1.4.1. Green urban areas
		1.4.2. Sport and leisure facilities
2. Agricultural areas	2.1.Arable land	2.1.1. Non-irrigated arable land
		2.1.2. Permanently irrigated land
		2.1.3. Rice fields
	2.2. Permanent crops	2.2.1. Vineyards
		2.2.2. Fruit trees and berry plantations
		2.2.3. Olive groves
	2.3. Pastures	2.3.1. Pastures
	2.4. Heterogeneous agricultural areas	2.4.1. Annual crops associated with permanent crops
		2.4.2. Complex cultivation patterns
		2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation
		2.4.4. Agro-forestry areas
3. Forests and semi-natural areas	3.1. Forests	3.1.1. Broad-leaved forest
		3.1.2. Coniferous forest
		3.1.3. Mixed forest
	3.2. Shrub and/or herbaceous vegetation association	3.2.1. Natural grassland
		3.2.2. Moors and heathland
		3.2.3. Sclerophyllous vegetation

		3.2.4. Transitional woodland shrub
	3.3. Open spaces with little or no vegetation	3.3.1. Beaches, dunes, and sand plains
		3.3.2. Bare rock
		3.3.3. Sparsely vegetated areas
		3.3.4. Burnt areas
		3.3.5. Glaciers and perpetual snow
4. Wetlands	4.1. Inland wetlands	4.1.1. Inland marshes
		4.1.2. Peatbogs
	4.2. Coastal wetlands	4.2.1. Salt marshes
		4.2.2. Salines
		4.2.3. Intertidal flats
5. Water bodies	5.1 Inland waters	5.1.1 Water courses
		5.1.2 Water bodies
	5.2 Marine waters	5.2.1 Coastal lagoons
		5.2.2 Estuaries
		5.2.3 Sea and ocean

Nomenclature definitions[11]

1. Artificial surfaces

1.1. Urban fabric

1. 1. 1. Continuous urban fabric

Most of the land is covered by buildings, roads and artificially surfaced area cover almost all the ground. Non-linear areas of vegetation and bare soil are exceptional.

1.1.2. Discontinuous urban fabric

Most of the land is covered by structures. Buildings, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces.

1.2. Industrial, commercial and transport

1.2.1. Industrial or commercial units

Artificially surfaced areas (with concrete, asphalt, tamacadam, or stabilised, e.g. beaten earth) devoid of vegetation, occupy most of the area in question, which also contains buildings and/or vegetated areas.

1.2.2. Road and rail networks and associated land

Motorways, railways, including associated installations (stations, platforms, embankments). Minimum width to include: I 00 m.

1.2.3. Port areas

Infrastructure of port areas, including quays, dockyards and marinas.

1.2.4. Airports

Airport installations: runways, buildings and associated land.

1.3. Mine, dump and construction sites

[11] Source: European Environmental Agency. Web site: http://reports.eea.eu.int/COR0-part2/en/tab_abstract_RLR

1.3.1. Mineral extraction sites

Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (opencast mines). Includes flooded gravel pits, except for river-bed extraction.

1.3.2. Dump sites

Landfill or mine dump sites, industrial or public.

1.3.3. Construction sites

Spaces under construction development, soil or bedrock excavations, earthworks.

1.4. Artificial, non-agricultural vegetated areas

1.4.1. Green urban areas

Areas with vegetation within urban fabric. Includes parks and cemeteries with vegetation.

1.4.2. Sport and leisure facilities

Camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones.

2. Agricultural areas

2.1. Arable land

Cultivated areas regularly ploughed and generally under a rotation system.

2.1.1. Non-irrigated arable land

Cereals, legumes, fodder crops, root crops and fallow land. Includes flower and tree (nurseries) cultivation and vegetables, whether open field, under plastic or glass (includes market gardening). Includes aromatic, medicinal and culinary plants. Excludes permanent pastures.

2.1.2. Permanently irrigated land

Crops irrigated permanently and periodically, using a permanent infrastructure (irrigation channels, drainage network). Most of these crops could not be cultivated without an artificial water supply. Does not include sporadically irrigated land.

2.1.3. Rice fields

Land developed for rice cultivation. Flat surfaces with irrigation channels. Surfaces regularly flooded.

2.2. Permanent crops

Crops not under a rotation system which provide repeated harvests and occupy the land for a long period before it is ploughed and replanted: mainly plantations of woody crops. Excludes pastures, grazing lands and forests.

2.2.1. Vineyards

Areas planted with vines.

2.2.2. Fruit trees and berry plantations

Parcels planted with fruit trees or shrubs: single or mixed fruit species, fruit trees associated with permanently grassed surfaces. Includes chestnut and walnut groves.

2.2.3. Olive groves

Areas planted with olive trees, including mixed occurrence of olive trees and vines on the same parcel.

2.3. Pastures

2.3.1. Pastures

Dense, predominantly graminoid grass cover, of floral composition, not under a rotation system. Mainly used for grazing, but the fodder may be harvested mechanically. Includes areas with hedges (bocage).

2.4. Heterogeneous agricultural areas

2.4.1. Annual crops associated with permanent crops

Non-permanent crops (arable lands or pasture) associated with permanent crops on the same parcel.

2.4.2. Complex cultivation

Juxtaposition of small parcels of diverse annual crops, pasture and/or permanent crops.

2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation

Areas principally occupied by agriculture, interspersed with significant natural areas.

2.4.4. Agro-forestry areas

Annual crops or grazing land under the wooded cover of forestry species.

3. Forests and semi-natural areas

3.1. Forests

3.1.1. Broad-leaved forest

Vegetation formation composed principally of trees, including shrub and bush understories, where broad-leaved species predominate.

3.1.2. Coniferous forest

Vegetation formation composed principally of trees, including shrub and bush understories, where coniferous species predominate.

3.1.3. Mixed forest

Vegetation formation composed principally of trees, including shrub and bush understories, where broad-leaved and coniferous species co~dominate.

3.2. Shrub and/or herbaceous vegetation associations

3.2.1. Natural grassland

Low productivity grassland. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briars, and heathland.

3.2.2. Moors and heathland

Vegetation with low and closed cover, dominated by bushes, shrubs and herbaceous plants (heath, briars, broom, gorse, laburnum, etc.).

3.2.3. Sclerophyllous vegetation

Bushy sclerophyllous vegetation. Includes maquis and garrige.

Maquis: a dense vegetation association composed of numerous shrubs associated with siliceous soils in the Mediterranean environment.

Garrigue: discontinuous bushy associations of Mediterranean calcareous plateaus. Generally composed of kermes oak, arbutus, lavender, thyme, cistus, etc. May include a few isolated trees.

3.2.4. Transitional woodland/shrub

Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/colonisation.

3.3. Open spaces with little or no vegetation

3.3.1. Beaches, dunes, and sand plains

Beaches, dunes and expanses of sand or pebbles in coastal or continental , including beds of stream channels with torrential regime.

3.3.2. Bare rock

Scree, cliffs, rocks and outcrops.

3.3.3. Sparsely vegetated areas

Includes steppes, tundra and badlands. Scattered high-attitude vegetation.

3.3.4. Burnt areas

Areas affected by recent fires, still mainly black.

3.3.5.Glaciers and perpetual snow

Land covered by glaciers or permanent snowfields.

4. Wetlands

4.1. Inland wetlands

Non-forested areas either partially, seasonally or permanently waterlogged. The water may be stagnant or circulating.

4.1. 1. Inland marshes

Low-lying land usually flooded in winter, and more or less saturated by water all year round.

4.1.2. Peatbogs

Peatland consisting mainly of decomposed moss and vegetable matter. May or may not be exploited.

4.2. Coastal wetlands

Non-wooded areas either tidally, seasonally or permanently waterlogged with brackish or saline water.

4.2.1. Salt marshes

Vegetated low-lying areas, above the high-tide line, susceptible to flooding by sea water. Often in the process of filling in, gradually being colonised by halophilic plants.

4.2.2. Salines

Salt-pans, active or in process of . Sections of salt marsh exploited for the production of salt by evaporation. They are clearly distinguishable from the rest of the marsh by their segmentation and embankment systems.

4.2.3. Intertidal flats

Generally unvegetated expanses of mud, sand or rock lying between high and low water-marks. On contour on maps.

5. Water bodies

5.1. Inland waters

5.1. 1. Water courses

Natural or artificial water-courses serving as water drainage channels. Includes canals. Minimum width to include: 100 m.

5.1.2. Water bodies

Natural or artificial stretches of water.

5.2. Marine waters

5.2.1. Coastal lagoons

Unvegetated stretches of salt or brackish waters separated from the sea by a tongue of land or other similar topography. These water bodies can be connected with the sea at limited points, either permanently or for parts of the year only.

5.2.2. Estuaries

The mouth of a river within which the tide ebbs and flows.

5.2.3. Sea and ocean

Zone seaward of the lowest tide limit.

ANNEX 6. LAND COVER DATABASE

This annex links the polygons of the Land cover/land use maps (Corine III) to an attribute database. This attribute database contains the composition of *land cover/use associations*. Each association may be composed of up to three land cover/use units (Corine III), for which the percentage proportions inside the association are given. For all associations a biological rating and area (in ha) are provided. For some associations prominent small landscape elements are specified.
The codes for the small landscape elements are as follows:
h=hedges, t=terraces, w= wadi, tr= big trees, reclam= land reclamation

HAFE

Table 14. Land cover database for Hafe study area

Polygon ID	Corine Unit 1	%	Corine Unit 2	%	Corine Unit 3	%	Small landscape elements	Biological rating	Area (ha)
1	24	100	0	0	0	0		6	12
2	13	70	14	20	2	10		2	7
3	36	70	18	30	0	0	h	2	2
4	21	100	0	0	0	0		4	12
5	25	60	27	40	0	0		6	88
7	25	100	0	0	0	0		6	8
8	24	100	0	0	0	0		6	6
9	21	100	0	0	0	0		4	3
10	10	50	14	40	2	10		1	42
11	14	70	13	20	2	10		2	130
12	6	100	0	0	0	0		1	15
14	25	100	0	0	0	0		6	86
15	10	50	14	30	13	20		1	5
16	24	100	0	0	0	0		6	6
17	6	100	0	0	0	0		1	9
18	36	100	0	0	0	0	h, t	1	12
19	25	100	0	0	0	0		6	3
20	14	60	25	40	0	0		3	3
21	20	100	0	0	0	0		6	36
22	36	100	0	0	0	0	h	1	9
23	28	50	25	50	0	0		3	25
24	18	60	14	20	13	20	h, w, t	3	4
25	24	80	20	20	0	0		6	24
26	20	80	24	20	0	0		6	5
28	26	100	0	0	0	0		5	3
30	25	60	27	40	0	0		6	86
31	1	100	0	0	0	0		1	1
32	7	100	0	0	0	0		1	2
33	1	100	0	0	0	0		1	1

34	1	100	0	0	0	0		1	5
35	1	100	0	0	0	0		1	2
36	26	100	0	0	0	0		5	12
37	24	100	0	0	0	0		6	84
38	24	100	0	0	0	0		6	74
39	24	100	0	0	0	0		6	6
40	6	100	0	0	0	0		1	33
41	24	100	0	0	0	0		6	2
42	6	100	0	0	0	0		1	76
43	24	100	0	0	0	0		6	4
44	24	100	0	0	0	0		6	5
45	26	100	0	0	0	0		5	1
46	24	100	0	0	0	0		6	1
47	10	100	0	0	0	0		1	8
48	10	100	0	0	0	0		1	222
49	25	100	0	0	0	0		6	3
50	24	100	0	0	0	0		6	30
51	36	100	0	0	0	0	w, t	1	52
52	6	100	0	0	0	0		1	15
53	21	100	0	0	0	0		4	12
54	25	100	0	0	0	0		6	44
55	20	100	0	0	0	0		6	18
58	36	100	0	0	0	0	t	1	133
59	24	50	10	50	0	0	t	6	9
60	10	100	0	0	0	0	h	1	4
61	25	80	24	20	0	0		6	21
62	10	100	0	0	0	0		1	75
63	14	60	25	40	0	0		3	10
64	25	50	28	50	0	0		5	4
65	10	40	14	30	25	30	t	3	25
66	21	100	0	0	0	0		4	24
73	25	60	24	40	0	0	w	6	574
74	25	40	27	30	14	30	h, t	6	196
75	36	60	24	30	0	0	h, w, t	3	159
76	6	100	0	0	0	0		1	90
77	10	40	13	30	25	30	h, t	3	23
78	36	80	25	20	0	0	h, t	3	40
79	36	100	0	0	0	0	h, t	1	2
80	34	100	0	0	0	0		1	14
81	25	100	0	0	0	0		6	25
82	36	90	2	10	0	0	t	1	66
83	36	80	25	20	0	0	t	3	5
84	20	100	0	0	0	0	w	6	105
85	14	50	13	40	25	10	t	3	122
86	14	60	13	40	0	0	t	2	29
87	25	60	28	40	0	0		6	33
88	13	80	2	20	0	0	h,t, tr	1	53

89	13	100	0	0	0	0	t	1	143
90	6	100	0	0	0	0		1	149
91	24	100	0	0	0	0		6	416
92	25	100	0	0	0	0		6	49
93	24	80	14	20	0	0		6	32
94	25	60	24	4	0	0		6	35
95	14	100	0	0	0	0		1	14
97	10	50	14	30	13	20		1	581
98	21	100	0	0	0	0		4	227
99	21	100	0	0	0	0		4	125
100	21	100	0	0	0	0		4	329
100	23	70	27	20	13	10	h, w	6	72
101	24	80	25	20	0	0		6	691
102	10	90	27	10	0	0	t	1	129
103	28	60	25	40	0	0		5	148
104	36	80	25	20	0	0	h, t	3	247
105	36	80	25	20	0	0	h, t	3	503
106	25	40	28	40	14	20	h, t, w	5	311
								TOTAL	7396

SWEIDA

Table 15. Land cover database for Sweida study area

Polygon ID	Corine Unit 1	%	Corine Unit 2	%	Corine Unit 3	%	Small landscape elements	Biological rating	Geology	Area (ha)
1	24	50	23	30	27	20		6		140
2	14	60	10	40	0	0	h	1		157
3	24	50	23	30	14	20		6		140
4	23	60	24	20	27	20		6		169
5	24	70	13	20	23	10		6		160
6	13	50	12	20	10	30		2		352
9	23	70	27	20	2	10		6		48
10	10	60	10	40	0	0		1		70
11	21	100	0	0	0	0		4		34
12	3	100	0	0	0	0		1		69
13	23	100	0	0	0	0		6		34
14	6	100	0	0	0	0		1		52
15	23	80	27	20	0	0		6	vulc	12
16	23	60	27	30	3	10	reclam	5		20
17	13	40	23	30	10	30		3	vulc	80
18	10	100	0	0	0	0		1		8
19	14	100	0	0	0	0		1		666
20	27	60	23	40	0	0	reclam	5		20
21	14	80	10	20	0	0		1		88
22	27	60	23	40	0	0		5	vulc	983
23	23	70	13	20	24	10	tr	6	vulc	111
24	10	40	13	40	14	20	h	1		464
25	12	60	13	30	27	10	h	3		198
26	12	50	1	50	0	0		2		12
27	27	80	23	20	0	0		5		325
27	27	50	35	30	23	20		5	vulc	479
29	23	60	27	20	24	20		6		1,041
30	24	70	23	20	27	10		6		374
32	27	80	23	20	0	0	h	3		347
33	12	70	27	30	0	0		2		158
34	24	70	27	20	23	10		6		24
35	13	70	10	30	0	0		1		140
36	24	70	27	20	23	10		6		255
37	13	40	10	30	12	30		2		21
38	23	40	35	40	24	20		6	vulc	64
39	12	50	13	30	27	20	h, t	3		2,256
40	35	60	24	20	27	20	h	3		17
41	23	40	13	40	24	20		5		5
43	23	70	13	20	24	10		6		11

44	23	80	24	10	23	10		6		18
45	28	100	0	0	0	0		2		9
46	23	80	13	10	24	10		6		28
47	23	70	24	10	13	20		6		24
100	1	100	0	0	0	0		1		115
101	23	80	13	10	24	10		6		134
102	35	100	0	0	0	0		1		178
103	23	100	0	0	0	0		6		119
104	13	100	0	0	0	0		1		169
105	13	100	0	0	0	0		1		88
106	34	100	0	0	0	0		1		44
107	13	70	23	30	0	0		3		241
108	23	60	35	40	0	0		6	vulc	97
109	23	60	13	40	0	0		6	vulc	223
110	34	100	0	0	0	0		1		151
111	1	100	0	0	0	0		1		31
112	13	40	10	30	24	30		3		126
113	13	50	12	50	0	0		1		326
114	13	60	23	40	0	0		3	vulc	45
115	13	70	23	30	0	0		3		52
116	13	100	0	0	0	0		1		988
117	1	100	0	0	0	0		1		69
118	23	60	10	20	27	20	reclam	6		395
119	1	100	0	0	0	0		1		77
121	23	60	24	40	0	0		6	vulc	137
122	23	70	24	10	27	20		6		63
123	23	80	27	20	0	0		6		2,908
124	1	100	0	0	0	0		1		83
125	1	100	0	0	0	0		1		63
126	1	100	0	0	0	0		1		79
128	14	80	10	20	0	0		1		105
129	34	100	0	0	0	0		2		393
130	1	100	0	0	0	0		1		61
131	35	60	24	20	27	20	h	3		149
132	12	50	23	50	0	0		5		22
133	35	80	24	10	27	10	h	3		287
134	35	70	23	30	0	0		3	vulc	84
135	23	40	35	40	24	20		6	vulc	1,064
136	24	40	21	30	23	30		6		34
137	23	40	27	40	35	20	h	5	vulc	40
138	27	60	12	30	23	10	h	3		77
139	23	40	35	40	27	20	h, t	5		61
140	1	100	0	0	0	0		1		125
141	34	100	0	0	0	0		1		806
142	24	70	27	20	23	10		6		137
143	23	60	35	40	0	0		6	vulc	10,729
144	23	60	35	40	0	0		6	vulc	8,517

145	14	50	10	30	23	20		3		24
146	23	80	13	10	24	10		6		286
147	13	40	10	40	23	20		3		17
148	23	60	35	20	10	20		6		641
149	23	60	35	40	0	0		6	vulc	6,197
150	35	70	23	20	27	10		3		1,720
151	13	50	23	50	0	0		5		37
152	23	60	35	40	0	0		6	vulc	398
153	23	60	35	40	0	0		6	vulc	189
154	23	60	35	40	0	0		6	vulc	320
155	1	100	0	0	0	0		1		933
156	1	100	0	0	0	0		1		162
158	27	80	23	20	0	0		5		210
159	1	100	0	0	0	0		1		61
162	27	60	23	40	0	0		5		114
163	10	50	23	30	27	20		2		58
170	1	100	0	0	0	0		1		128
171	1	100	0	0	0	0		1		1,328
172	1	100	0	0	0	0		1		372
173	10	100	0	0	0	0		1		70
174	1	100	0	0	0	0		1		77
175	1	100	0	0	0	0		1		180
176	1	100	0	0	0	0		1		1,155
177	34	100	0	0	0	0		1		381
178	35	100	0	0	0	0		1		40
179	23	100	0	0	0	0		6	vulc	257
180	12	100	0	0	0	0		1		123
181	23	50	13	40	27	10	h, t	5		88
182	24	70	23	20	27	10		6		9
183	23	70	10	20	35	10	reclam	6		45
184	23	70	35	20	24	10		6	vulc	15
185	10	50	13	40	27	10		2		298
186	10	50	13	40	27	10		1		1,529
187	34	100	0	0	0	0		1		23
188	35	70	23	30	0	0		3	vulc	3,963
189	35	70	23	30	0	0		3	vulc	462
190	13	50	23	40	27	10	reclam	3		347
191	23	100	0	0	0	0	h	6		51
192	23	60	35	40	0	0	h	6	vulc	360
193	1	100	0	0	0	0		1		489
194	23	100	0	0	0	0		6		187
195	34	100	0	0	0	0		1		36
196	21	100	0	0	0	0		3		227
197	12	70	27	30	0	0		2		13,056
198	13	100	0	0	0	0		1		672
199	1	100	0	0	0	0		1		138