LIFE14 CCA/GR/000389 - AgroClimaWater
Promoting water efficiency and supporting the shift towards a climate resilient agriculture in Mediterranean countries

Sub-deliverable C2.2: Runoff, leaching and erosion risk assessment and use of agrochemicals in high risk areas

Action C2: Identification and assessment of water efficiency in the three F.ORs - Before LIFEAgroClimaWater

Action:		C2
Release:		Final Version
Responsible:		HYETOS
Contribution:		
	PART A	LRI
	PART B	HYETOS

NOVEMBER 2016

Project LIFE14 ENV/GR/000389–AgroClimaWater is implemented with the contribution of the LIFE Programme of the European Union and project's partner scheme

Blank on purpose

Terminology / Abbreviations

Term	Description
A	long-term average annual soil loss
A_s	specific contributing area
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AWMS	Agricultural Water Management System
C	cover and management factor
CN	Curve Number
CORINE	coordination of information on the environment
DEM	Digital Elevation Model
Eq	Equation
ESDB	European Soil Database
ESRI	Environmental Systems Research Institute
Fig.	Figure
GDEM	Global Digital Elevation Map
GIS	Geographic information system
ha	Hectare
HCVAs	High Conservation Value Areas
HM	Havgas – Milatos
k	Soil erodibility factor
km^2	Square kilometer
L	Slope length factor
LS	Topographic factor
M	Meter
m^2	Square meter
MFI	Modified Fournier Index
MJ	Megaloule
mm	Millimeter
No	Number
NRCS	Natural Resources Conservation Service
NW	North West
P	Conservation support practice factor
PPPs	Plant Protection Products
R	Rainfall - rainfall erosivity factor
S	slope steepness factor
SCS	Soil Conservation Service
SL	Slope
SRTM	Shuttle Radar Topography Mission
t	Tone
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
β	Slope angle

Contents

Table of Figures

Tables

INTRODUCTION

The main scope of project's action C2 is the assessment of the water efficiency of the three participants F.ORs before the LIFE AgroClimaWater project in order to proceed with the formulation of the Water Management Adaptation Strategy (WMAS) for the three FORs (Action C3). In addition, through C2 the four principles of EWS standard as it was adopted in the Agricultural Water Management System (AWMS) formed in the frame of action A2 in reference to the identification and assessment of the impacts of current agricultural practices on water sources and High Conservation Value Areas (HCVAs) as well as the identification of the initiatives undertaken by the participant F.ORs' regarding water management are implemented.

The present sub-deliverable C2.2 was developed in order to cover the needs of C2 action in reference to the identification of runoff, leaching and erosion potential both for the entire area of the pilot sub-basins and the registered orchards. In addition, the use of agrochemicals in the registered orchards is evaluated in terms of the potential to have an impact on the potentially affected destinations (water bodies and HCVAs) considering their hazardous to the aquatic environment and their classification in the risk classes.

Sub-deliverable C2.2 is divided into the following two parts:

- Part A "Runoff, leaching and erosion risk assessment"
- Part B "Use of agrochemicals in high risk areas"

Part A "Runoff, leaching and erosion risk assessment" includes a methodology for runoff, leaching and erosion risk assessment and the most important results of the identification of runoff, leaching and erosion potential both for the entire pilot sub-basins and especially the agricultural lands and each registered parcel included in the data collection system. Moreover, through this part the project's scientific team marks critical areas that demonstrate significant potential for runoff, leaching and erosion and develops the background in order to identify the runoff, leaching and erosion potential for other parcels in the pilot sub-basins.

As far as **Part B "Use of agrochemicals in high risk areas"** is concerned it includes an analyses and the main results of the identification of potentially affected sub-basins and orchards which are located in areas with higher or equal to moderate runoff, erosion and leaching potential within the three pilot areas (Platanias, Mirabello and Metapontino), taking also into account the agrochemical practices that are applied per registered orchard as a result of the data collected through the 1st AWMS form in reference to the agricultural practices that are applied in the three pilot areas.

PART A – RUNOFF, LEACHING AND EROSION RISK ASSESSMENT

1. INTRODUCTION

Runoff and leaching constitutes two of the non-point source discharges and depending on the local climate, geomorphological and land use conditions, they may contribute significantly to the pollution of surface water and groundwater bodies. Erosion constitutes one of the most significant environmental problems, the significance of which has been recognized several decades ago. Therefore, as part of the impact assessment performed in the context of Action C2, it is necessary to develop and apply a methodology for runoff, leaching and erosion risk assessment that will identify the runoff, leaching and erosion potential:

- For the entire pilot basin and especially the agricultural lands, so as: a) to mark critical areas that demonstrate significant potential for runoff, leaching and erosion and b) to develop the background in order to identify the runoff, leaching and erosion potential of each farm located in the pilot basin.
- For each farm included in the data collection system.

Since the Platanias and Voukolies sub-basins in Platanias area includes only a part of Tavronitis River basin, which constitutes the major surface water body in the area, the total area of Tavronitis River basin was included in the following analysis in order to have a more clear view of runoff, leaching and erosion risk. In terms of Metapontino area, the pilot basin selected in A1 action is part of Agri River basin. Since performing such a risk assessment analysis for the entire Agri River basin (more than 1,700 km^2) is out of the purposes of the present study, the whole 4MA (a and b parts) basin was included in the analysis for Metapontino area. Concerning Mirabello area, the pilot sub-basin of Havgas - Milatos selected in A1 action constitute a hydrologically autonomous basin and therefore this basin was used for the purposes of the risk assessment study. The results of risk assessment are linked to the adjacent surface and groundwater bodies included in the pilot basin.

2. RISK ASSESSMENT METHODOLOGY

2.1. *RUNOFF AND LEACHING*

Before the description of risk assessment methodology some general terms are presented. According to the Water Science Glossary of Terms of United States Geological Survey (USGS, Water Science Glossary of Terms), runoff is defined as "*that part of the precipitation, snow melt, or irrigation water that appears in uncontrolled (not regulated by a dam upstream) surface streams, rivers, drains or sewers*", while leaching is defined as "*the process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water*". In a simple manner, these two processes are acting competitive since the more water is flowing as runoff, the less water is available to enter into the soil profile and therefore available for leaching.

The factors affecting runoff can be divided into two categories (USGS, Runoff (surface water runoff)):

1. <u>The meteorological factors</u> in which the type of precipitation, the rainfall characteristics (intensity, amount, duration) and the spatial distribution of precipitation within the watershed are amongst the most important.
2. <u>The physical factors</u> in which land use, vegetation, soil type, watershed shape, elevation, slope, topography and structures such as ponds, lakes and reservoirs that prevent or alter runoff from continuing downstream are included.

Leaching constitutes a more complex hydrological process compared to runoff. In order for leaching to take place, the soil water content has to exceed field capacity and therefore water inputs, either as rainfall or as irrigation, are considered as one of the major factors that control leaching. There are several other factors that affect leaching and are common with the factors that affect runoff, including soil structure, land use and vegetation. Except from the above and when considering a specific pollutant, there are several internal chemical and physical reactions that take place and significantly affecting the leaching process. For example, comparing nitrate and phosphate, nitrate leaching potential is higher compared to phosphate due to the fact that its interaction with the negatively charged matrix of most top soils is negligible and therefore nitrate is very mobile in the soil (Lehmann & Schroth, 2003). In contrast, phosphate indicates much lower mobility in soil water because of its higher absorption to mineral surfaces.

The runoff and leaching risk methodology presented below is developed according to the following directions:

- The methodology has to be simple and easily understood.
- The methodology has to be based on widely applied and accepted methods.
- The tools used to apply the methodology have to be easily applied and widely used.
- The dataset used to apply the methodology have to be simple, easily accessible and if it is possible freely available.

Aiming at simplicity and taking into account the above mentioned directions, as well as the fact that slope (length and steepness), rainfall and soil type are amongst the most important factors influencing runoff generation (Fang et al., 2015), the runoff risk methodology developed in the context of AgroClimaWater project comprises of the following three components:

- the Runoff Curve Number (CN) component,

- the slope (SL) component and
- the Rainfall (R) component.

According to Natural Resources Conservation Service (NRCS) of United States Department of Agriculture (USDA) (1986) the CN corresponds to an empirical parameter applied in hydrology for the prediction of direct runoff or infiltration from rainfall excess. The CN constitutes the fundamental parameter of the runoff curve number method, which was originally developed by USDA Soil Conservation Service (SCS) at 1954 in order to simulate direct runoff from agricultural fields for specific rainfall events and since then, SCS-CN method is considered as the most widely applied method for runoff estimation (Ajmal et al., 2015), while it has been integrated in a wide variety of hydrologic, erosion and water quality models (Mohammad & Adamowski, 2015). CN is a function of soil type, land use and antecedent soil moisture conditions.

According to NRCS-USDA (1996), soil are classified into four hydrologic groups with regard to their infiltration characteristics. Each hydrologic group indicates a group of soils with similar runoff potential under similar storm and cover conditions. Based on the above definition, the 4 soil hydrologic groups are presented as follows (NRCS-USDA 1996):

- **Group A**: This group indicate soils of low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Soils typically with less than 10% clay and more than 90% sand or gravel, and with gravel or sand textures are included in this group.
- **Group B**: This group includes soils with moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils are moderately well drained to well drained with moderately fine to moderately coarse textures and typically have between 10% and 20% clay and 50%-90% sand and have loamy sand or sandy loam textures.
- **Group C**: This group includes soils with moderately high runoff potential when thoroughly wet with somewhat restricted water transmission. Group C soils indicate moderately fine to fine textures and they typically have between 20% and 40% clay and less than 50% sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures.
- **Group D**: The runoff potential of soils included in this group is considered as high, while water movement through the soil is restricted to very restricted. Group D soils typically indicated greater than 40% clay, less than 50%, and have clayey textures.

From the description of soil hydrologic groups, it is easily deduced that at least, textural or sand-clay-silt content have to be determined in order to specify the hydrologic group of a soil. Possible sources for this kind of information can be retrieved from soil maps of the specific study area. In case that soil maps are not available, related data can be retrieved by the European Soil Database developed by Institute for Environment and Sustainability of European Commission - Joint Research Centre (The European Soil Database). The database is available both in raster and vector GIS format and includes a wide variety of parameters including information on the textural classes of surface and subsurface soil profile.

In combination with soil type, land use/cover constitutes the other fundamental factor that determines CN value for a specific area. In case that a local land cover map is not available for the study area, there are several land cover sources available on the public domain. Concerning the European Union countries, one of the most widely

applied datasets in hydrologic studies is the CORINE land cover dataset (CORINE land cover). With a scale of 1:100,000, CORINE includes 44 land cover classes and demonstrates a useful representation of land cover distribution in Europe.
Based on soil hydrologic group and land use, an extensive record of CN values have been estimated and proposed by NRCS (1986). The land use have been divided into three main categories including cultivated agricultural land, other agricultural land and urban areas. Based on these categories and taking into account the soil hydrologic group, the user can assign the appropriate CN in the study area. For the purposes of the present study, the SWAT model database was used in which the appropriate CN values have been assigned in specific land cover according to the soil hydrologic group. The corresponding table is presented in Appendix I (Table 51).
As mentioned above, slope is considered as one of the most influential parameters that can significantly affect runoff and subsequently leaching potential. Slope gradient can be easily calculated in GIS software using a Digital Elevation Model (DEM) and it is expressed as degrees or percentage. DEM is usually the product of elevation contours digitization which are further interpolated using a GIS software. Nevertheless, the last decade a wide variety of DEMs have been produced using satellite imagery data and the remote sensing technology. Some of these DEMs are available in the public domain, such as the ASTER GDEM (ASTER Global Digital Elevation Map) and the SRTM DEM (Shuttle Radar Topography Mission). In the context of the present study slope gradient was divided into six categories according to runoff potential, as presented in Table 1. A similar classification scheme has been also used in the methodological approach for runoff and leaching risk assessment applied in SAGE10 project (LIFE09 ENV/GR/000302 SAGE 10).

Table 1: Runoff potential categorization according to the slope range.

Slope Range (%)	Runoff Potential	Reclassification Value
0 – 2	Negligible	0
2 – 6	Low	1
6 – 12	Moderate	2
12 – 18	High	3
18 - 25	Very High	4
>25	Extremely High	5

Rainfall is considered as the major contributor to runoff due to the fact that it constitutes the water source of the runoff process. In fact it is not only the rainfall amount related to runoff, but also its intensity and duration. Nevertheless, in a simplistic way, the more precipitation that reach the ground, the more water is available for runoff. Therefore, in order to incorporate the rainfall component in the runoff risk assessment methodology the annual rainfall spatial distribution within the basin has to be produced. There are several ways that can be applied in order to produce the annual rainfall spatial distribution, which are highly depending on data availability. In case that meteorological stations density within the basin is adequate, geostatistical interpolation techniques can be applied. Moreover, the precipitation gradient approach may also be used in order to produce annual rainfall spatial distribution. Another option applicable for large basins is the usage of already available gridded datasets of observed precipitation, such as the E-OBS dataset

developed in the context of European Climate Assessment & Dataset project. For the purposes of the present study, it is assumed that when annual precipitation is <400 mm, the runoff risk is considered as negligible, while for annual precipitation values >1200 mm the runoff risk is considered as very high.
Since the variation range of the three components is significantly different (31-100 for CN, 0-5 for slope, 0-∞ for precipitation), it was necessary to perform a standardization procedure in order to obtain a common variation scale. Therefore linear increasing fuzzy membership functions were applied in the three components. The variation range of the produced spatial distribution maps is 0-1. After the standardization process, which can be easily applied in ArcGIS software, the three components are summed and as a results the runoff risk assessment map is produced with values ranging between 0 and 3. This range was classified into five categories which are presented in Table 2.

Table 2: Runoff potential categories according to the runoff assessment methodology.

Runoff potential values	Description
0 - 0.6	Very low runoff risk
0.6 – 1.2	Low runoff risk
1.2 – 1.8	Moderate runoff risk
1.8 – 2.4	High runoff risk
2.4 – 3.0	Very high runoff risk

Leaching risk assessment was also based on the three components applied for runoff risk assessment taking into account the fact that leaching and runoff are acting in a competitive way since the more water is flowing as runoff the less water is available to enter into the soil profile and therefore available for leaching. Therefore, in the context of leaching assessment it is considered that higher CN values indicate higher runoff potential and subsequently lower leaching potential. Similarly for slope, higher values indicated higher runoff potential and subsequently lower leaching potential. Considering the above, decreasing linear fuzzy membership functions were applied in CN and slope data and similarly to runoff, 5 leaching potential categories were identified which are presented in Table 3.

Table 3: Leaching potential categories according to the leaching assessment methodology.

Leaching risk values	Description
0 - 0.6	Very low leaching risk
0.6 – 1.2	Low leaching risk
1.2 – 1.8	Moderate leaching risk
1.8 – 2.4	High leaching risk
2.4 – 3.0	Very high leaching risk

The above described methodology is summarized in Fig. 1.

2.2. *SOIL EROSION*

According to Primetel et al. (1995) about 1/3 of the global arable land has been lost during the last 40 years through the erosion process. The significance of erosion as an environmental problem is higher for the Mediterranean region, due to the fact that the climate, topographic and soil characteristics combined to human activities in Mediterranean are producing high erosion potential (Garcia-Ruiz et al., 2013). According to Bakker et al. (2007), the largest reductions in crop yields because of erosion are likely to be observed in Greece followed by Portugal, Italy, Spain and the south of France.

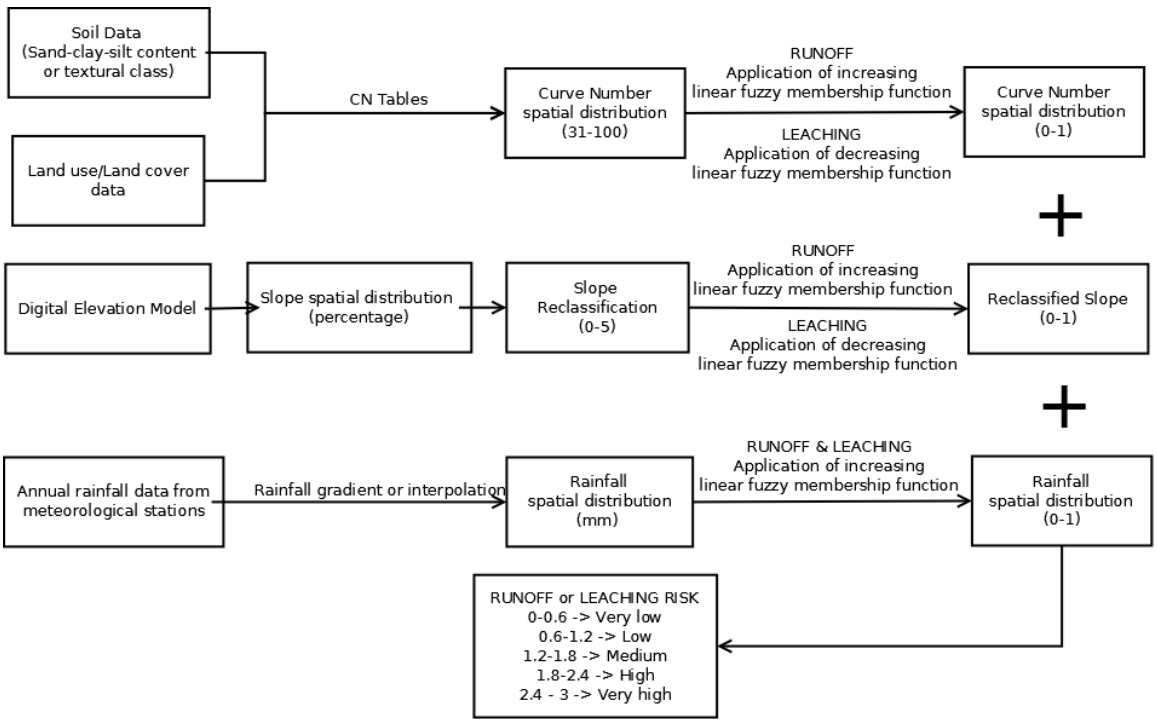

Fig. 1: Runoff and leaching risk assessment methodology developed in the context of AgroClimaWater project

In the context of the present study, the Universal Soil Loss Equation (USLE) (Wischmeier & Smith, 1978) was applied in order to assess the erosion risk in the three basins. USLE constitutes a mathematical model able to estimate the long-term average annual rate of erosion based on rainfall pattern, soil properties, topography, land use and management practices. Since its development at 1930s by the U.S. Department of Agriculture (USDA) Soil Conservation Service, USLE has been widely applied around the world, mainly due its robustness and simplicity. The mathematical expression of USLE is presented in Eq. 1.

$$\mathbf{A = R*K*L*S*C*P} \qquad \text{Eq.1}$$

Where, **A** is the long-term average annual soil loss [t/ha year^{-1}], **R** is the rainfall erosivity factor [MJ mm/(ha ha year^{-1})], **K** is the soil erodibility factor [t ha h/ (ha MJ mm)], **L** is the slope length factor, **S** is the slope steepness factor, **C** is the cover and management factor and **P** is the conservation support practice factor.

According to Lal (1990), rainfall erosivity expresses the aggressiveness of the rain to produce erosion, while R factor is defined as the sum of the products of the total rainstorm energy and the maximum 30-minute rainstorm intensity for each rainstorm event during a given time period. Calculating R factor based on the above definition is not always an option, since data requirements are hardly satisfied. However, long-term average R factor values have been found to be strongly correlated with more readily available data such as monthly and annual rainfall and Modified Fournier Index (MFI) (Arnoldus 1980). The latter is defined by Eq.2.

$$MFI = \sum_{1}^{12} \frac{p_i^2}{P} \qquad \text{Eq.2}$$

Where, p_i is the average monthly rainfall height for the month i and P is the average annual rainfall height.

In order to calculate R factor based on MFI values, two equation (Eq. 3 and 4) were used for the purposes of the present study, developed by Ferro et al. (1999) and Renard & Freimund (1994) for the areas of Sicily-Italy and Morocco, respectively.

$$R = 0.612 * MFI^{1.56} \qquad \text{Eq.3}$$

$$R = 0.264 * MFI^{1.5} \qquad \text{Eq.4}$$

The average R factor values resulted from the above two equations were used for the two basins located in Crete. A similar approach has been used for erosion investigation in Crete island by Kouli et al. (2008). In the case of the Italian basin, Eq. 3 was applied.

Based on R factor calculation for each of the meteorological stations, the spatial distributions of R factor were produced. Similarly to rainfall, an R factor gradient can be developed which correlates R factor to elevation or geostatistical interpolation techniques can be applied.

The K factor indicates the rate of soil loss per erosion index unit for a given soil determined on a standard plot (Wischmeier plot). K factor depends on several properties such as organic matter content, texture, structure and permeability of the soil profile. This factor is usually determined using empirical equations which contain the aforementioned properties, such as sand-clay-silt content, organic matter concentration, geometric mean particle size etc. For the purposes of the present study, the results of Panagos et al. (2014) were used in order to assign the K factor values in the soil profiles of the three basins. In this study, K factor maps were produced using the LUCAS soil survey data for the entire Europe, while K factor average values have been calculated for the 7 soil surface texture classes of the European Soil Database (ESDB). These K factors values were estimated from the corresponding diagram of Panagos et al. (2014) (Table 4) and were further assigned to the soil the three basin according to their soil surface texture class.

Table 4: Average K value for the soil surface texture classes of ESDB.

ESDB soil surface texture class	**K factor [t h MJ^{-1} mm^{-1}]**

No information	0.0291
Coarse	0.0282
Medium	0.0325
Medium fine	0.0395
Fine	0.0347
Very fine	0.0309
Organic soils	0.0264

The L and S factors are approached together, since they represent the influence of topography in soil erosion. In the context of the present study, the equations of Moore et al. (1993) were applied in order to calculate L and S factors:

$$L = 1.4\left(\frac{A_s}{22.13}\right)^{0.4}$$ Eq. 5

$$S = \left(\frac{\sin\beta}{0.0896}\right)^{1.3}$$ Eq. 6

Where, A_s is the specific contributing area (m^2/m) and β is the slope angle expressed in degrees. According to van der Knijff et al. (1999), the approach of Moore et al. (1993) indicates an advantage when compared to the original equations presented by Wischmeier & Smith (1978): specific contributing areas are incorporated into slope length estimate which is more amenable to three-dimensional landscapes.

When working into GIS environment, A_s can be substituted by flow accumulation value multiplied by the cell size of the corresponding flow accumulation grid. The flow accumulation grid can be produced by flow direction which is produced by DEM. There are specific tools for flow accumulation and direction calculation within the ESRI ArcGIS environment.

According to Wischmeier & Smith (1978), C factor is defined as the ratio of soil loss from land with a specific vegetation/crop and management system to the corresponding soil loss from continuous fallow and tilled land. Therefore, C factor expresses the potential of land cover and the corresponding management practices to reduce soil loss, taking into account that soil loss is decreasing as the vegetation cover increases. Several methods for the determination of C factor have been proposed including empirical equations and remote-sensing techniques. In the context of the present study the results of Panagos et al. (2015) were used, in which C factor has been estimated at the European scale. More specifically C factor values were estimated for several land cover classes as indicated in CORINE land cover, while for several land cover classes, country specific average values were produced. The results of Diodato et al. (2011) and Teh (2011) were used for land cover classes not included in the study of Panagos et al. (2015). More details about C factor values applied for each of the three basins will be presented in methodology application section.

P factor expresses the effects of practices that aim to reduce the amount and rate of runoff and subsequently contribute to soil loss reduction. Such practices include cross slope farming, contour farming and strip cropping. Since there is no information about

such practices and in order to calculate the maximum potential erosion rates, P factor value was assumed to be equal to 1 for all the three basins.
The results of USLE spatial application in the three basin were classified according to the classification scheme presented in Table 5 which was also use in the context of SAGE10 project (LIFE09 ENV/GR/000302 SAGE 10).

Table 5: Average annual soil erosion classes applied in the context of AgroClimaWater project.

Range of average annual soil erosion (t/ha year^{-1})	Classification
0 – 7.4	Very low
7.4 – 12.5	Low
12.5 – 24.7	Moderate
24.7 – 37	High
> 37	Very high

3. APPLICATION OF RISK ASSESSMENT METHODOLOGY

3.1. *RUNOFF*

3.1.1. Havgas – Milatos sub-basin (Mirabello area)

In order to identify soil characteristics in the pilot Havgas – Milatos sub-basin, data from ESDB were retrieved, while in order to identify the soil texture class of the soil profile the dominant surface and sub-surface textural classes were considered. Only one soil unit was identified for the pilot Havgas – Milatos sub-basin in which soils of medium fine textural class are met (Fig. 2). The soil hydrologic group category assigned in these soils was "C". The land cover distribution based on CORINE2000 land cover data is presented in Fig. 3, according to which olive groves and sclerophyllous vegetation are the two dominant land cover categories. CN values produced as the result of soil and land cover data are presented in Fig. 4a, while the result of increasing linear fuzzy membership function application with minimum and maximum at 31 and 100, respectively, is presented in Fig. 4b. The average CN value for pilot Havgas – Milatos sub-basins was found to be 77.7. Higher CN values are met in sparsely vegetated areas, while low CN values was found in sclerophyllous vegetation areas.

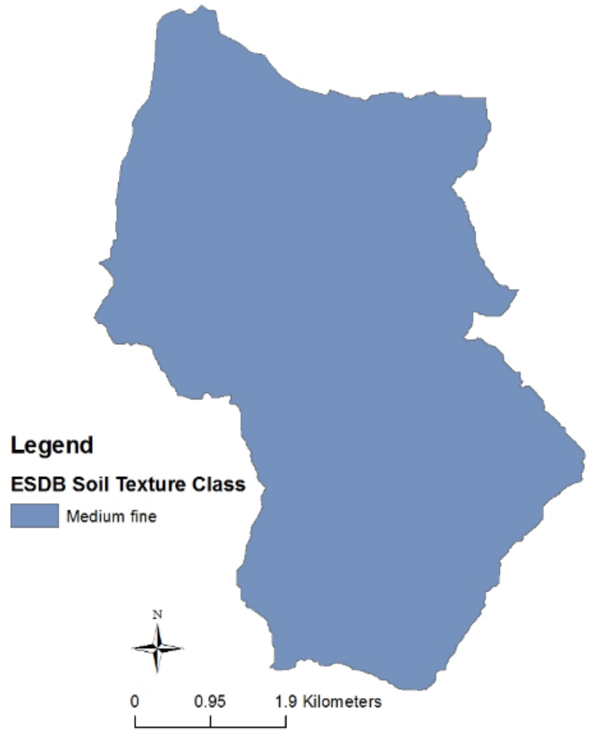

Fig. 2: Soil textural class distribution in Havgas - Milatos sub-basin

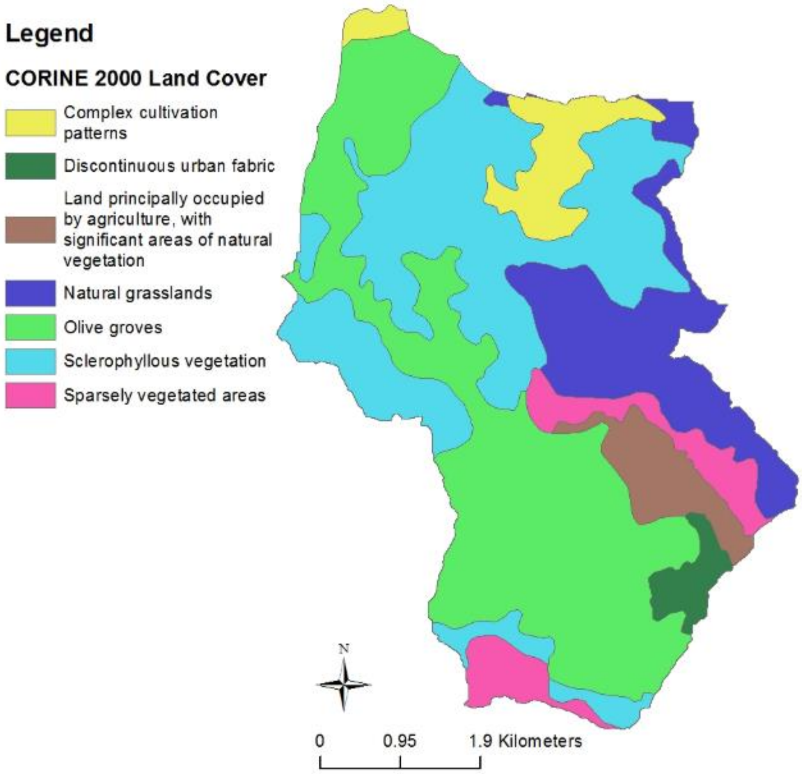

Fig. 3: Land cover distribution in Havgas – Milatos sub-basin according to CORINE2000 data

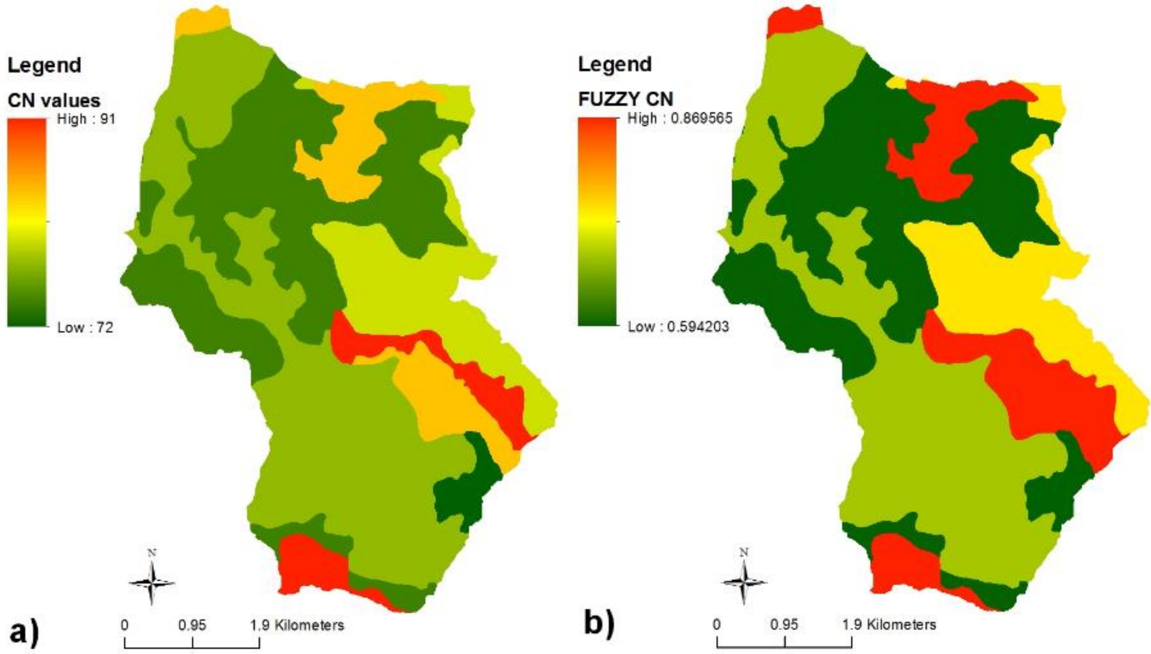

Fig. 4: Spatial distribution of a) CN values and b) the results of fuzzy membership function application in CN values for Havgas - Milatos sub-basin

Considering slope component of the runoff risk assessment methodology, a high accuracy (5m X 5m pixel size) DEM provided by Hellenic Cadastral Service was used in order to calculate slope in Havgas – Milatos sub-basin. The slope calculation, as well as the classification according to Table 1 categories are presented in Fig. 5. Despite the small size of Havgas – Milatos sub-basin (about 30 km^2), elevation indicates a wide range of variation between 0 and 920 m. Similarly wide was the range of slope variation (0-316%), while the average slope of the basin was about 34%. The slope reclassification indicate that a significant part of the basin demonstrate slope > 25%, which were further reflected in the results of the increasing linear fuzzy membership function application presented in Fig. 5d.

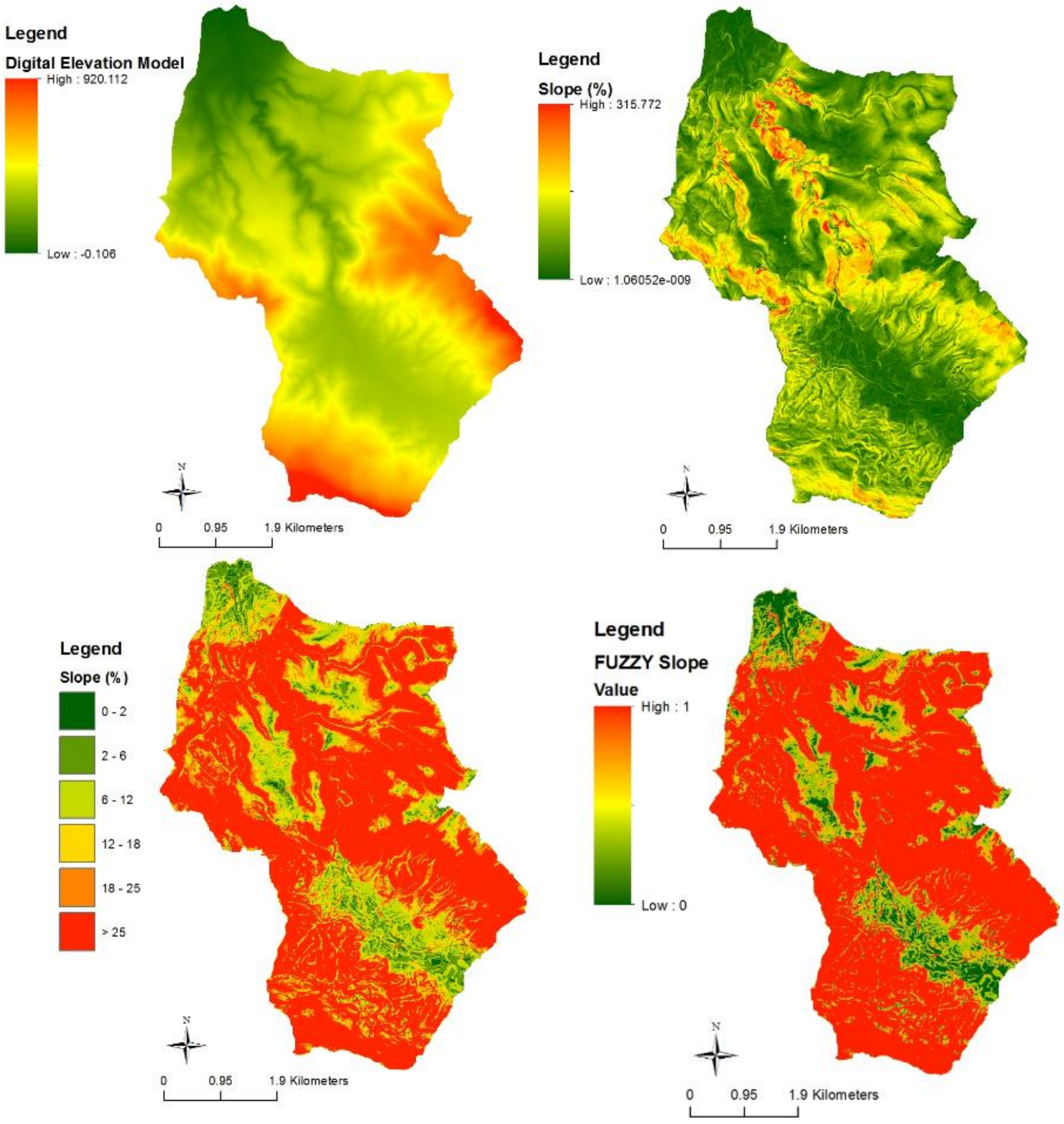

Fig. 5: The DEM (a) used in order to calculate slopes (b) in Havgas - Milatos sub-basin. The spatial distribution of reclassified slope values (c) and the results of fuzzy membership function application (d) are also presented

Data from three meteorological stations for the period 1962-2004 was collected in order to produce an annual rainfall gradient equation for the basin and subsequently construct the annual rainfall spatial distribution. The location of the three meteorological stations is presented in Fig. 6, while the annual rainfall gradient equation is presented in Fig. 7. This equation was applied cell by cell using the DEM presented in Fig. 5a and the spatial distribution of rainfall was calculated which is illustrated in Fig. 8a. The average annual rainfall for the pilot sub-basins was estimated at 891 mm. A linear increasing fuzzy membership function was applied in rainfall data with minimum and maximum values at 400 and 1200 mm, respectively, and the results are presented in Fig. 8b.

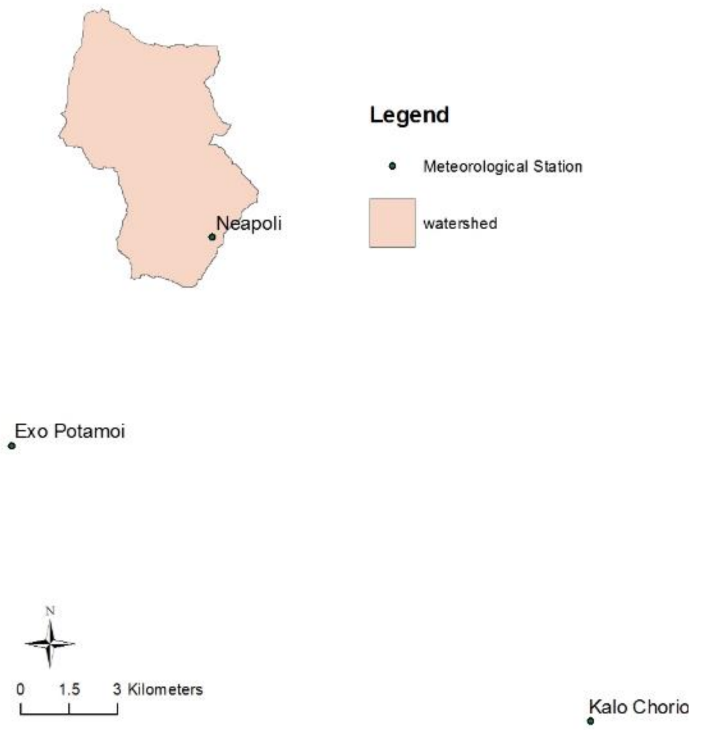

Fig. 6: Spatial distribution of the meteorological stations location in Havgas – Milatos sub-basin

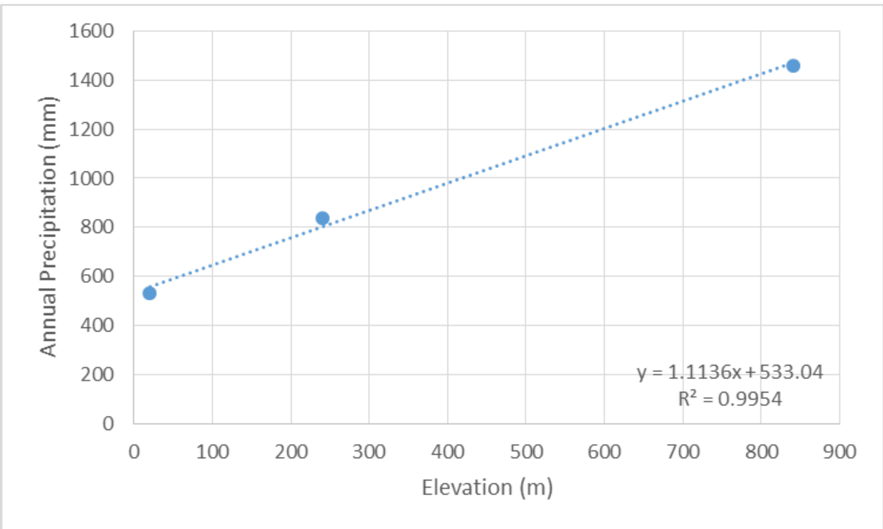

Fig. 7: Diagram of annual rainfall vs elevation. The annual rainfall gradient for Havgas – Milatos sub-basin is also presented

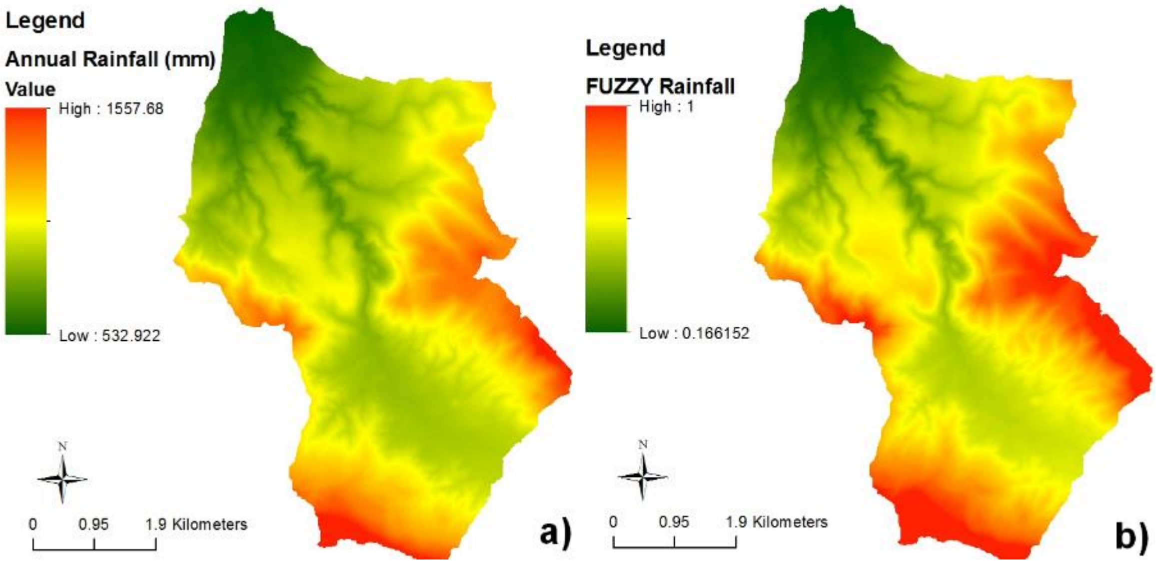

Fig. 8: Spatial distribution of annual rainfall (a) and the results of fuzzy membership function application (b) for Havgas - Milatos sub-basin

3.1.2. Tavronitis basin (Platanias area)

The soil textural classes as resulted from the interpretation of the dominant surface and sub-surface soil texture classes of European Soil Database (ESDB) data are presented in Fig. 9, while the land cover map according to CORINE2000 land cover is presented in Fig. 10.

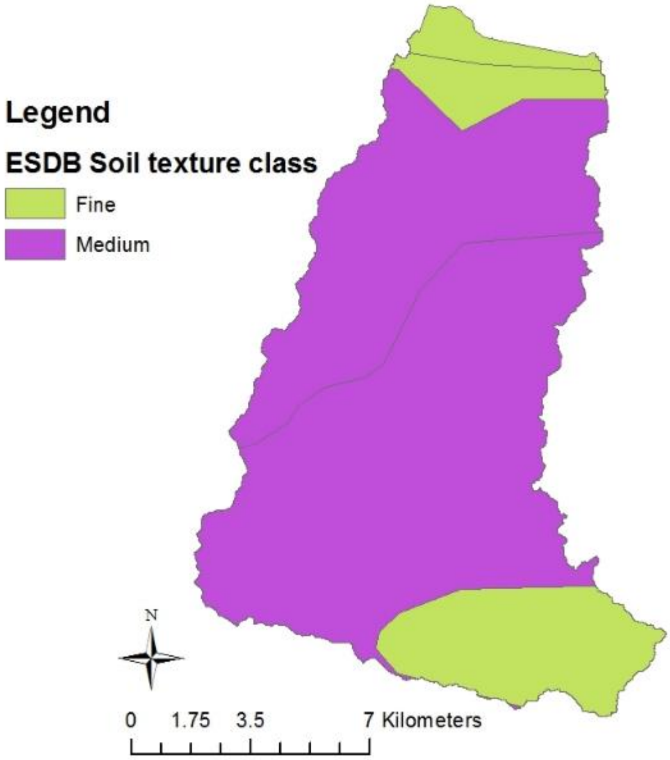

Fig. 9: Soil textural class distribution in the pilot basin of Tavronitis basin

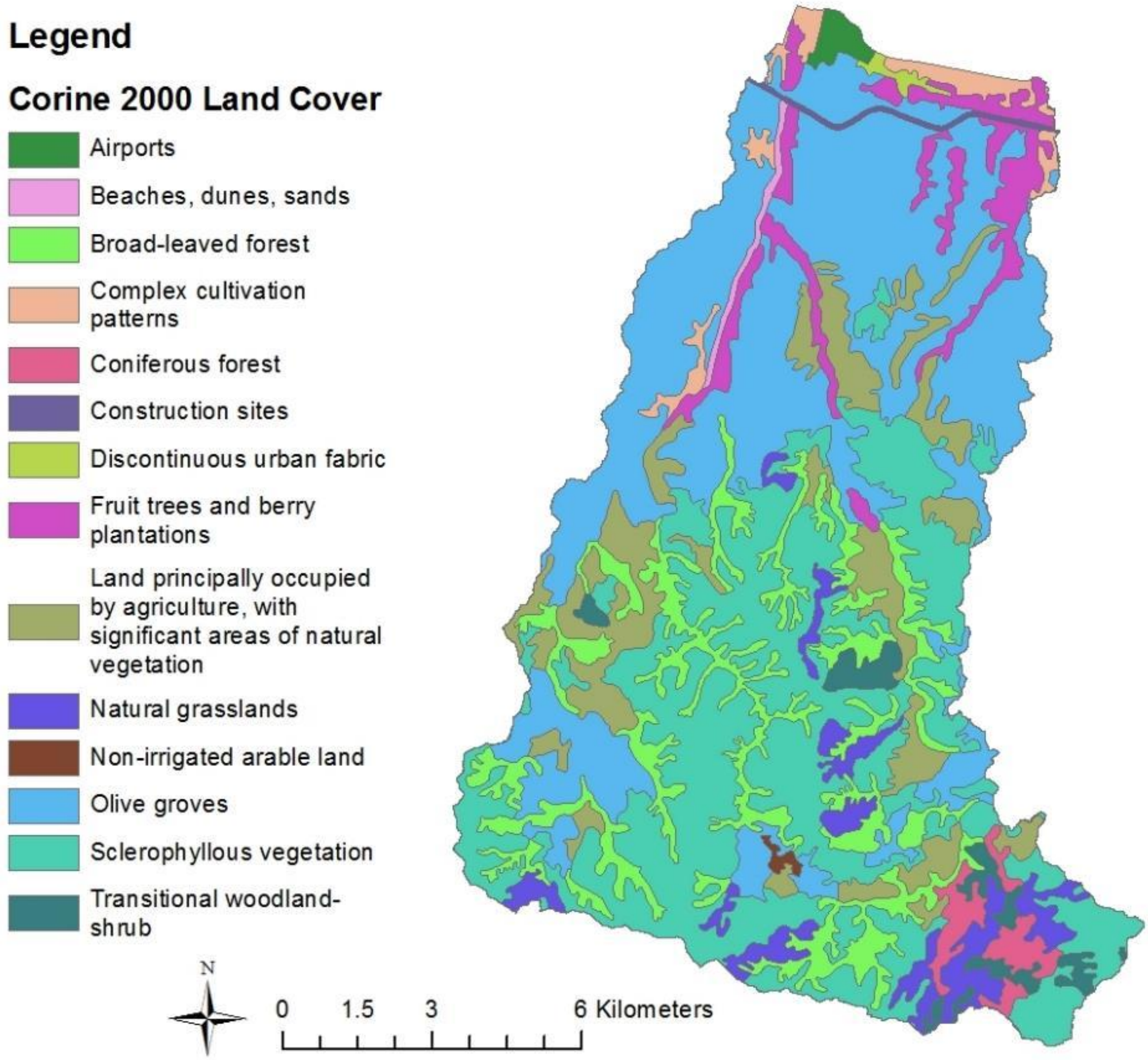

Fig. 10: Land cover distribution in the pilot basin of Tavronitis basin according to CORINE2000 data

Soil of medium textural class are dominating in Tavronitis basin, while two zones of fine texture soils were found in the north and south part. The soil hydrologic group assigned in medium soils was the "C" class and the "D" class was assigned to fine soils. The land cover distribution based on CORINE2000 land cover data is presented in Fig. 10, according to which olive groves are dominating in the north part of the basin, while sclerophyllous vegetation is the dominant land cover category found in the south part of the basin. CN values produced as the result of soil and land cover data are presented in Fig. 11a, while the result of increasing linear fuzzy membership function application with minimum and maximum values at 31 and 100, respectively, is presented in Fig. 11b. The average CN value for Tavronitis River basin was found to be 69. Higher CN values are found in the fine soil zones, while low CN values are found in the forested areas.

Considering slope component of the runoff risk assessment methodology, a high accuracy (5m X 5m pixel size) Digital Elevation Model (DEM) provided by Hellenic

Cadastral Service was used in order to calculate slope in Tavronitis River basin. The slope calculation results, as well as the classification according to Table 1 classes are presented in Fig. 12. The elevation variation range of Tavronitis River basin was found to be wide since minimum elevation was 0 m and maximum elevation was 1408 m. The average elevation of the basin was 416 m. Similarly wide was the range of slope variation (0-326%) while the average slope of the basin was about 41%. The slope reclassification indicated that the major part of the basin demonstrate slope > 25%, which were further reflected in the results of the increasing linear fuzzy membership function application presented in Fig. 12.

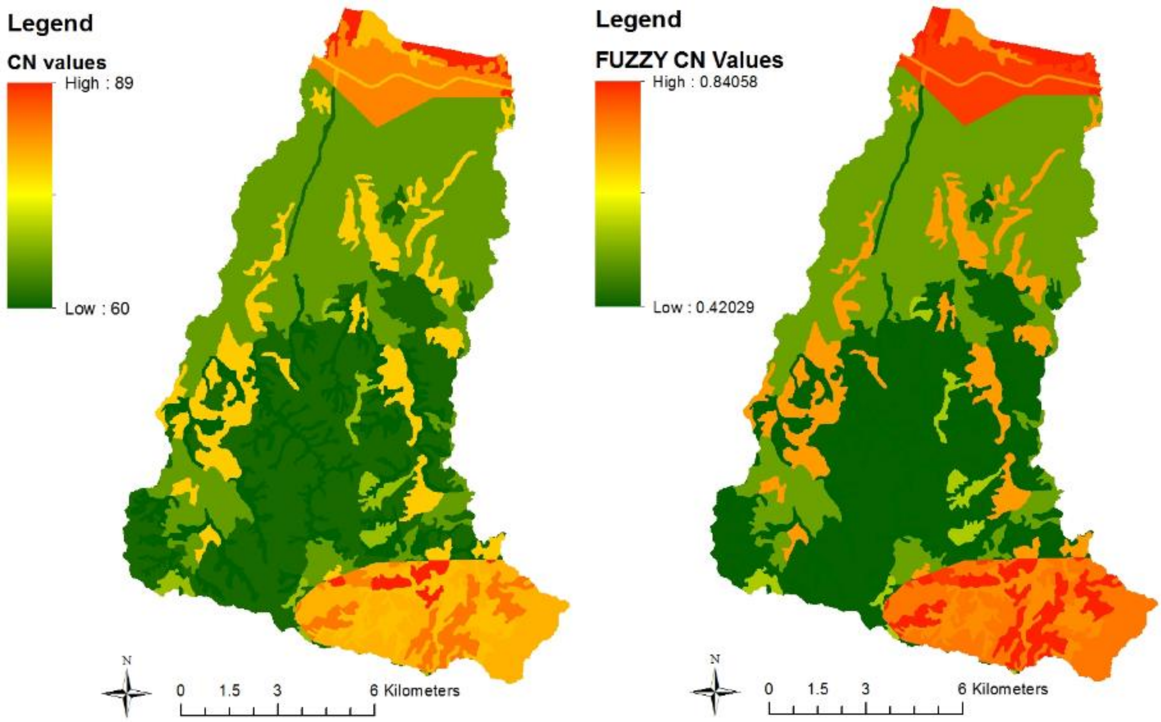

Fig. 11: Spatial distribution of a) CN values and b) the results of fuzzy membership function application in CN values for Tavronitis basin

Data from four meteorological stations for the period 1977-1996 was collected in order to produce an annual rainfall gradient equation for the basin and subsequently construct the annual rainfall spatial distribution. The location of the three meteorological stations is presented in Fig. 13, while the annual rainfall gradient equation is presented in Fig. 14. This equation was applied cell by cell using the DEM presented in Fig. 12a and the spatial distribution of rainfall was calculated which is shown in Fig. 15a.

The average annual rainfall for the pilot basin was estimated at 1458 mm. This value may be overestimated, since there is no rainfall data for elevation higher than 840 m and consequently the rainfall gradient maybe overestimates rainfall in higher elevations. A linear increasing fuzzy membership function was applied in rainfall data with minimum and maximum values at 400 and 1200 mm, respectively, and the results are presented in Fig. 15b.

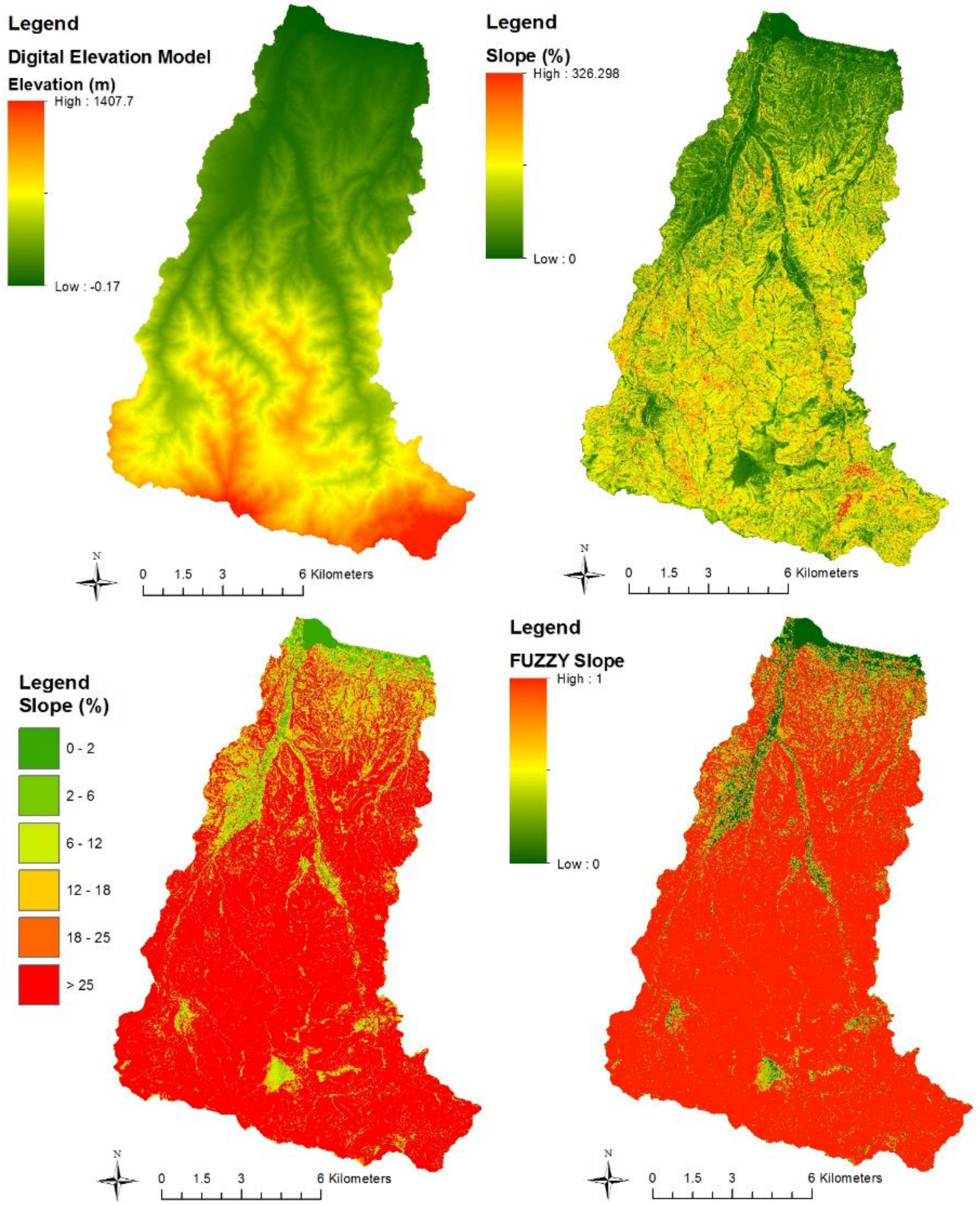

Fig. 12: The DEM (a) used in order to calculate slopes (b) in Tavronitis basin. The Spatial distribution of reclassified slope values (c) and the results of fuzzy membership function application (d) are also presented

Fig. 13: Spatial distribution of the meteorological stations location in Tavronitis basin

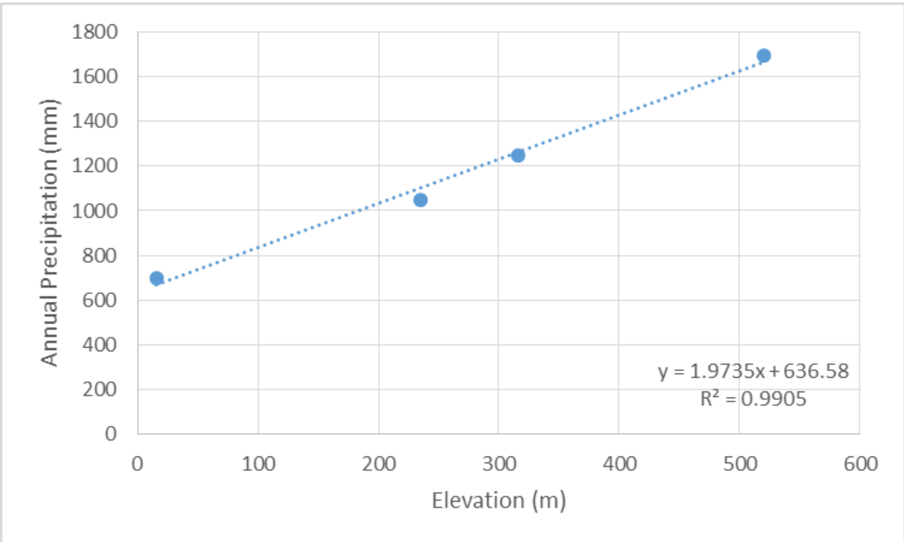

Fig. 14: Diagram of annual rainfall vs elevation. The annual rainfall gradient is also presented for Tavronitis basin

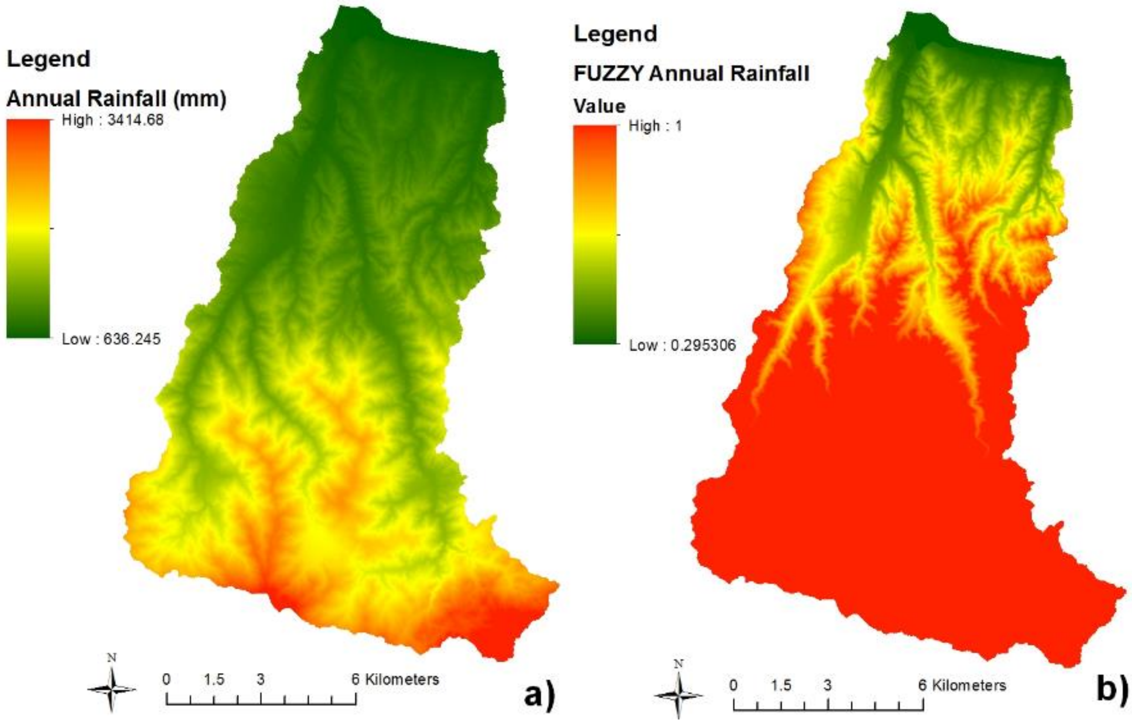

Fig. 15: Spatial distribution of annual rainfall (a) and the results of fuzzy membership function application (b) for Tavronitis basin

3.1.3. Agri sub-basin (Metapontino area)

Soil data presented in Deliverable A.1.1 were used in order to define soil textural classes in Agri sub-basin Fig. 16. Soil of medium fine textural class are dominating in Agri sub-basin, while medium soils are met along the course of Agri River. Two zones of fine soils were found in the north and south part. The soil hydrologic group assigned in coarse soils was the "A" class, while the corresponding classes for moderate coarse, medium, medium fine and fine soil were "B", "C", "C" and "D", respectively.

The land cover distribution based on CORINE2000 land cover data as presented in Fig. 17, indicate complex land cover patterns with non-irrigated arable land dominating in the western part of the basin. CN values produced as the result of soil and land cover data are presented in Fig. 18a, while the result of increasing linear fuzzy membership function application with minimum and maximum at 31 and 100, respectively, is presented in Fig. 18b. CN demonstrated a wide range of variation, while average CN value for Agri pilot sub-basin was found to be 79.3.

With regard to slope component of the runoff risk assessment methodology, an ASTER GDEM Version 2 DEM was used in order to calculate slope in Metapontino pilot basin. Slope calculation results, as well as the classification according to Table 1 classes are presented in Fig. 19. The elevation variation range of Agri sub-basin was found to be wide, since minimum elevation was 0 m and maximum elevation was 1095 m.

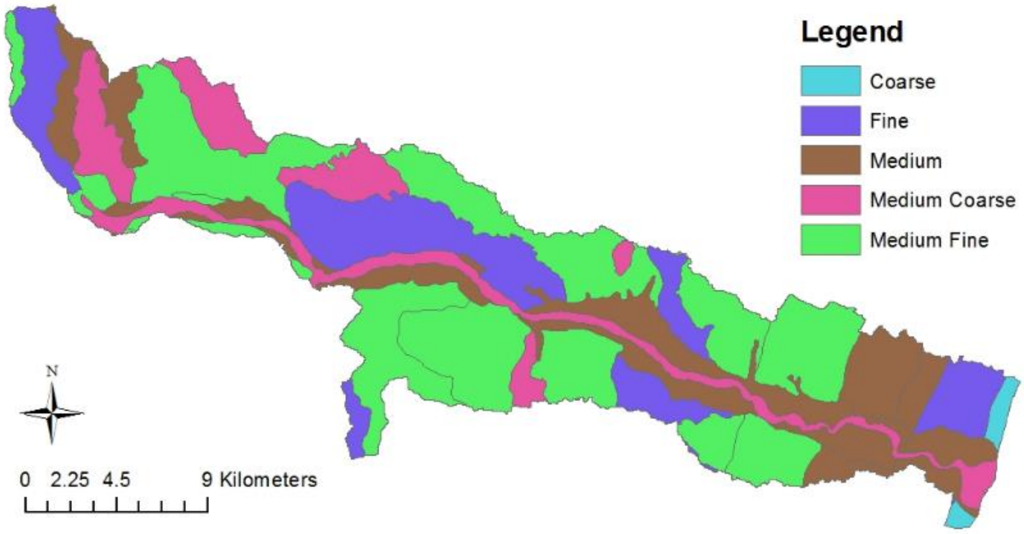

Fig. 16: Soil textural class distribution in the pilot Agri sub-basin

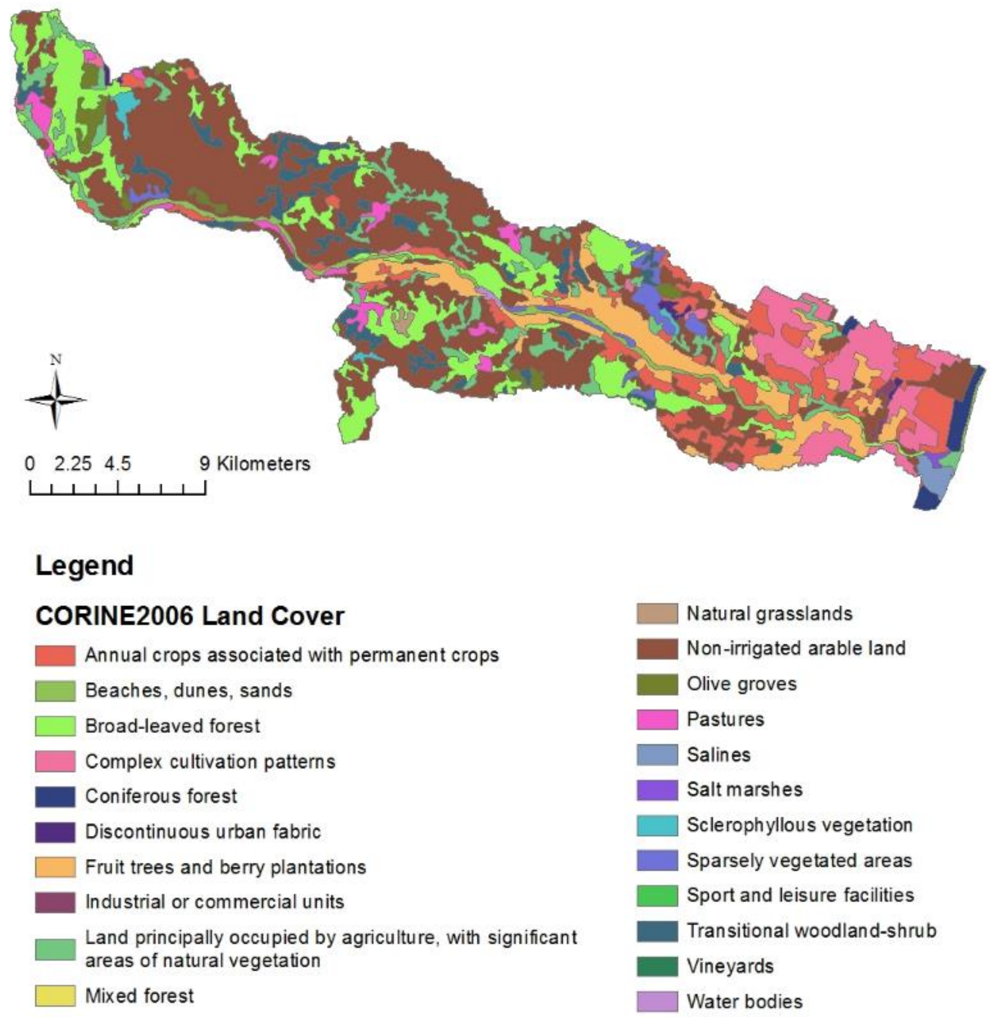

Fig. 17: Land cover distribution in the pilot Agri sub-basin according to CORINE2000 data

The average elevation of the basin was 235 m. Slope gradient ranged between 0 and 119% while the average slope of the basin was about 16%. The slope reclassification indicated slope values > 25%, mainly for the western part of the basin, which were further reflected in the results of the increasing linear fuzzy membership function application presented in Fig. 19d.

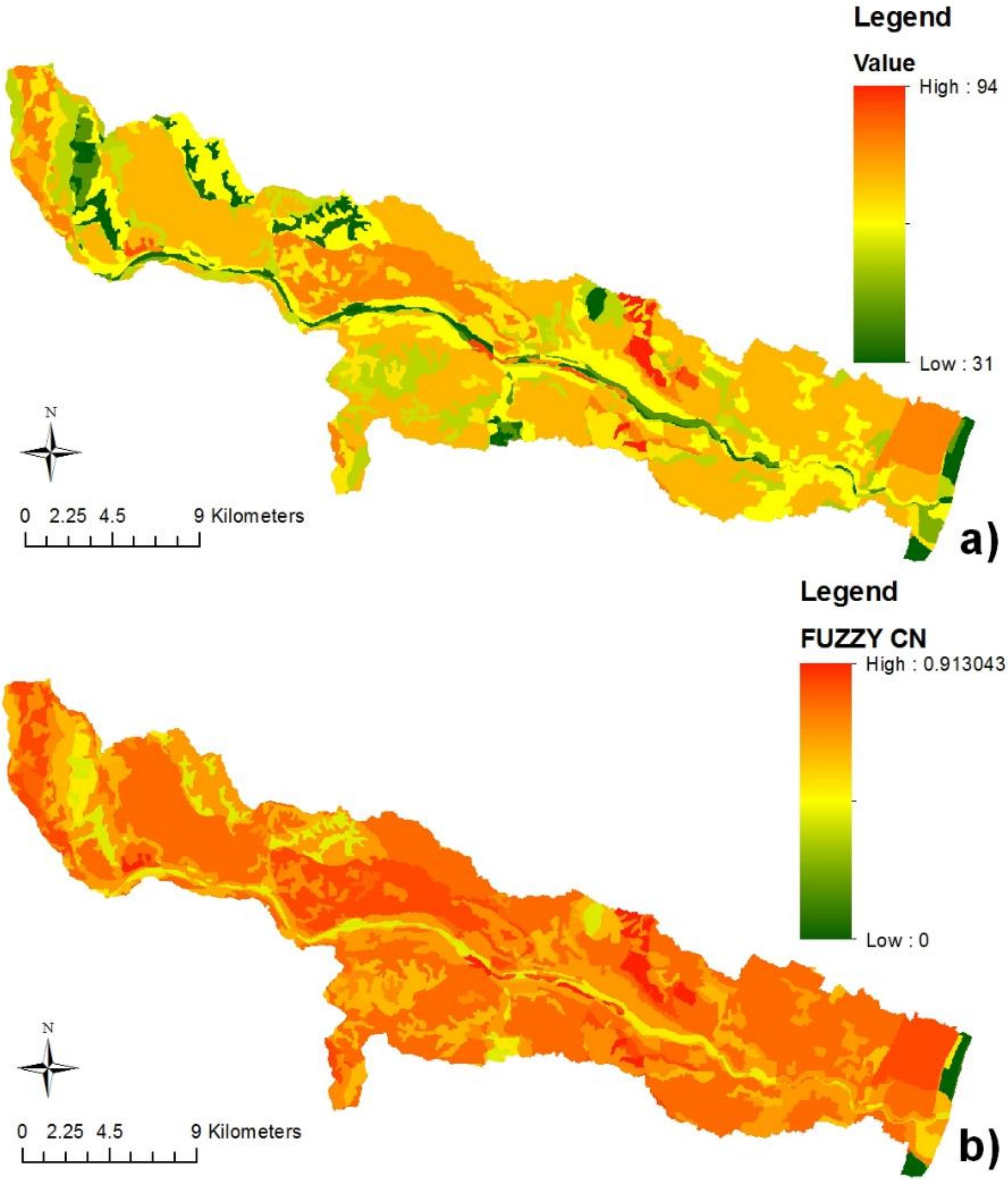

Fig. 18: Spatial distribution of a) CN values and b) the results of fuzzy membership function application in CN values for Agri sub-basin

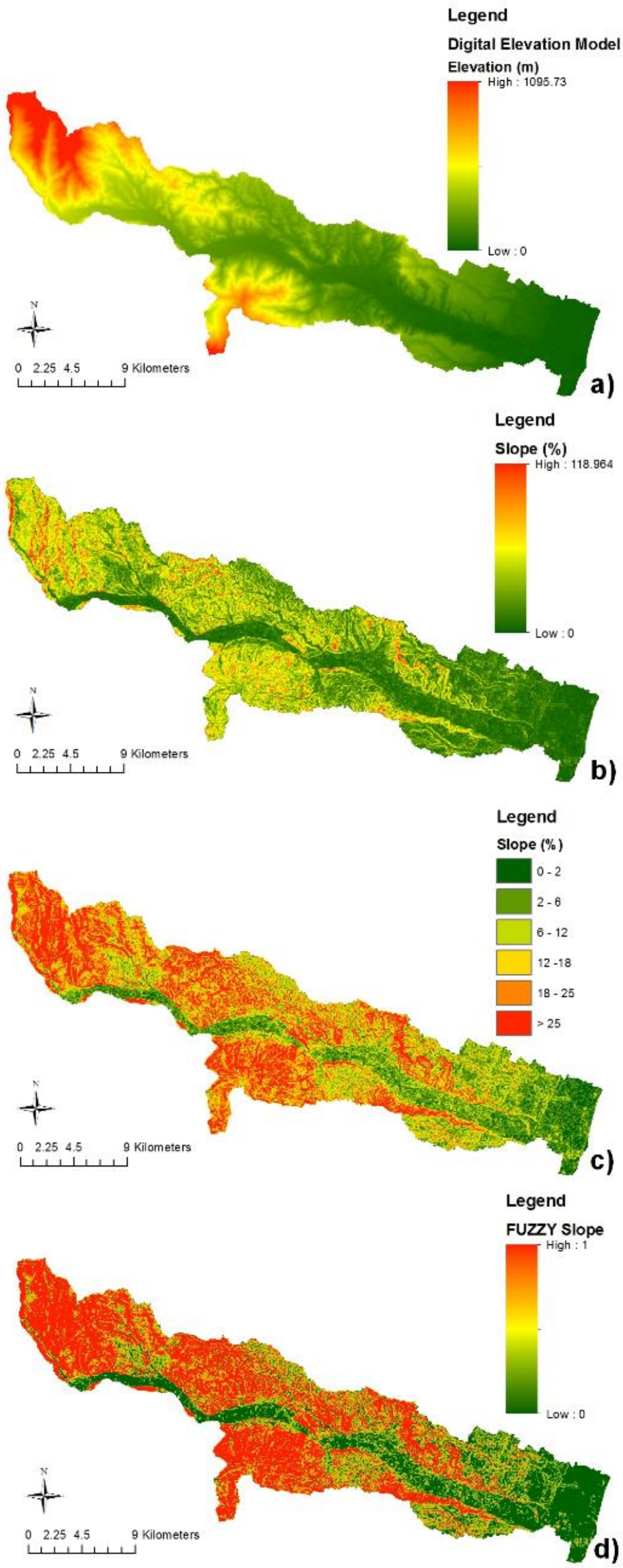

Fig. 19: The DEM (a) used in order to calculate slopes (b) in Agri sub-basin. The Spatial distribution of reclassified slope values (c) and the results of fuzzy membership function application (d) are also presented

Data from 12 meteorological stations for the period 2010-2015 was collected in order to produce the annual rainfall distribution in Agri sub-basin. The location of the 12 meteorological stations is presented in Fig. 20. Since there was no clear correlation between annual rainfall and elevation identified for Agri sub-basin, ordinary Kriging interpolation was applied in order to produce the average annual rainfall spatial distribution, which is presented in Fig. 21a. The average annual rainfall for the pilot basin was estimated at 635 mm. Similarly to the other two basins, a linear increasing fuzzy membership function was applied in rainfall data with minimum and maximum values at 400 and 1200 mm, respectively, and the results are presented in Fig. 21b.

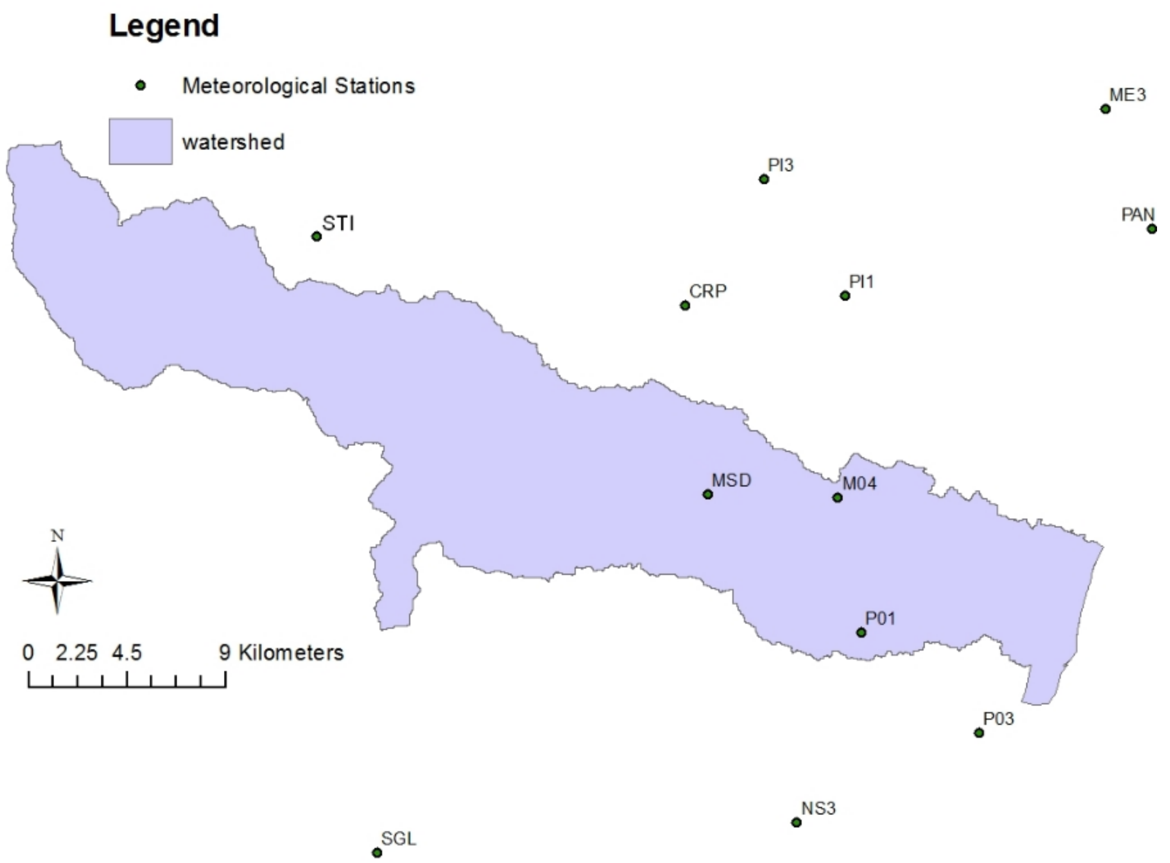

Fig. 20: Spatial distribution of the meteorological stations location in Agri sub-basin

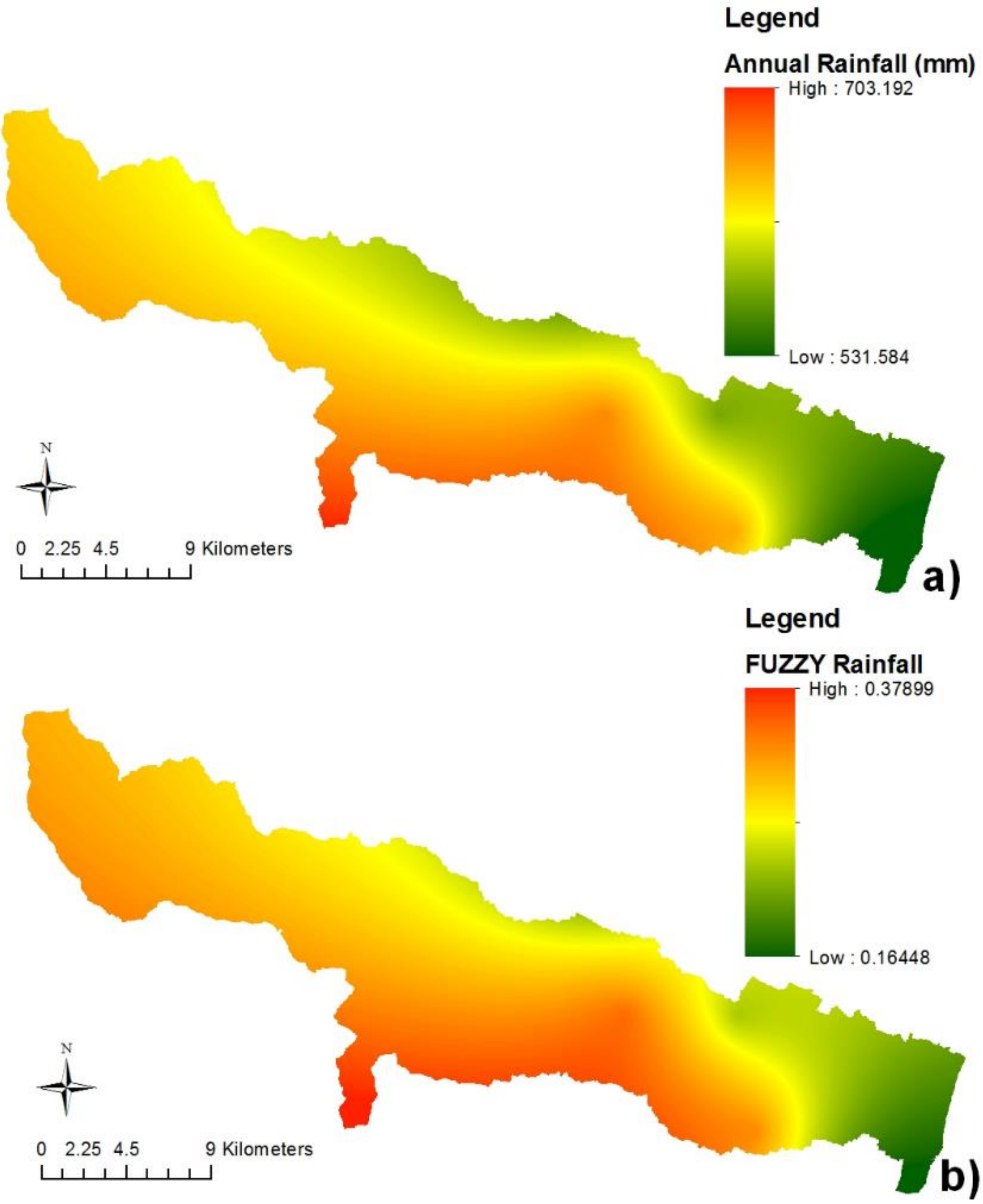

Fig. 21: Spatial distribution of annual rainfall (a) and the results of fuzzy membership function application (b) for Agri sub-basin

3.2. *LEACHING*

3.2.1. Havgas- Milatos sub-basin (Mirabello area)

As presented in Section 2.1, runoff and leaching risk assessment are based on the three same components with the difference that CN and slope components are inversely contributing to leaching compared to runoff. Therefore a decreasing linear membership functions was applied in CN and slope spatial distribution (Fig. 4a and Fig. 5c) and the results are illustrated in Fig. 22.

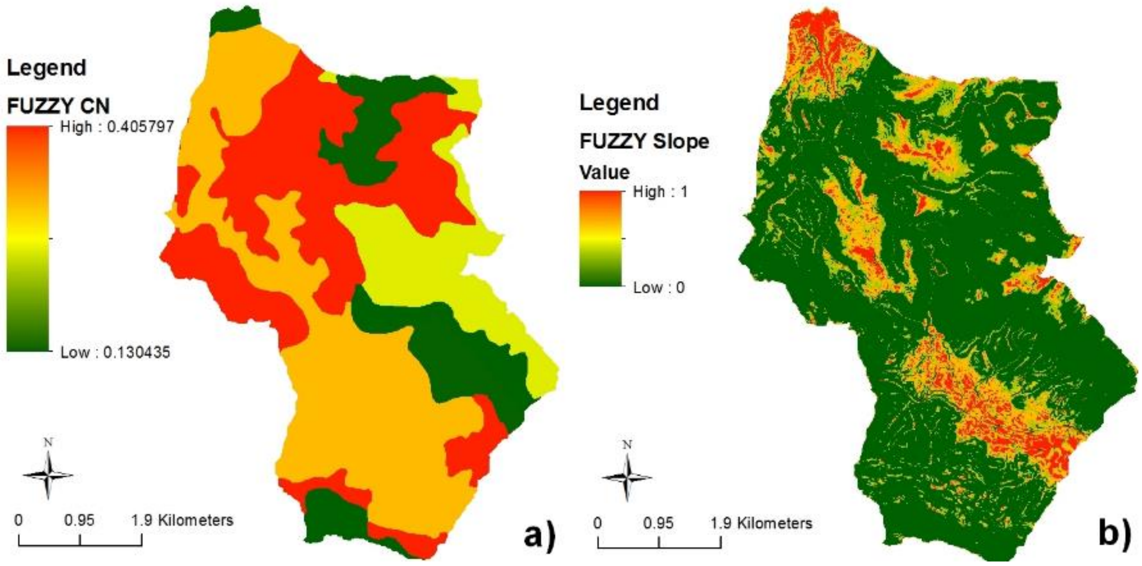

Fig. 22: Spatial distribution of CN and slope values after the application of decreasing linear fuzzy membership function for Havgas - Milatos sub-basin

3.2.2. Tavronitis basin (Platanias area)

Similarly to Havgas - Milatos sub-basin, the results of application of decreasing linear fuzzy membership function to CN (Fig. 11a) and slope (Fig. 12c) data in Tavronitis River basin are presented in Fig. 23.

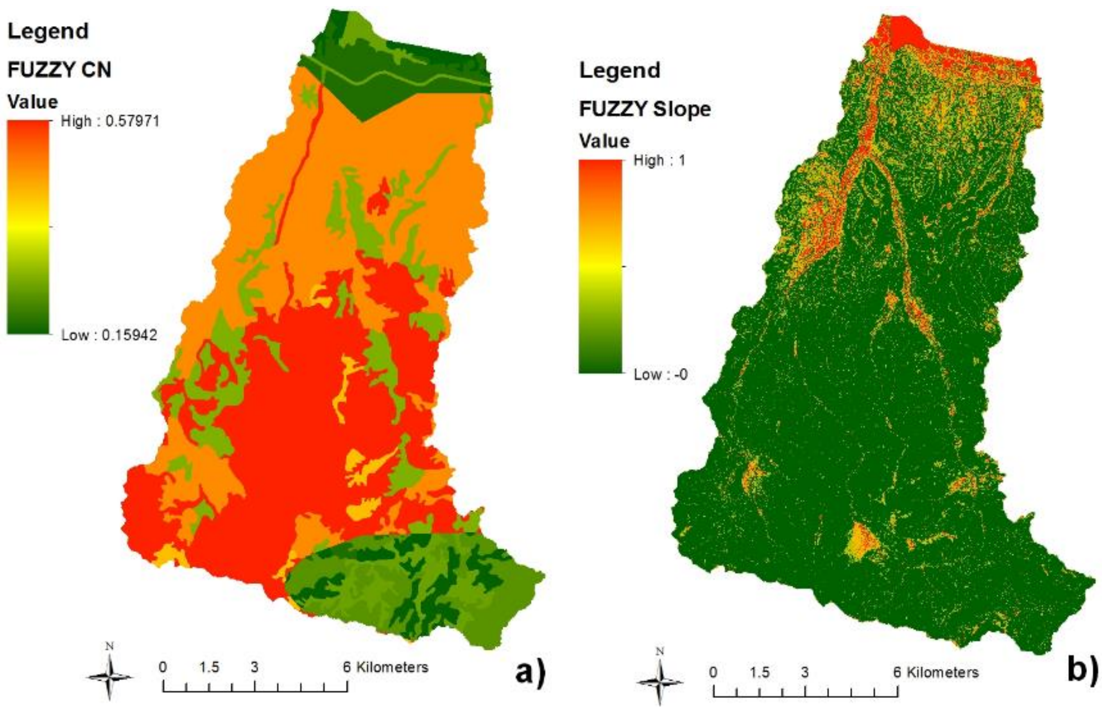

Fig. 23: Spatial distribution of CN and slope values after the application of decreasing linear fuzzy membership function for Tavronitis basin

3.2.3. Agri sub-basin (Metapontino area)

Similarly to the other two basins, the results of application of decreasing linear fuzzy membership function to CN (Fig. 18a) and slope (Fig. 19c) data in Agri sub-basin are presented in Fig. 24.

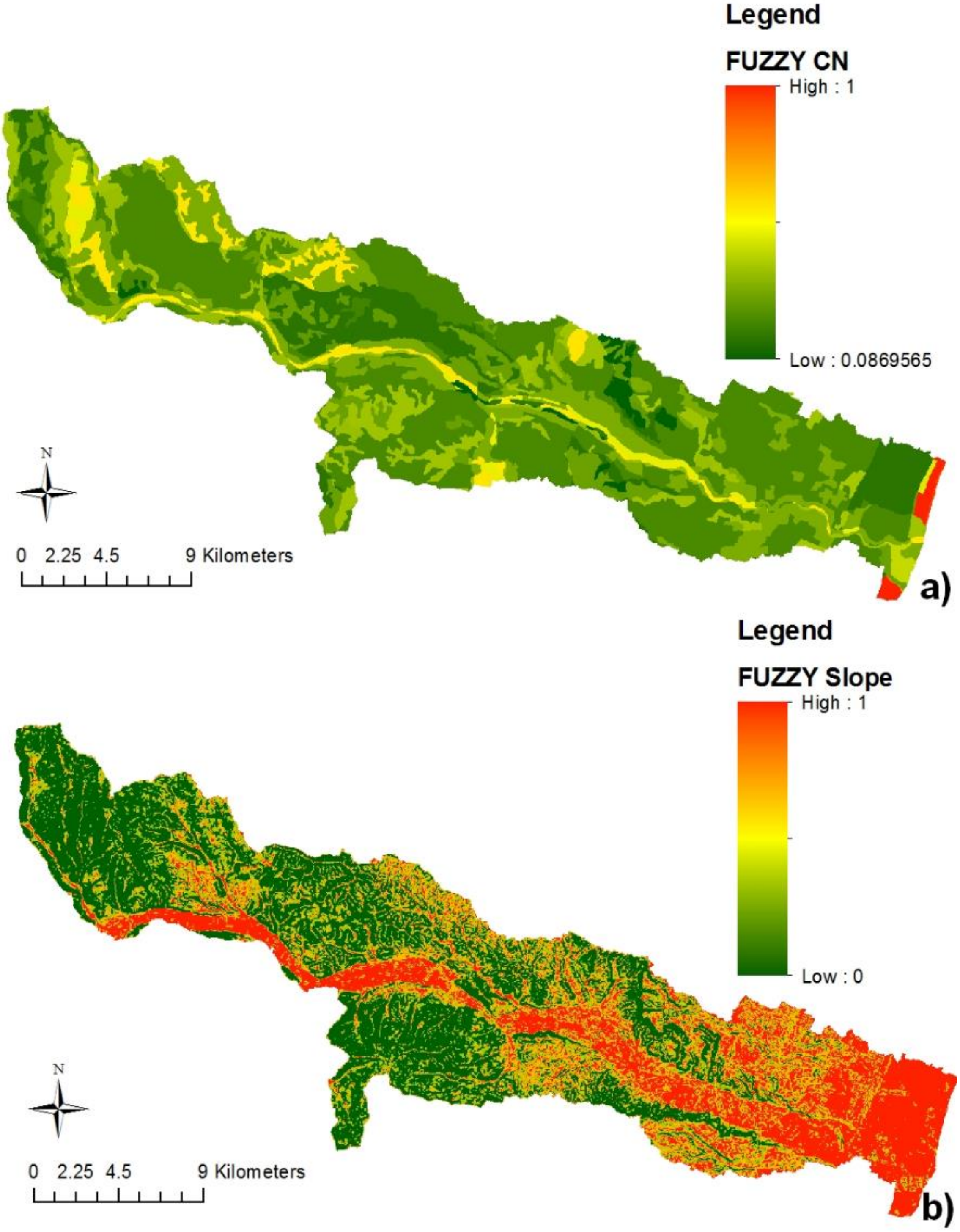

Fig. 24: Spatial distribution of CN and slope values after the application of decreasing linear fuzzy membership function for Agri sub-basin

3.3. *EROSION*

3.3.1. Havgas – Milatos sub-basin (Mirabello area)

In order to calculate the R factor, monthly rainfall data for the period 1962-2004 were used and the MFI was calculated according to Eq. 2. Then, Eqs. 3 and 4 were applied in order to calculate average annual rainfall erosivity for each of the three meteorological station, the location of which was presented in Fig. 6 and the results were averaged. Finally and similarly to rainfall height, an average annual rainfall erosivity vs elevation equation was produced (Fig. 25) and the resulted spatial distribution of rainfall erosivity for Havgas - Milatos sub-basin is presented in Fig. 26. Rainfall erosivity was found to range between 308 and 1773 [MJ mm/(ha ha year^{-1})], with higher rainfall erosivity values presented in higher elevation areas, in which higher rainfall height has been assigned. The average R factor value for Havgas - Milatos sub-basin was 821 MJ mm/(ha ha year^{-1}).

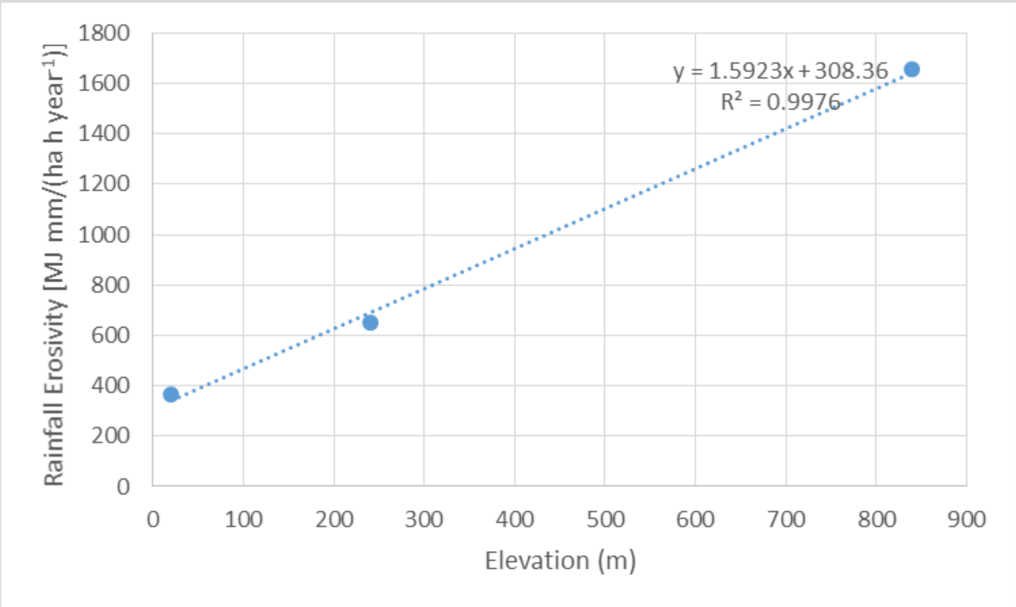

Fig. 25: Diagram of average annual rainfall erosivity vs elevation. The annual rainfall erosivity gradient is also presented for Havgas – Milatos sub-basin

Concerning the soil erodibility (K) factor, the produced spatial distribution based on soil textural class and the corresponding K factor values presented in Table 4, is presented in Fig. 27. Since only one soil profile was indicated in ESDB, soil erodibility factor was 0.0325 t ha h/(ha MJ mm) for the whole basin.

The topographic (LS) factor was calculated according to Eqs. 5 and 6. More specifically, the DEM which is presented in Fig. 5a was used in order to produce the flow direction (

Fig. 28b) and flow accumulation grids (

Fig. 28c). Finally slope grid expressed in degrees (

Fig. 28a) was used and the product of Eqs 5 and 6 application (LS Factor) is presented in

Fig. 28d. LS factor in Havgas - Milatos sub-basin ranged between 0 and 387. Lower values of LS factor were indicated in low slope areas, while higher values were presented in high slope areas. The average LS factor for Havgas - Milatos sub-basin was 8.39.

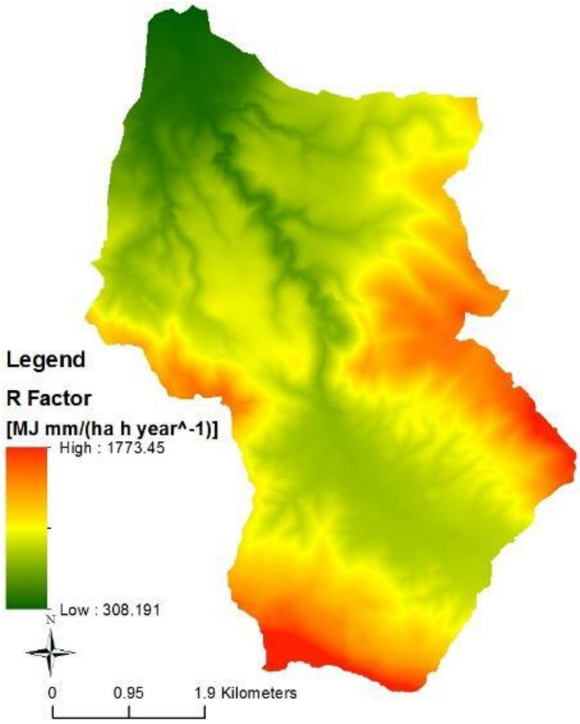

Fig. 26: Average annual rainfall erosivity (R factor) spatial distribution in Havgas - Milatos sub-basin

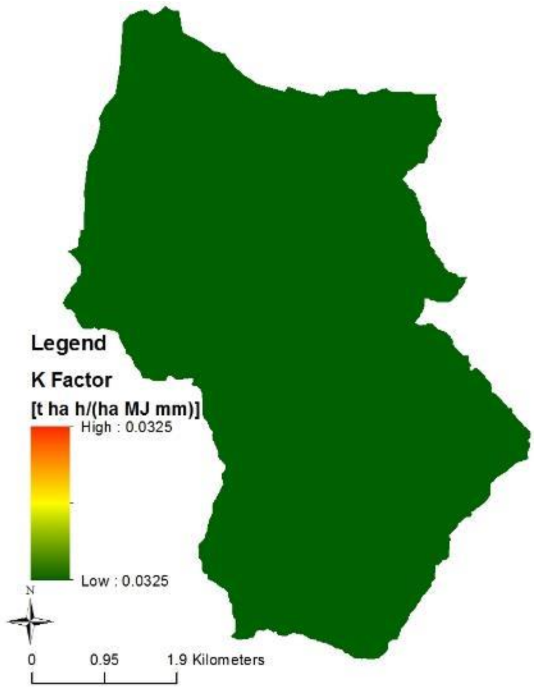

Fig. 27: Spatial distribution of soil erodibility (K) factor in Havgas - Milatos sub-basin

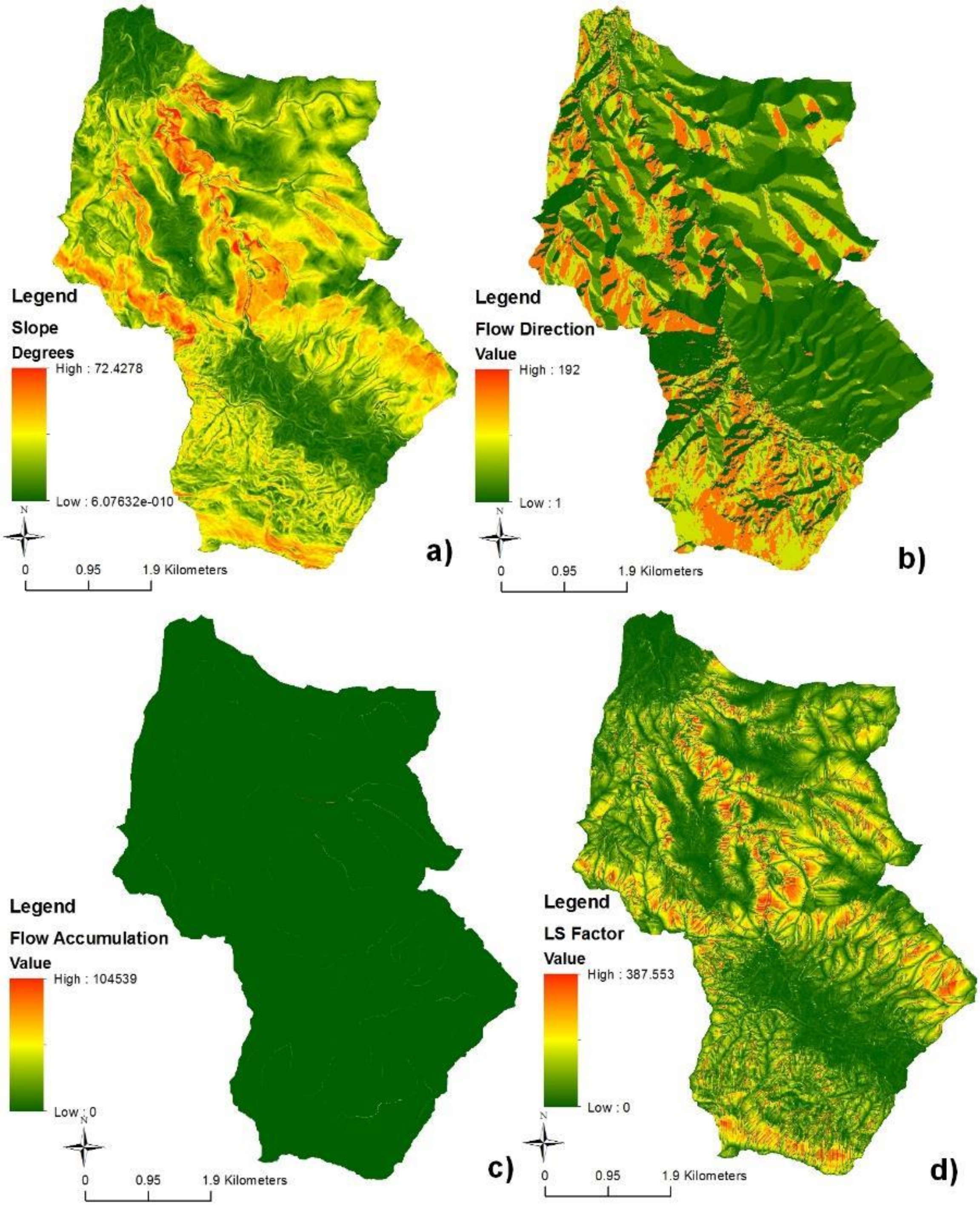

Fig. 28: Spatial distribution of slope (a), flow direction (b), flow accumulation (c) and topographic (LS) factor (d) in Havgas - Milatos sub-basin

The values of C factor used according to Diodato et al. (2011), Teh (2011) and Panagos et al. (2015) for the different land use classes of CORINE 2000 identified in Havgas - Milatos sub-basin are presented in Table 6. The spatial distribution of C factor in Havgas - Milatos sub-basin is presented in Fig. 29. C factor values varied from 0.0522 (natural grasslands) to 0.2652 (sparsely vegetated areas), while the average value for the whole basin was 0.137.

Table 6: Land cover and management (C) factor values applied in Havgas - Milatos sub-basin

CORINE2000 Land Cover Code	Description	C Factor value
112	Discontinuous urban fabric	0.15
223	Olive groves	0.2094
242	Complex cultivation patterns	0.1476
243	Land principally occupied by agriculture, with significant areas of natural vegetation	0.1307
321	Natural grasslands	0.0522
323	Sclerophyllous vegetation	0.0623
333	Sparsely vegetated areas	0.2652

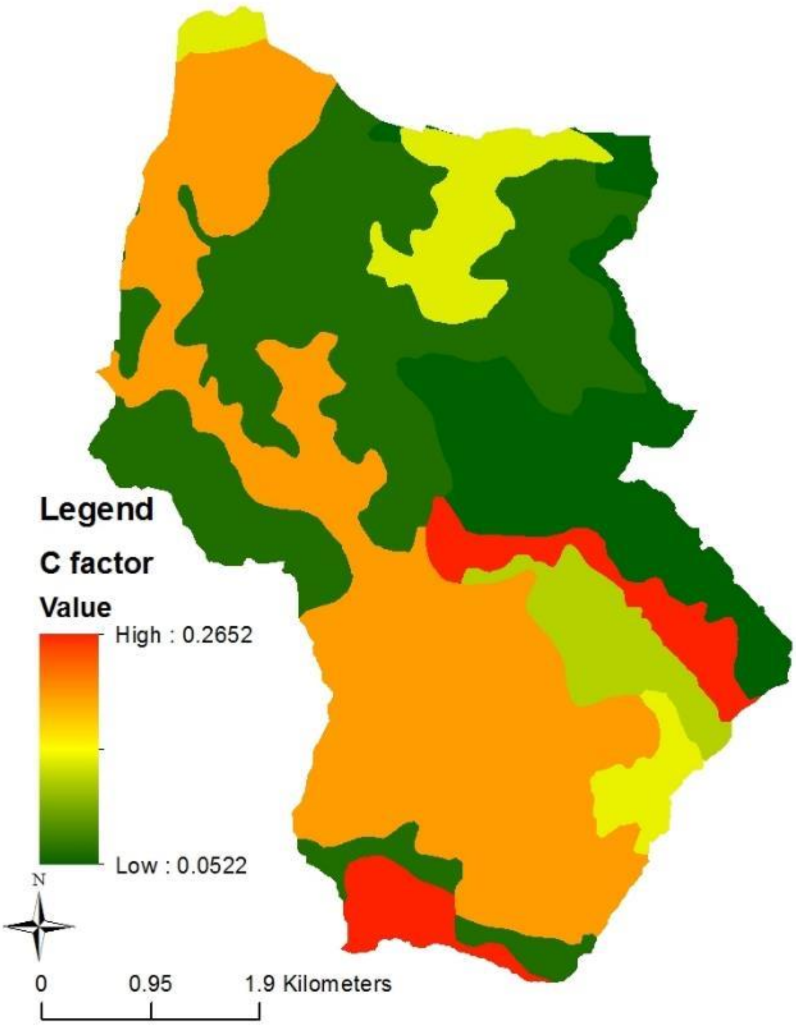

Fig. 29: Spatial distribution of land cover and management (C) factor in Havgas - Milatos sub-basin

3.3.2. Tavronitis Basin (Platanias area)

Similarly to Havgas - Milatos sub-basin and in order to calculate the rainfall erosivity (R) factor, monthly rainfall data for the period 1977-1996 were used and the MFI was calculated according to Eq. 2. Then, Eqs. 3 and 4 were applied in order to calculate average annual rainfall erosivity for each of the four meteorological station, the location of which was presented in Fig. 13 and the results were averaged. Finally and similarly to rainfall height, an average annual rainfall erosivity vs elevation equation was produced (Fig. 30) and the resulted spatial distribution of rainfall erosivity for Tavronitis River basin is presented in Fig. 31. Rainfall erosivity indicated a wide range of variation (364-3900 MJ mm/(ha ha year^{-1})) due to the significant spatial variability of rainfall. The average R factor value for Tavronitis River basin watershed was 1823 MJ mm/(ha ha year^{-1}).

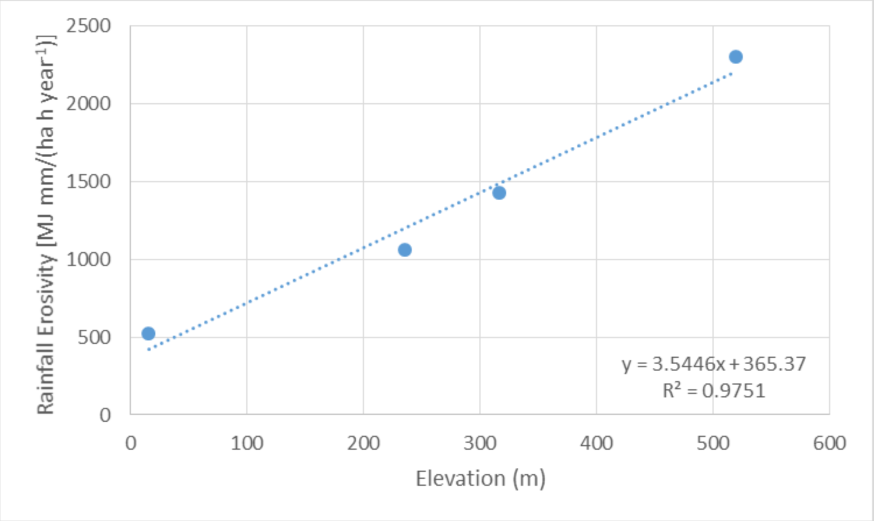

Fig. 30: Diagram of average annual rainfall erosivity vs elevation. The annual rainfall erosivity gradient for Tavronitis basin is also presented

Concerning the soil erodibility (K) factor, the produced spatial distribution based on soil textural class and the corresponding K factor values presented in Table 4, is presented in Fig. 32. The average K factor value for Tavronitis River basin was 0.0328. Similarly to Havgas - Milatos sub-basin, topographic (LS) factor was calculated according to Eqs. 5 and 6. More specifically, the DEM which is presented in Fig. 12a was used in order to produce the flow direction (Fig. 33b) and flow accumulation grids (Fig. 33c). Finally slope grid expressed in degrees (Fig. 33a) was used and the product of Eqs 5 and 6 application (LS Factor) is presented in Fig. 33d. LS factor in Tavronitis River basin ranged between 0 and 401, while the average LS factor value was 7.92. Lower values of LS factor were indicated in low slope areas, while higher values were presented in high slope areas.

The values of C factor used according to Diodato et al. (2011), Teh (2011) and Panagos et al. (2015) for the different land use classes of CORINE 2000 identified in Tavronitis River basin are presented in Table 7. The spatial distribution of C factor in Tavronitis River basin is presented in Fig. 34. C factor ranged between 0.0014 for forested areas of the basin and 0.3269 for non-irrigated arable land, while the average C factor value for the basin was 0.119.

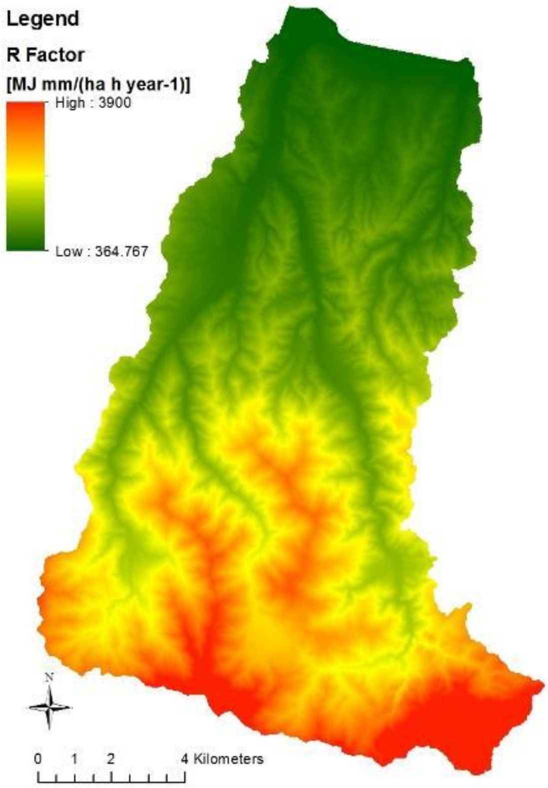

Fig. 31: Average annual rainfall erosivity (R factor) spatial distribution in Tavronitis basin

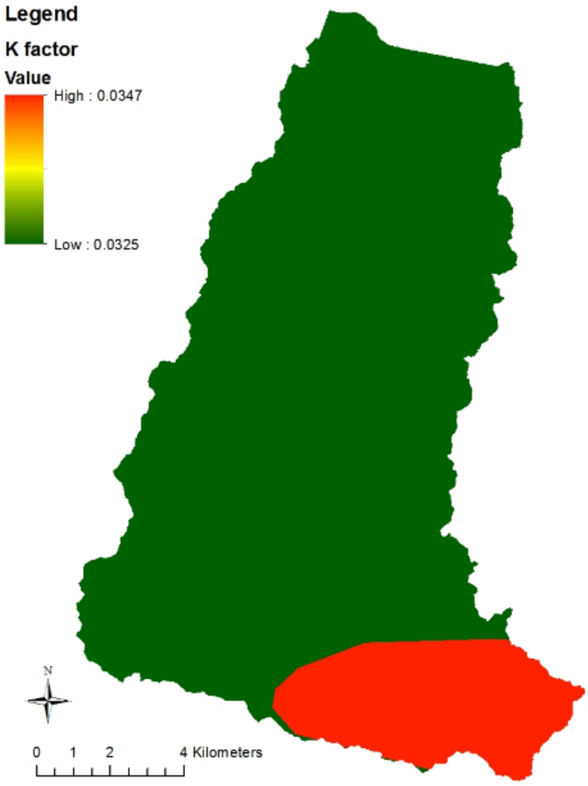

Fig. 32: Spatial distribution of soil erodibility (K) factor in Tavronitis basin

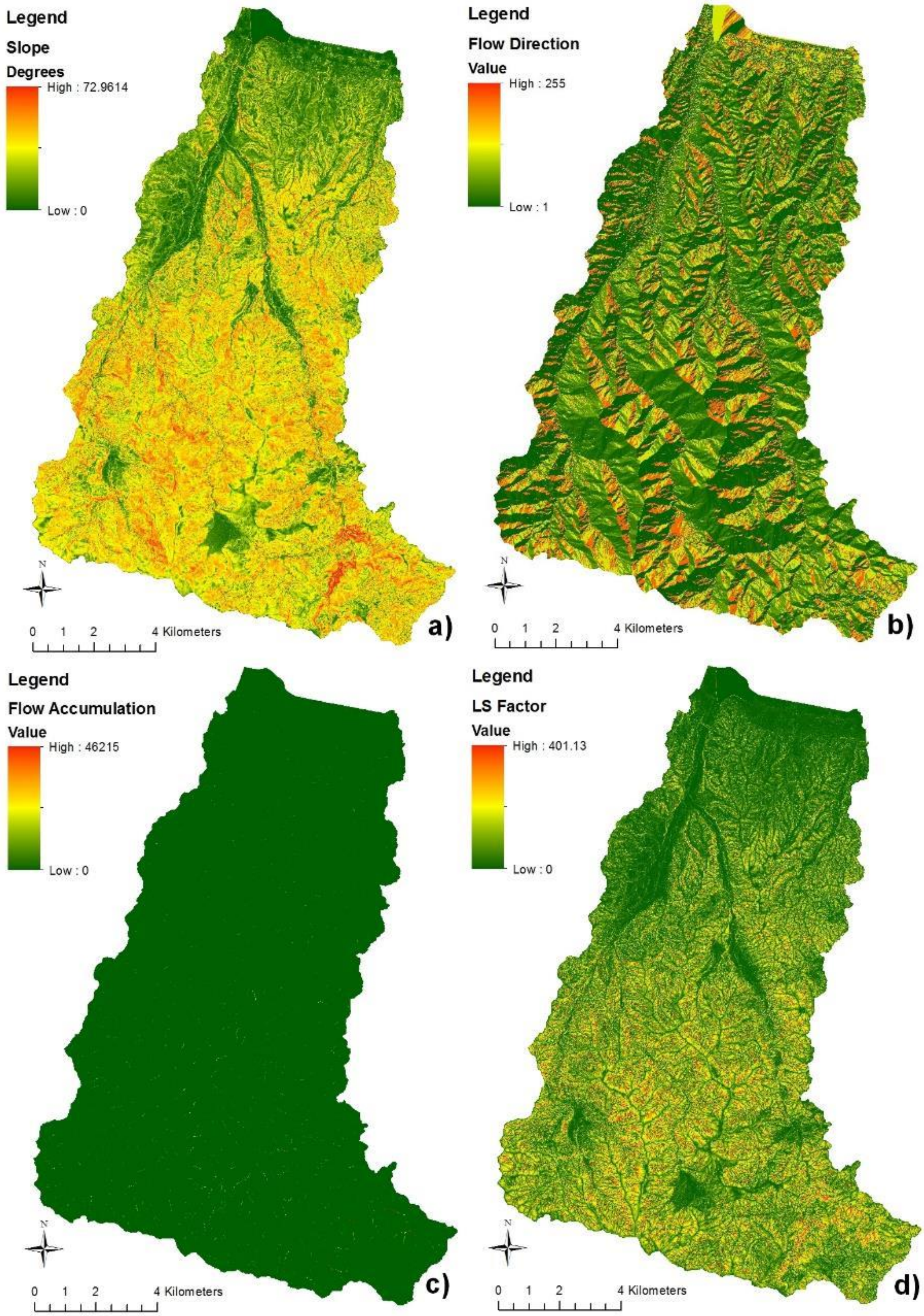

Fig. 33: Spatial distribution of slope (a), flow direction (b), flow accumulation (c) and topographic (LS) factor (d) in Tavronitis basin

Table 7: Land cover and management (C) factor values applied in Tavronitis basin

CORINE2000 Land Cover Code	Description	C Factor value
112	Discontinuous urban fabric	0.15
124	Airports	0.15
133	Construction sites	0.15
221	Non-irrigated arable land	0.3269
222	Fruit trees and berry plantations	0.2188
223	Olive groves	0.2094
242	Complex cultivation patterns	0.1476
243	Land principally occupied by agriculture, with significant areas of natural vegetation	0.1307
311	Broad-leaved forest	0.0014
312	Coniferous forest	0.0014
321	Natural grasslands	0.0522
323	Sclerophyllous vegetation	0.0623
324	Transitional woodland-shrub	0.026
331	Beaches, dunes, sands	0.3062

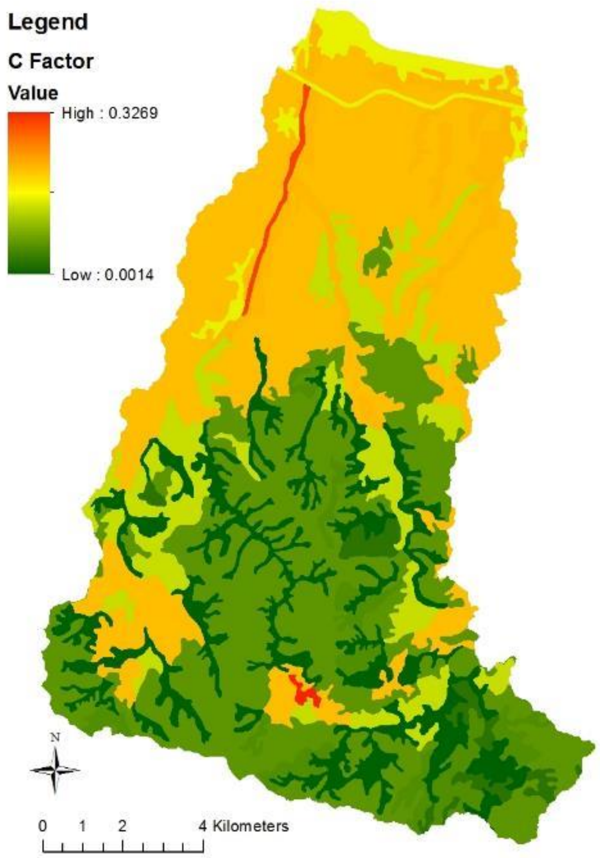

Fig. 34: Spatial distribution of land cover and management (C) factor in Tavronitis basin

3.3.3. Agri Sub-basin (Metapontino area)

Similarly to the other basins and in order to calculate the rainfall erosivity (R) factor, monthly rainfall data for the period 2010-2015 were used and the Modified Fournier Index (MFI) was calculated according to Eq. 2. Then, Eq. 3 was applied in order to calculate average annual rainfall erosivity for each of the meteorological station, the location of which was presented in Fig. 20. Finally and similarly to rainfall height, the spatial distribution of average annual rainfall erosivity was produced using ordinary Kriging interpolation (Fig. 35). Rainfall erosivity variation varied between 345 and 457 MJ mm/(ha ha year^{-1}, while the average R factor value for Agri sub-basin was 413 MJ mm/(ha ha year^{-1}).

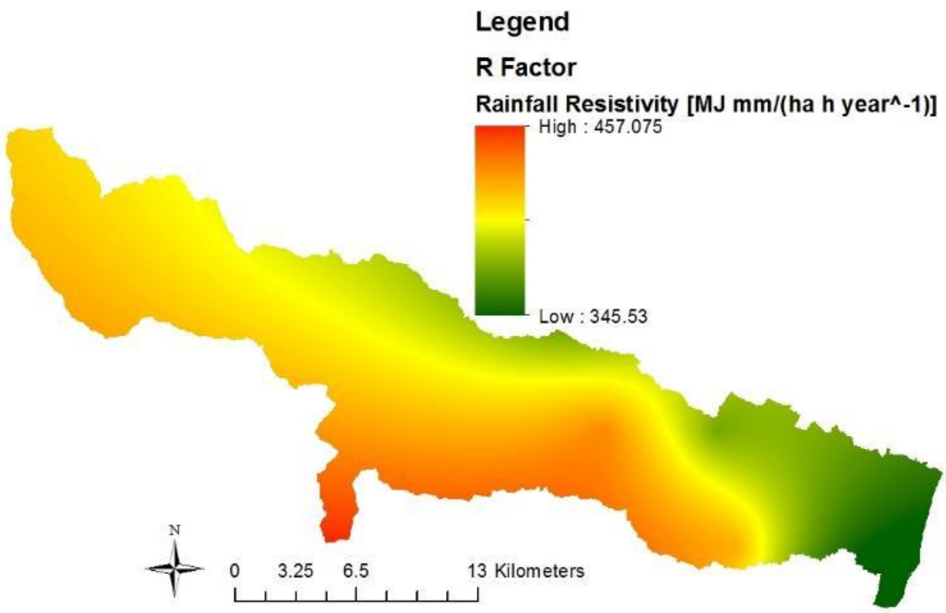

Fig. 35: Average annual rainfall erosivity (R factor) spatial distribution in Agri sub-basin

Concerning the soil erodibility (K) factor, the produced spatial distribution based on soil textural class and the corresponding K factor values presented in Table 4, is presented in Fig. 36. The average K factor value for Tavronitis River basin was 0.0348. Similarly to the other two basins basin, topographic (LS) factor was calculated according to Eqs. 5 and 6. More specifically, the DEM which is presented in Fig. 19a was used in order to produce the flow direction (Fig. 37b) and flow accumulation grids (Fig. 37c). Finally slope grid expressed in degrees (Fig. 33a) was used and the product of Eqs 5 and 6 application (LS Factor) is presented in Fig. 37d. LS factor in Agri sub-basin ranged between 0 and 108, while the average LS factor value was 3.88. Lower values of LS factor are indicated in low slope areas, while higher values are presented in high slope areas.

The values of C factor used according to Diodato et al. (2011), Teh (2011) and Panagos et al. (2015) for the different land use classes of CORINE 2006 identified in Agri sub-basin are presented in Table 8. The spatial distribution of C factor in Agri sub-basin is presented in Fig. 38. C factor ranged between 0 for several artificial surfaces land cover classes and 1 for beaches, dunes, sands land cover class, while the average C factor value for the basin was 0.2035.

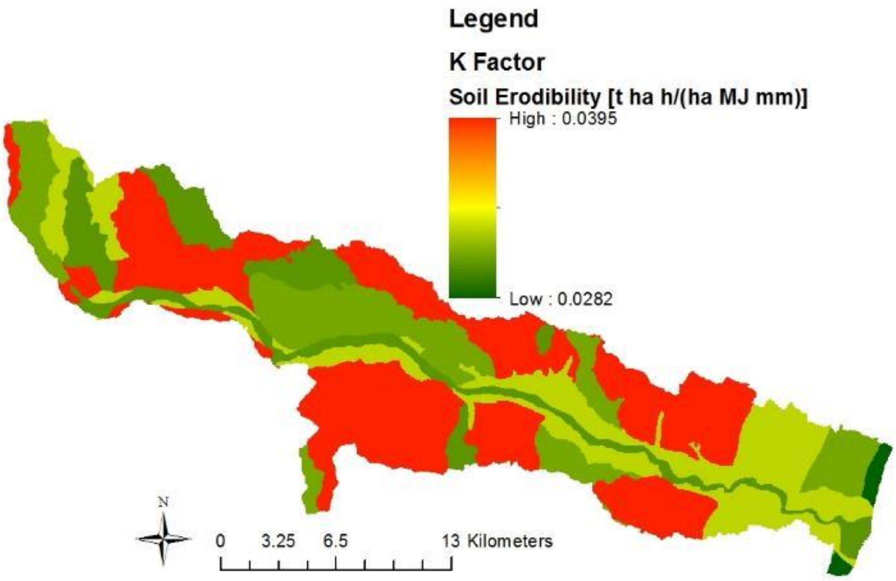

Fig. 36: Spatial distribution of soil erodibility (K) factor in Agri sub-basin

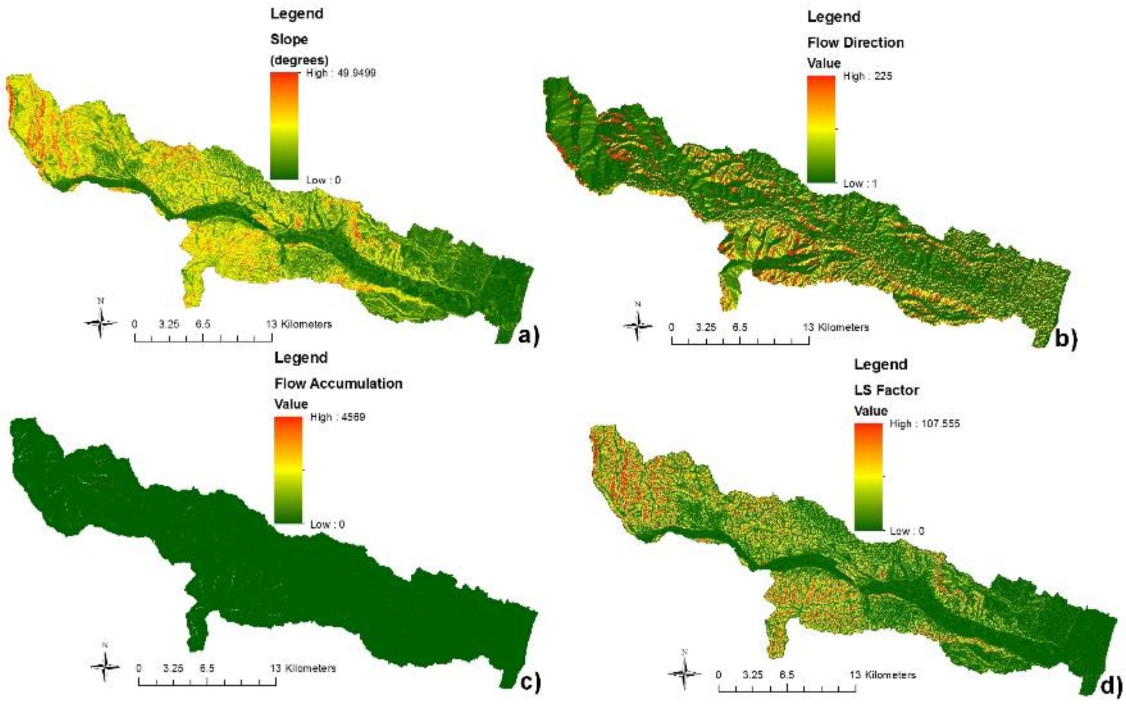

Fig. 37: Spatial distribution of slope (a), flow direction (b), flow accumulation (c) and topographic (LS) factor (d) in Agri sub-basin

Table 8: Land cover and management (C) factor values applied in Agri sub-basin

CORINE2006 Land Cover Code	Description	C Factor value
112	Discontinuous urban fabric	0.15
121	Industrial or commercial units	0.15

123	Port areas	0
133	Construction sites	0
142	Sport and leisure facilities	0
211	Non/irrigated arable land	0.3
221	Vineyards	0.3454
222	Fruit trees and berry plantations	0.2188
223	Olive groves	0.2163
231	Pastures	0.0988
241	Annual crops associated with permanent crops	0.2323
242	Complex cultivation patterns	0.1478
243	Land principally occupied by agriculture, with significant areas of natural vegetation	0.1245
311	Broad/leaved forest	0.0013
312	Coniferous forest	0.0013
313	Mixed forest	0.0013
321	Natural grasslands	0.0416
323	Sclerophyllous vegetation	0.0623
324	Transitional woodland/shrub	0.0242
331	Beaches, dunes, sands	1
333	Sparsely vegetated areas	0.2509
421	Inland marshes	0.001
422	Peat bogs	0.001
512	Water bodies	0
523	Sea and ocean	0

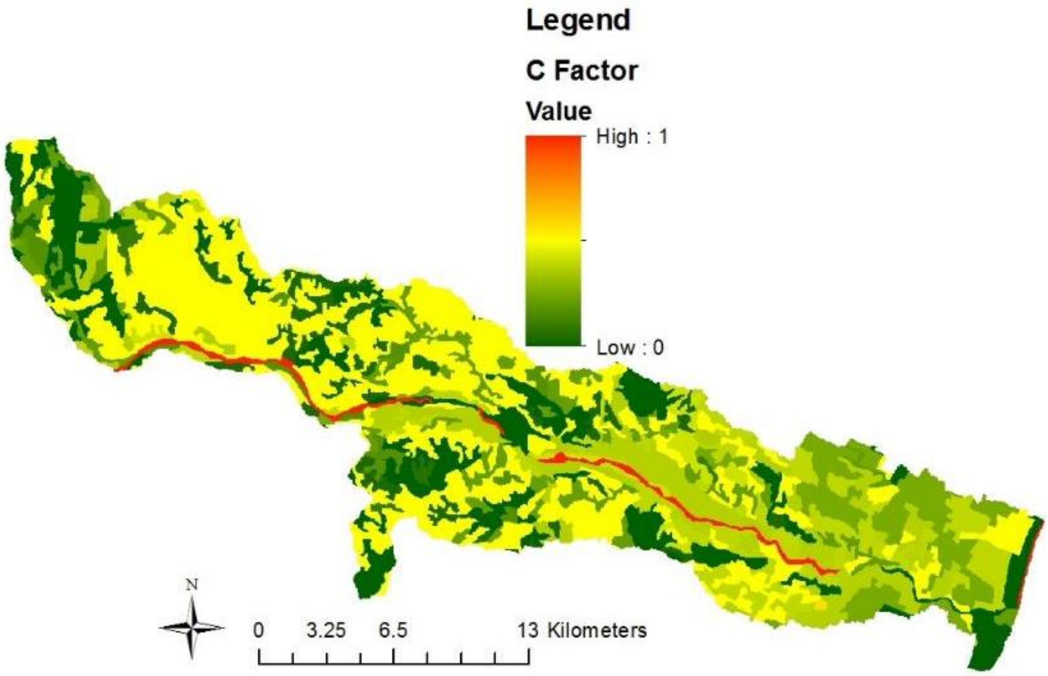

Fig. 38: Spatial distribution of land cover and management (C) factor in Agri sub-basin

4. RUNOFF RISK ASSESSMENT RESULTS

4.1. *FOR THE STUDIED AREAS*

4.1.1. Havgas - Milatos sub-basin

The results of runoff risk assessment methodology application at Havgas - Milatos sub-basin are presented in Fig. 39. High runoff potential is indicated for the major part of the basin, while medium runoff potential is presented mainly in the mild slope areas. In contrast, Very high runoff risk potential is presented in the mountainous areas mainly because of the steep slopes and higher rainfall. The average runoff potential for Havgas - Milatos sub-basin was found to be 2.10 and it is characterized as high according to the classification scheme presented in Table 2.

With regard to runoff potential of agricultural areas in Havgas - Milatos sub-basin, basic statistical parameters are presented in Table 9. The average runoff potential for all agricultural area classes was found to be high (values >1.8 and <2.4). The average runoff potential of olive groves, which constitute the dominant land cover for Havgas - Milatos sub-basin (36.52% of the total basin area), was 1.92 and it is considered as high, while the corresponding range of variation was 0.84 (Low) – 2.66 (Very High), thus indicating a significant degree of runoff potential variation for olive groves in Havgas - Milatos sub-basin. Higher average runoff potential was calculated for land principally occupied by agriculture, with significant areas of natural vegetation (2.28) and lower average runoff potential was calculated for complex cultivation patterns (1.82).

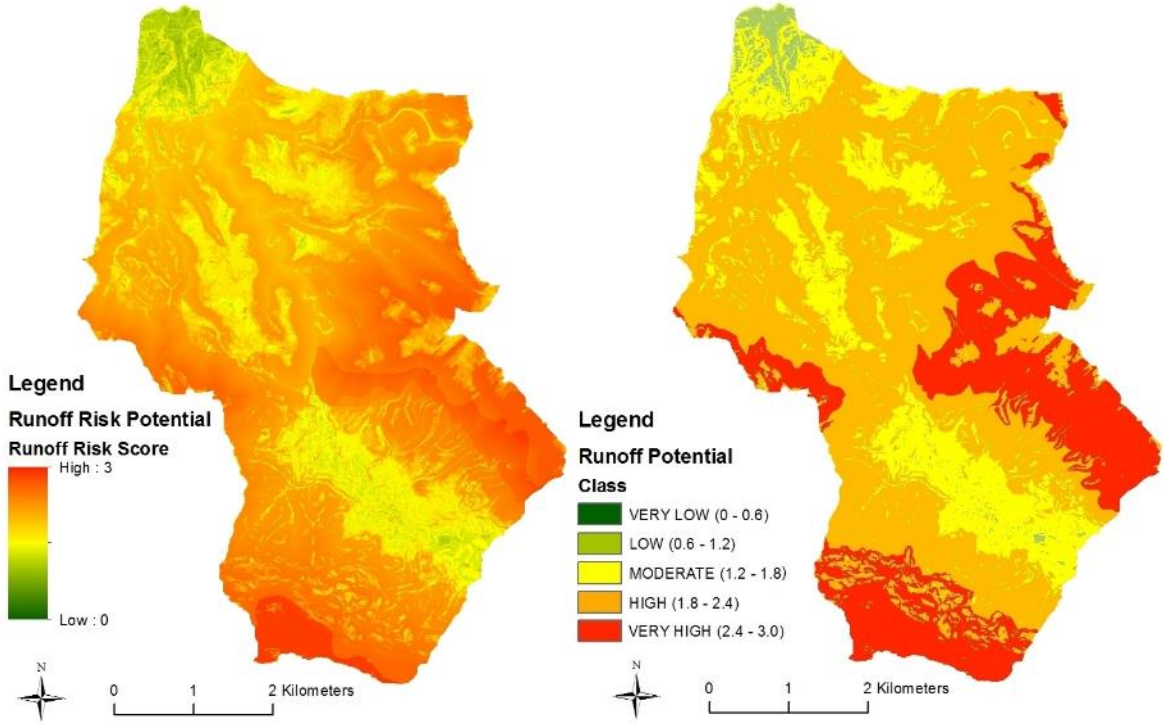

Fig. 39: Spatial distribution of runoff potential score and classes in Havgas - Milatos sub-basin

Table 9: Runoff potential statistics for the agricultural areas of Havgas - Milatos sub-basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km²)	(%)	Score	Class	Score	Class	Score	Class
223	Olive groves	10.99	36.52	0.84	Low	2.66	Very High	1.92	High
242	Complex cultivation patterns	1.74	5.79	0.92	Low	2.41	Very High	1.82	High
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1.38	4.57	1.31	Moderate	2.51	Very High	2.28	High

With regard to the potential impact of agricultural runoff to river water systems, it has to be mentioned that there is no surface water body officially identified in the corresponding Water Resources Management Plan (Hellenic Special Secretariat for Water 2015), because of the small basin size (about 30 km^2), which overall produces low runoff volumes and therefore river flow is ephemeral and probably event based. Nevertheless, the study area basin was discretized into 6 sub-basins the spatial distribution of which is presented in Fig. 40. In general, agricultural runoff to river water systems can be considered as high due to the fact that agricultural land constitutes the major land use in the basin (46.88% of the total basin area) and the runoff potential of agricultural areas is classified as high, as presented in Table 9. Runoff potential variation in agricultural lands of each sub-basin is presented in Table 10. On the average, high runoff potential was estimated for sub-basins HM-2, HM-3, HM-5 and HM-6, which cover about 88% of the agricultural land situated in Havgas - Milatos sub-basin. Sub-basins HM-1 and HM-4 are presenting moderate runoff potential.

Table 10: Runoff potential statistics for the agricultural areas in each sub-basin of Havgas - Milatos sub-basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km²)	(%)	Score	Class	Score	Class	Score	Class
HM-1	1.22	8.62	0.84	Low	1.98	High	1.27	Moderate
HM-2	1.19	8.46	0.87	Low	2.40	Very high	1.94	High
HM-3	0.31	2.23	1.26	Moderate	2.32	High	1.87	High
HM-4	0.48	3.42	0.83	Low	2.27	High	1.77	Moderate
HM-5	2.24	15.89	0.85	Low	2.34	High	1.86	High
HM-6	8.66	61.36	1.10	Moderate	2.66	Very high	2.07	High

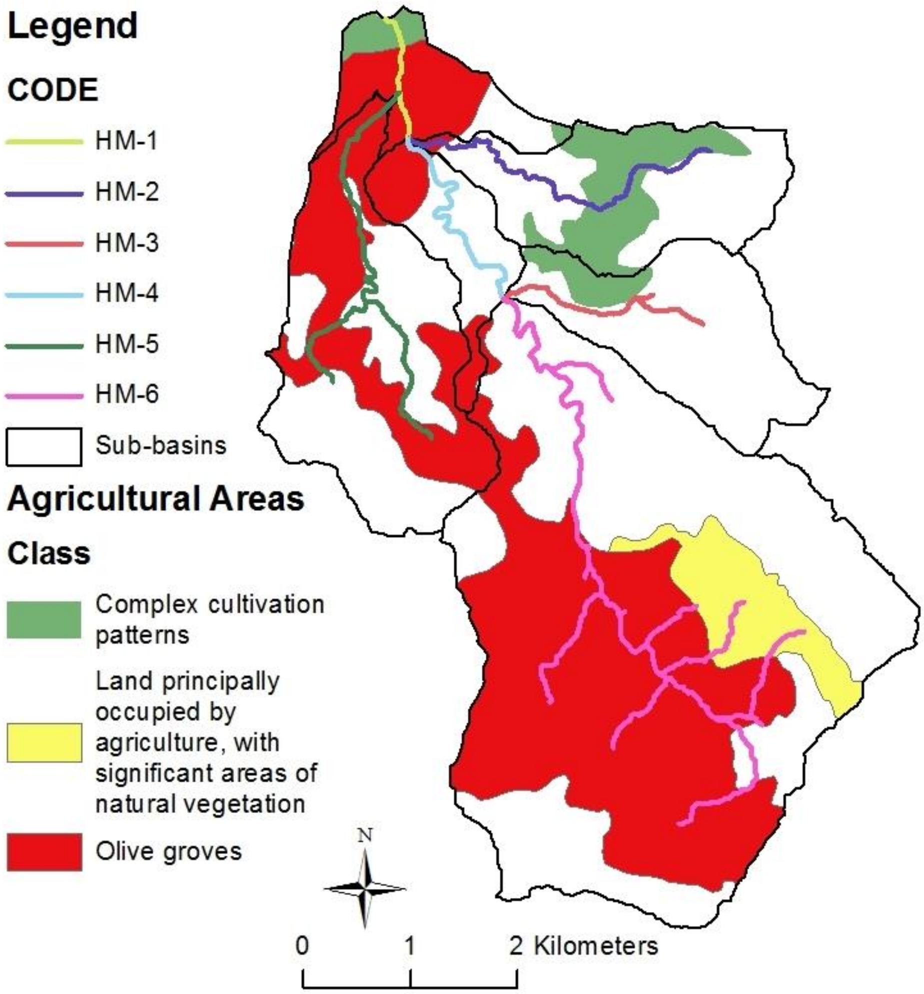

Fig. 40: Agricultural areas and main river course in Havgas - Milatos sub-basin

4.1.2. Tavronitis basin

The results of runoff risk assessment methodology application in Tavronitis River basin are presented in Fig. 41. Very high runoff potential is indicated for the southern part of Tavronitis River basin, while moderate and high runoff potential is dominating in the northern part. The average runoff potential for Tavronitis River basin was found to be 2.26 and it is characterized as high according to the classification scheme presented in Table 2.

Concerning the runoff potential of agricultural areas in Tavronitis River basin, basic statistical parameters are presented in Table 11. The average runoff potential for all agricultural areas classes ranged from moderate to high. The lowest average runoff potential was calculated for fruit trees and berry plantations (1.59-Moderate), while the highest runoff potential was calculated for land principally occupied by agriculture, with significant areas of natural vegetation (2.52-Very high). Especially for olive groves, which constitute the dominant land cover for Tavronitis River basin (32.34%), the average runoff potential was 2.06 and it is considered as high, while the corresponding range of variation was 0.88 (Low) – 2.75 (Very High), thus indicating a significant degree of runoff potential variation for olive groves in Tavronitis River basin.

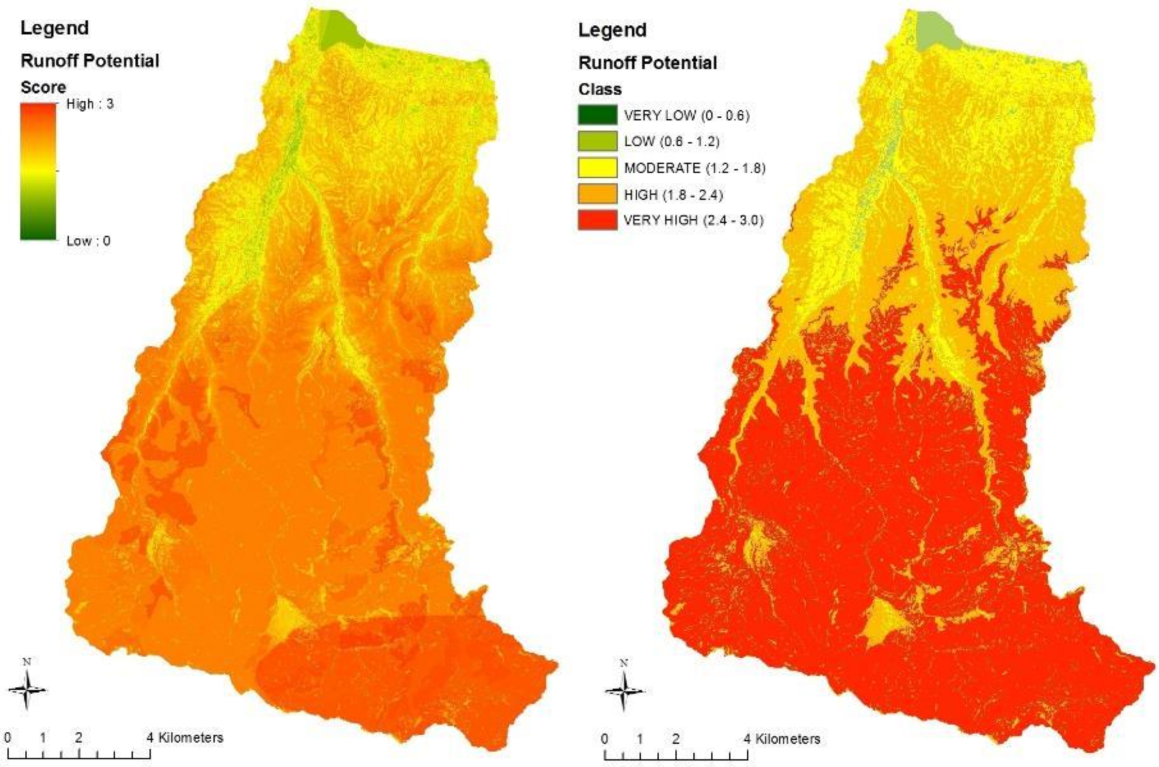

Fig. 41: Spatial distribution of runoff potential score and classes in Tavronitis basin

Table 11: Runoff potential statistics for the agricultural lands of Tavronitis basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km²)	(%)	Score	Class	Score	Class	Score	Class
221	Non-irrigated arable land	0.26	0.16	1.51	Moderate	2.51	Very High	2.00	High
222	Fruit trees and berry plantations	7.86	4.76	0.85	Low	2.33	High	1.59	Moderate
223	Olive groves	53.41	32.34	0.88	Low	2.75	Very High	2.06	High
242	Complex cultivation patterns	2.95	1.79	1.05	Low	2.45	Very High	1.58	Moderate
243	Land principally occupied by agriculture, with significant areas of natural vegetation	17.08	10.34	1.15	Low	2.84	Very High	2.52	Very High

With regard to the potential impact of agricultural land runoff to river water bodies, it can be considered as high due to the fact that almost half of the basin's area is agricultural (49.39% of the total basin area) and the runoff potential of agricultural areas was 2.09, thus classified as high. One major river system (Tavronitis River) and two streams are identified in Tavronitis River basin, the location of which is presented in Fig. 42. Tavronitis River is further subdivided into 7 river water bodies, while the other two streams included in Maleme basin have not been officially designated in Water Resources Management Plan (Hellenic Special Secretariat for Water 2015). As presented in Fig. 42, the northern part of Tavronitis River course flows within agricultural areas, while agricultural activities are also developed along the course of the other two streams located in Maleme basin. Runoff potential variation of agricultural lands for each sub-basin is presented in Table 12. Except from Maleme and GR3901R000301006N basins, which are presenting on the average moderate runoff potential, the corresponding classes for the other sub-basins, which are located southern, are indicated as of high or very high runoff potential.

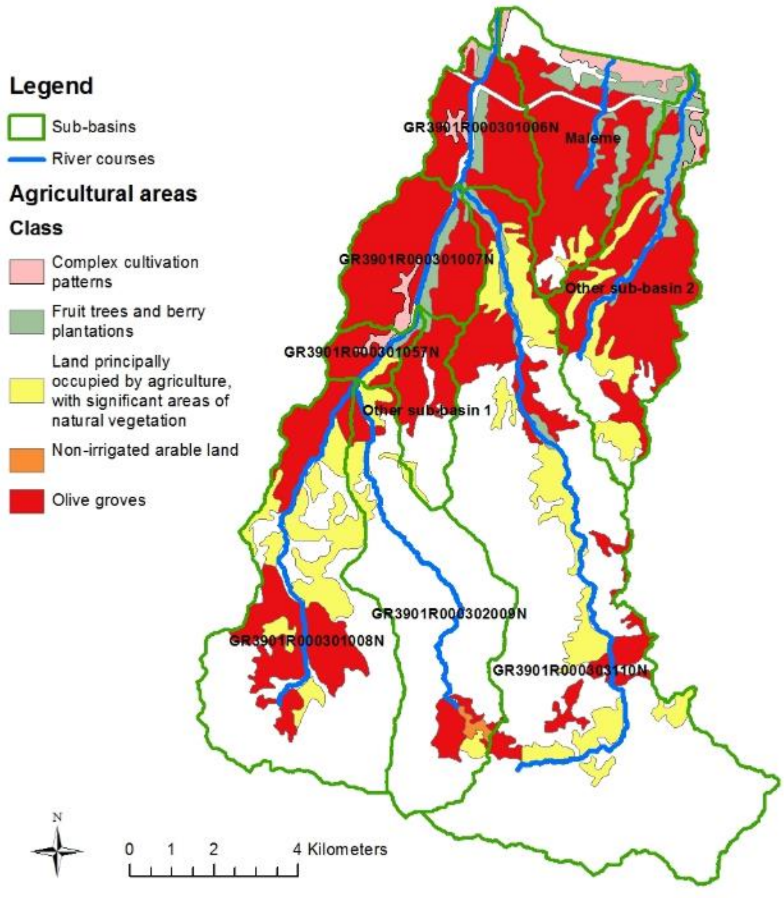

Fig. 42: Agricultural areas and main river course in Tavronitis basin

Table 12: Runoff potential statistics for the agricultural areas in each sub-basin of Tavronitis basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km²)	(%)	Score	Class	Score	Class	Score	Class
GR3901R000301006N	7.08	8.72	0.79	Low	2.37	High	1.79	Moderate

Maleme	12.60	15.51	0.90	Low	2.61	Very high	1.77	Moderate
Other sub-basin 2	15.16	18.67	0.85	Low	2.68	Very high	2.09	High
GR3901R000301007N	9.03	11.11	0.84	Low	2.61	Very high	1.83	High
GR3901R000303110N	15.62	19.22	0.91	Low	2.84	Very high	2.27	High
GR3901R000301057N	2.44	3.01	0.94	Low	2.53	Very high	1.99	High
GR3901R000301008N	12.77	15.72	1.12	Low	2.68	Very high	2.48	Very high
GR3901R000302009N	3.66	4.51	1.11	Low	2.84	Very high	2.34	High
Other sub-basin 1	2.88	3.55	1.02	Low	2.68	Very high	2.28	High

4.1.3. Agri sub-basin

The results of runoff risk assessment methodology application in Agri sub-basin are presented in Fig. 43. Moderate runoff potential dominates in the basin while zones of high runoff potential are also met. Low runoff areas are identified along Agri River course which are attributed to "Beaches, dunes, sands" land cover, while low runoff is also identified in the eastern part of the basin. The average runoff potential of Agri sub-basin was found to be 1.56 and it is characterized as moderate according to the classification scheme presented in Table 2.

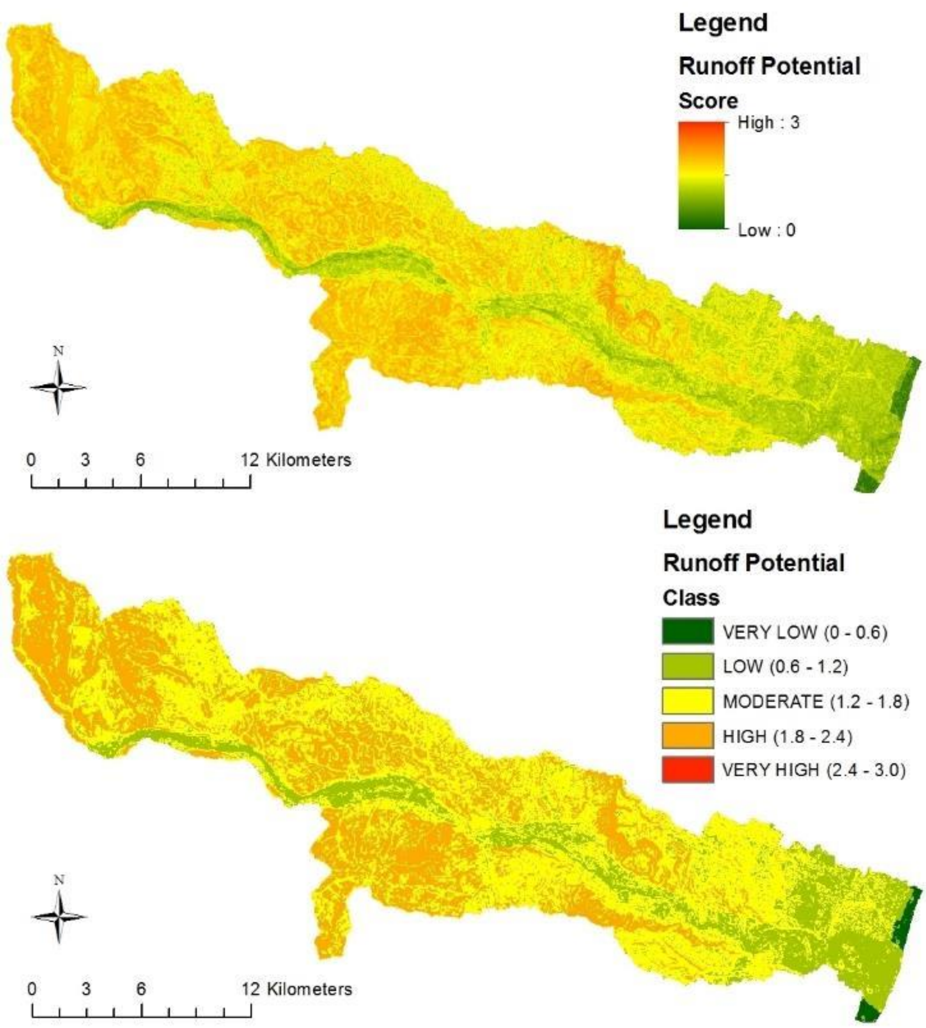

Fig. 43: Spatial distribution of runoff potential score and classes in Agri sub-basin

Concerning the runoff potential of agricultural areas in Agri sub-basin, basic statistical parameters are presented in Table 13. The average runoff potential for all agricultural areas categories was classified as moderate. The lowest average runoff potential was calculated for fruit trees and berry plantations (1.24-Moderate), while the highest runoff potential was calculated for land principally occupied by agriculture, with significant areas of natural vegetation (1.72-Very high). Especially for non-irrigated arable land, which constitute the dominant land cover for Agri sub-basin (36.58%), the average runoff potential was 1.66 and it is considered as moderate, while the corresponding range of variation was 0.65 (Low) – 2.26 (High).

Table 13: Runoff potential statistics for the agricultural lands of Agri sub-basin.

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km^2)	(%)	Score	Class	Score	Class	Score	Class
211	Non/irrigated arable land	151.22	36.58	0.65	Low	2.26	High	1.66	Moderate
221	Vineyards	0.26	0.06	0.98	Low	1.79	Moderate	1.39	Moderate
222	Fruit trees and berry plantations	38.15	9.23	0.71	Low	2.09	High	1.24	Moderate
223	Olive groves	7.34	1.78	0.81	Low	2.21	High	1.59	Moderate
241	Annual crops associated with permanent crops	39.35	9.52	0.74	Low	2.19	High	1.40	Moderate
242	Complex cultivation patterns	28.79	6.97	0.82	Low	2.13	High	1.28	Moderate
243	Land principally occupied by agriculture, with significant areas of natural vegetation	29.65	7.17	0.73	Low	2.23	High	1.72	Moderate

With regard to the potential impact to river water bodies from agricultural land runoff, it can be considered as moderate to high due to the fact that more than 70% of the basin's area is agricultural and the runoff potential of agricultural areas was 2.09, thus classified as moderate. Agri River flows through Agri sub-basin, which constitutes part of Agri River basin that covers an area of about 1,700 km^2. Sauro river which constitute a significant tributary of Agri River, and also some streams are also identified and presented in Fig. 44. The basin was discretized into 14 sub-basin, 4 of which belong to Sauro river and 10 to Agri River. As demonstrated in Fig. 44, agricultural activities are developed along almost the whole length of Agri River course and its tributaries. Runoff potential variation in agricultural lands of each sub-basin is presented in Table 14. Except from Agri 10 sub-basin which indicated on the average low runoff potential and sub-basins Agri 6 and Sauro 1 for which runoff potential was estimated on the average as high, the other 11 sub-basins, covering more than 90% of the agricultural land presented moderate runoff potential.

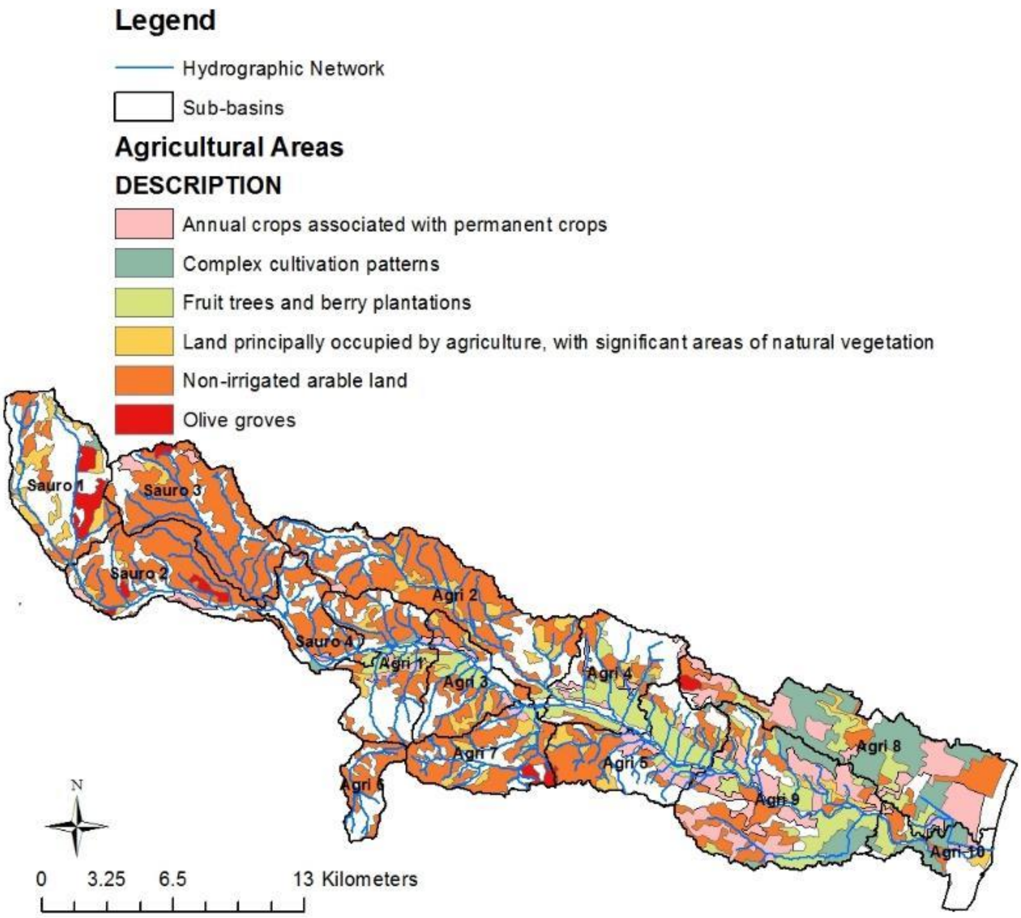

Fig. 44: Agricultural areas and main river course in Agri sub-basin

Table 14: Runoff potential statistics for the agricultural areas in each sub-basin of Agri sub-basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km²)	(%)	Score	Class	Score	Class	Score	Class
Agri 1	15.33	5.20	0.72	Low	2.11	High	1.65	Moderate
Agri 10	7.87	2.67	0.25	Very low	1.75	Moderate	1.08	Low
Agri 2	34.98	11.87	0.70	Low	2.11	High	1.66	Moderate
Agri 3	13.86	4.70	0.73	Low	2.19	High	1.68	Moderate
Agri 4	15.28	5.19	0.77	Low	2.19	High	1.45	Moderate
Agri 5	21.53	7.31	0.76	Low	2.26	High	1.53	Moderate
Agri 6	4.79	1.63	1.09	Low	2.18	High	1.84	High
Agri 7	15.95	5.41	0.84	Low	2.11	High	1.77	Moderate
Agri 8	45.85	15.56	0.28	Very low	2.11	High	1.27	Moderate
Agri 9	45.87	15.57	0.73	Low	2.16	High	1.39	Moderate
Sauro 1	15.19	5.15	0.81	Low	2.14	High	1.83	High
Sauro 2	21.31	7.23	0.75	Low	2.19	High	1.61	Moderate
Sauro 3	27.93	9.48	0.90	Low	2.06	High	1.70	Moderate
Sauro 4	8.94	3.03	0.81	Low	2.12	High	1.66	Moderate

4.2. *FOR REGISTERED FARMS*

4.2.1. Havgas – Milatos sub-basin

The location of registered farms in Havgas - Milatos sub-basin are presented in Fig. 45. The majority of the farms are located at the southern part of the basin and more specifically in sub-basin HM-6, while a significant number of farms are found at the northern part (sub-basin HM-1 and HM-5). Higher runoff potential is indicated for the farms located at the southern part (sub-basin HM-6) and this is attributed both in higher slopes and rainfall.

The distribution of registered farms in the five runoff potential classes is presented in Fig. 46. The majority of the farms are found in high runoff potential class (71 farms or 70.3%), while 22 farms (or 21.8%) are found in moderate runoff potential class. Only 4 farms indicated very high runoff potential and also 4 farms indicated low runoff potential, while none of the 101 registered farms was found to be classified as of very low runoff potential.

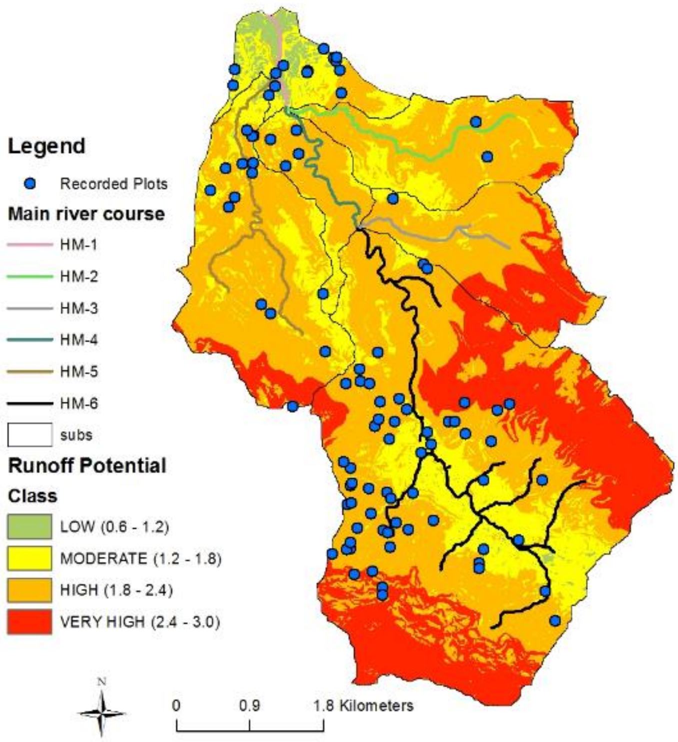

Fig. 45: Location and runoff potential of registered farms at Havgas - Milatos sub-basin

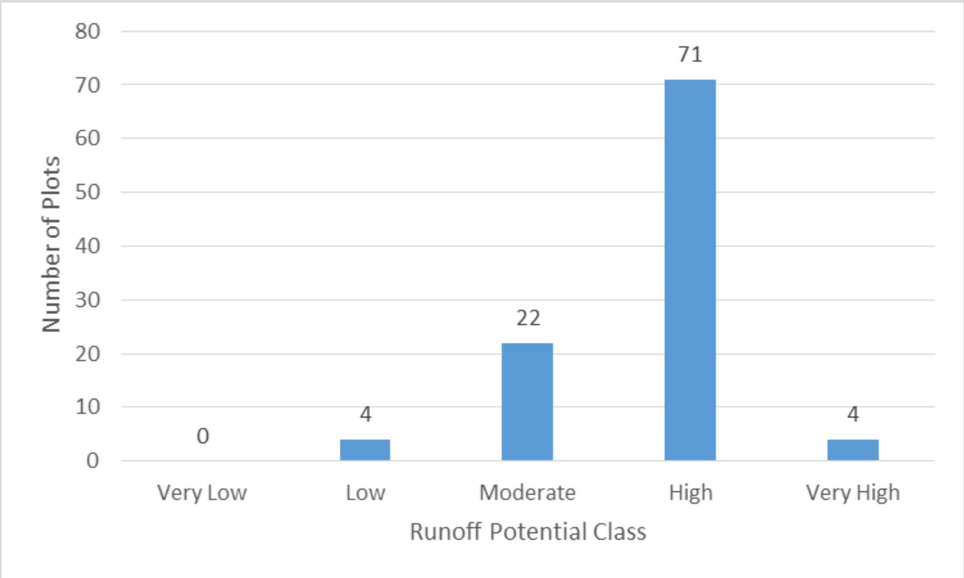

Fig. 46: Distribution of runoff potential of the registered farms located in Havgas - Milatos sub-basin into the five classes

4.2.2. Tavronitis basin

The location of registered farms in Tavronitis River basin and sub-basins are presented in Fig. 47. The majority of the farms are located at the northern part of the basin and more specifically in sub-basins GR3901R000301006N, GR3901R000301007N, GR3901R000301057N and Tavronitis 1. This fact comes in agreement to the pilot basin boundaries. From a first view, the majority of the farms are indicating high or moderate runoff potential.

The distribution of registered farms in the five runoff potential classes is presented in Fig. 48. The majority of the farms are found in high runoff potential class (60 farms or 60%), while 38 farms (or 38%) are found in moderate runoff potential class. Only 2 farms indicated low runoff potential, while none of the 100 registered farms was found to be classified as of either very low or very high runoff potential.

4.2.3. Agri sub-basin

The location of registered farms within Agri sub-basin are presented in Fig. 49. The majority of the farms are located at the eastern part of the basin and more specifically in sub-basins Agri 4, 5, 8, 9 and 10. This fact comes in agreement to the pilot basin boundaries (4MAa basin). From a first view, the majority of the farms located at the central part of the basin are indicating moderate to high runoff potential, while the farms located at the eastern part of the basin are indicating low to moderate runoff potential.

The distribution of registered farms in the five runoff potential classes is presented in Fig. 50. The majority of the farms are found in moderate runoff potential class (56 farms or 56%), while 42 farms (or 43%) are found in low runoff potential class. Only 2 farms indicated high runoff potential, while none of the 100 registered farms was found to be classified as of either very low or very high runoff potential.

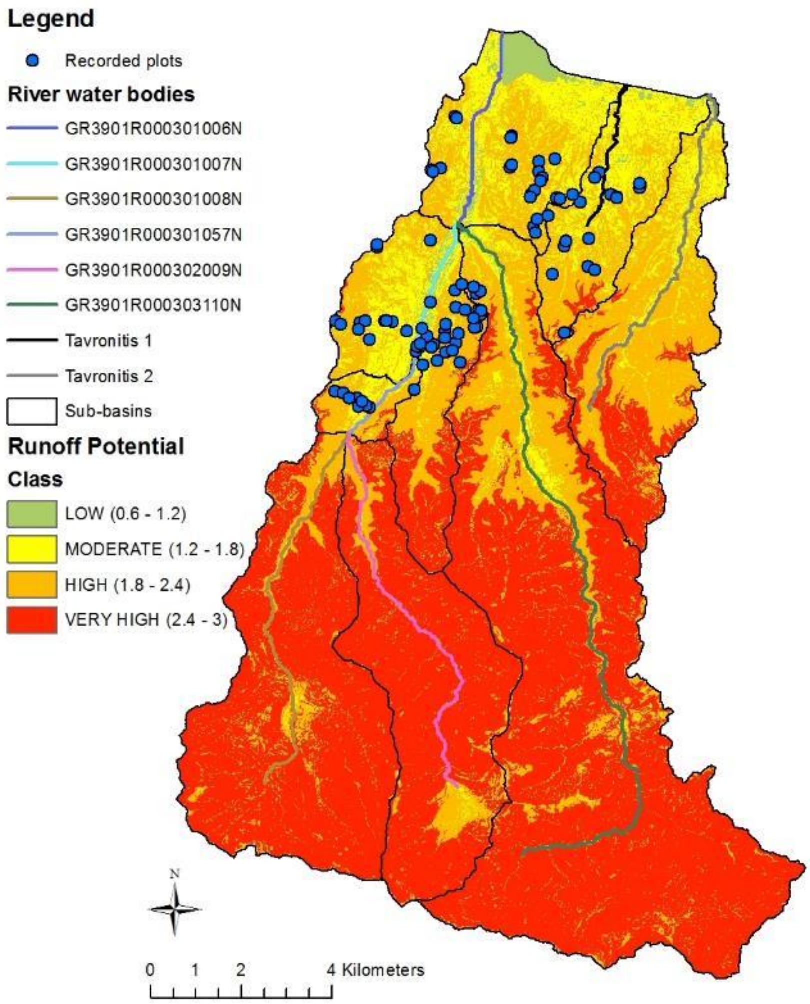

Fig. 47: Location and runoff potential of registered farms at Tavronitis basin

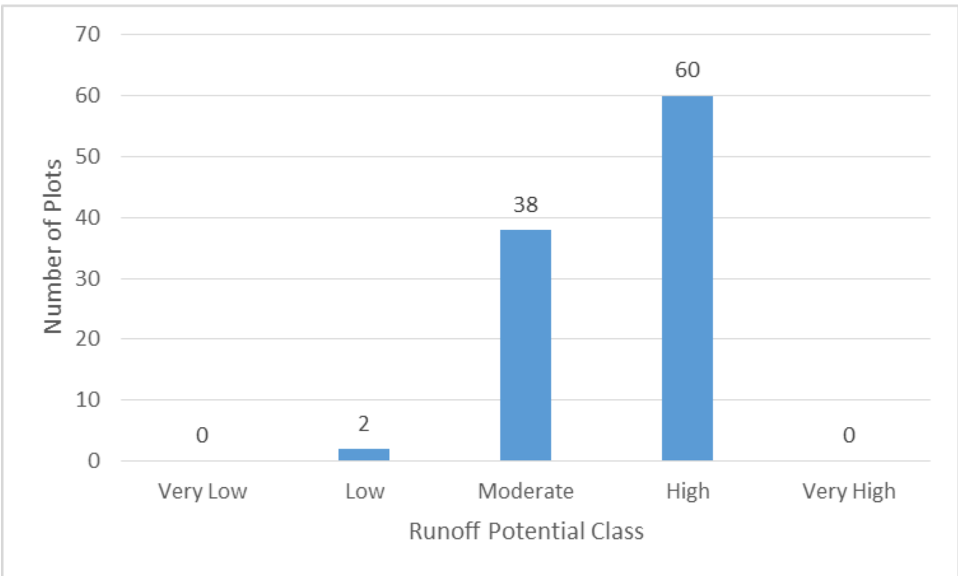

Fig. 48: Distribution of runoff potential of the registered farms located within Tavronitis River basin into the five classes

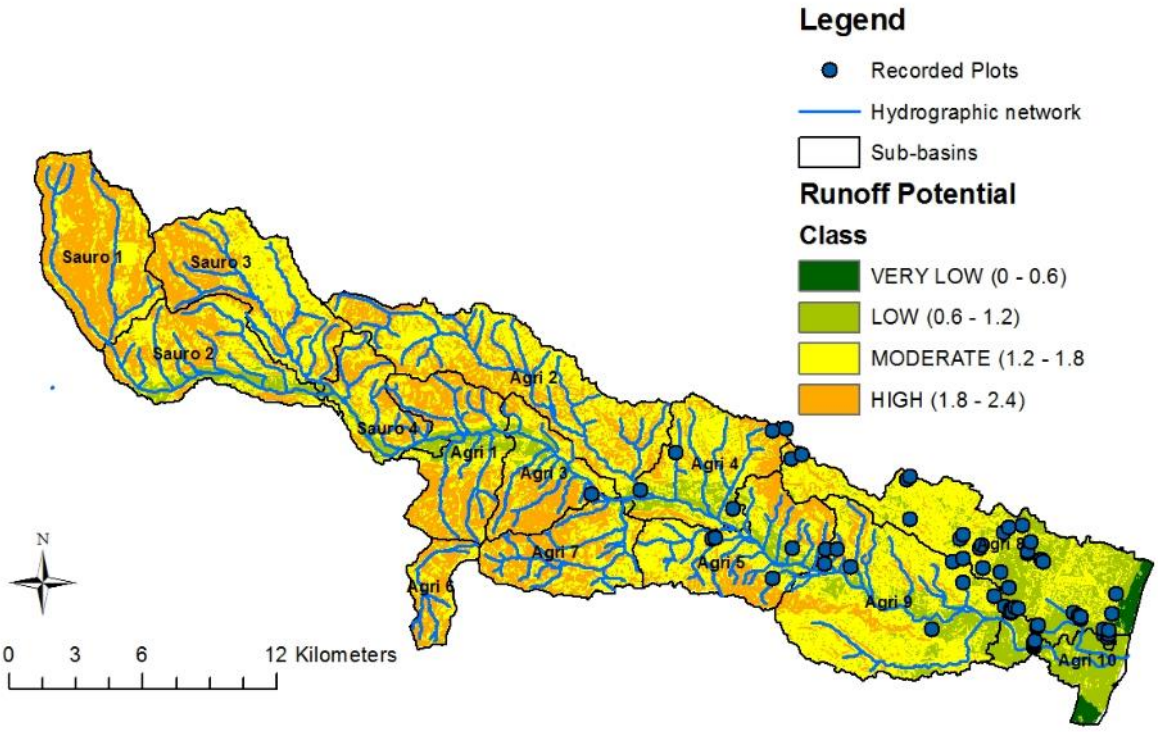

Fig. 49: Location and runoff potential of registered farms at Agri sub-basin

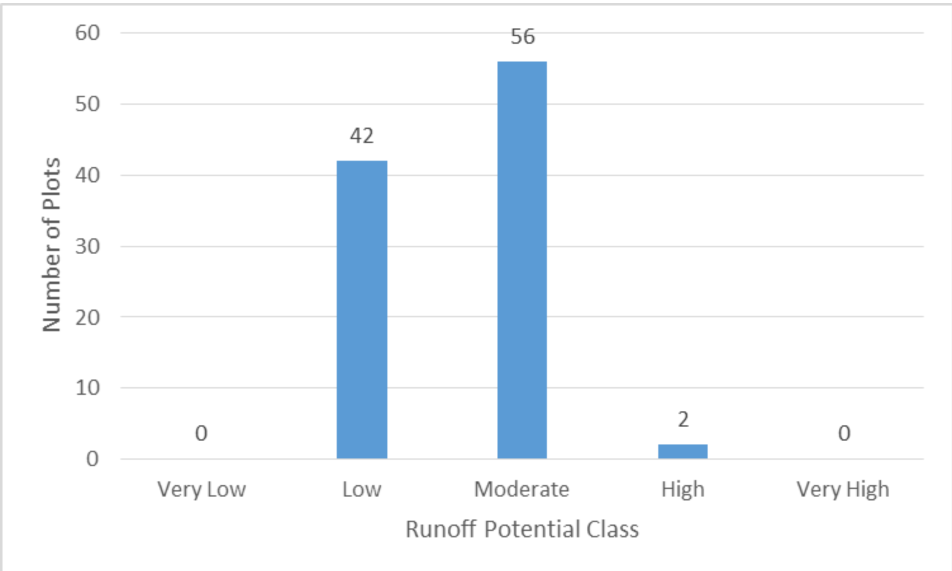

Fig. 50: Distribution of runoff potential of the registered farms located in Agri sub-basin into the five classes

5. LEACHING RISK ASSESSMENT RESULTS

5.1. *FOR THE STUDIED AREAS*

5.1.1. Havgas – Milatos sub-basin

The results of application of leaching risk assessment methodology in Havgas - Milatos sub-basin are presented in Fig. 51. Low and moderate leaching potential classes are dominating, while a zone of high leaching potential is identified in the eastern part of the basin. A statistical overview of leaching potential of agricultural lands in Havgas - Milatos sub-basin is presented in Table 15. On the average, low leaching potential is demonstrated for all the three agricultural land cover types. Nevertheless, the highest average leaching potential is presented for olive groves (1.14), which constitutes the dominant agricultural land cover type for Havgas - Milatos sub-basin, followed by complex cultivation patterns (1.13) and land principally occupied by agriculture, with significant areas of natural vegetation (0.96). Leaching potential demonstrate a wide range of variation for all the three land cover types, thus indicating that either very low or high leaching potential areas are identified.

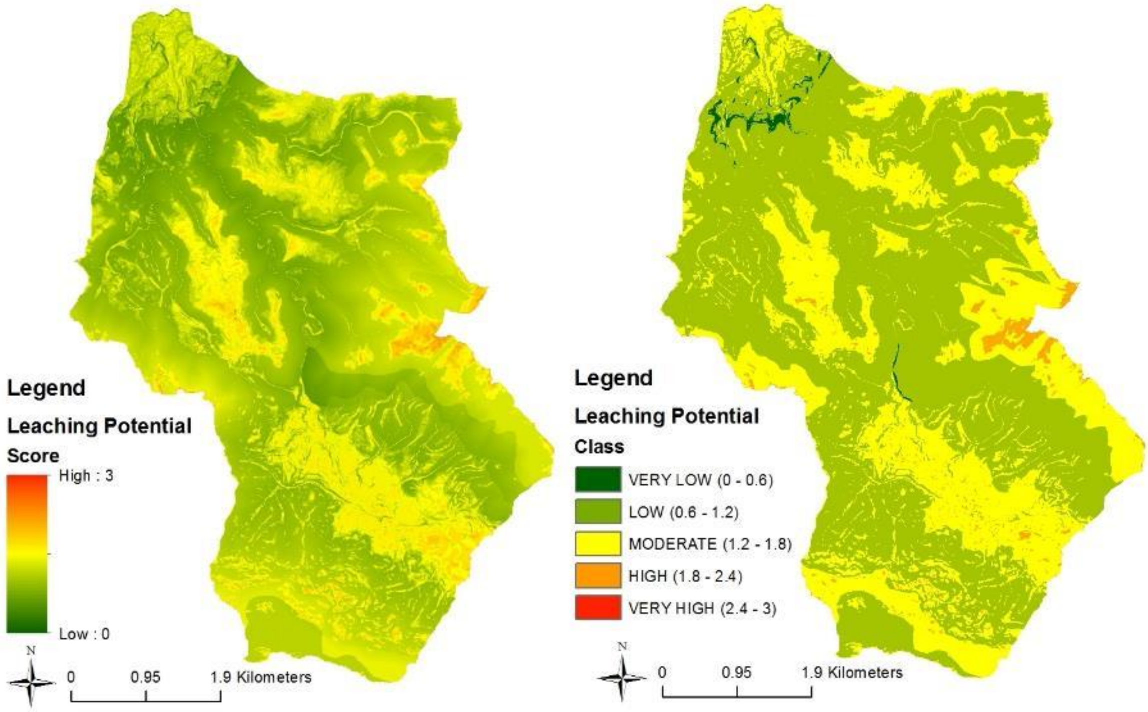

Fig. 51: Spatial distribution of leaching potential score and classes in Havgas - Milatos sub-basin

Table 15: Leaching potential statistics for the agricultural lands of Havgas - Milatos sub-basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km^2)	(%)	Score	Class	Score	Class	Score	Class
223	Olive groves	10.99	36.52	0.51	Very Low	2.25	High	1.14	Low

242	Complex cultivation patterns	1.74	5.79	0.41	Very Low	1.85	High	1.13	Low
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1.38	4.57	0.74	Low	1.97	High	0.96	Low

The spatial distribution of groundwater bodies in Havgas - Milatos sub-basin is illustrated in Fig. 52. Five groundwater bodies were identified in Havgas - Milatos sub-basin, while karst formations are dominating. Karst of Fournai-Elounda and Karst of Sisio-Milatos-Elounda are considered the most significant groundwater bodies, since they cover the major part of the basin. Leaching potential statistics of agricultural lands met in each groundwater body are presented in Table 16. Agricultural lands are established in 4 out of the 5 groundwater bodies found within Havgas - Milatos sub-basin. The major part of agricultural land are found in Fractured System of Dikti, followed by Karst of Fournai-Elounda and Karst of Sisio-Milatos-Elounda. All groundwater bodies in which agricultural land are met demonstrate on the average low leaching potential. More specifically, higher average leaching potential is demonstrated for Fractured System of Dikti (1.18), followed by Karst of Fournai-Elounda (1.14) and Karst of Sisio-Milatos-Elounda (1.02). Leaching potential of agricultural land demonstrate a wide range of variation for all groundwater bodies, thus indicating that either very low or high leaching potential areas are identified.

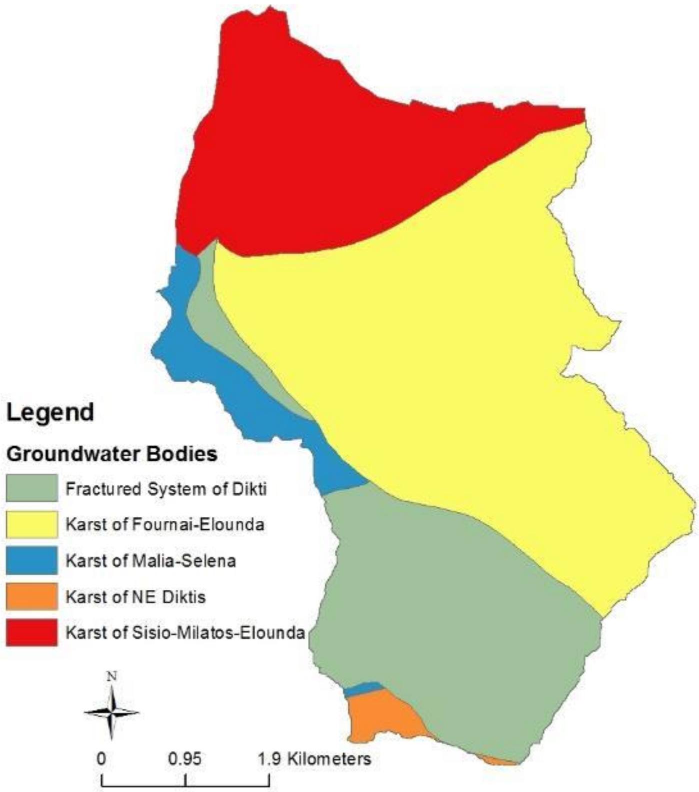

Fig. 52: Spatial distribution of groundwater bodies located within Havgas - Milatos sub-basin

Table 16: Leaching potential statistics of agricultural lands for each groundwater body located within Havgas - Milatos sub-basin

Groundwater Body	Area		Minimum		Maximum		Average	
	(km²)	(%)	Score	Class	Score	Class	Score	Class
Karst of Malia-Selena	0.21	0.71	0.75	Low	1.91	High	0.98	Low
Karst of Fournai-Elounda	4.75	15.80	0.58	Very Low	1.99	High	1.14	Low
Karst of Sisio-Milatos-Elounda	3.65	12.12	0.41	Very Low	1.85	High	1.02	Low
Fractured System of Dikti	5.49	18.24	0.75	Low	2.25	High	1.18	Low

5.1.2. Tavronitis basin

The results of application of leaching risk assessment methodology in Tavronitis River basin are presented in Fig. 53. Low and moderate leaching potential classes are dominating, while a zone of high leaching potential is identified in the mild-slope, southern part of the basin. A statistical overview of leaching potential of agricultural lands in Tavronitis River basin is presented in Table 17. On the average, moderate leaching potential is demonstrated for all the five agricultural land cover types, except from non-irrigated arable land which indicate high average leaching potential. Nevertheless, this agricultural land type covers a negligible part of the basin (0.16%). The highest average leaching potential is presented for olive groves (1.40), which constitutes the dominant agricultural land cover type, followed by fruit trees and berry plantations (1.31) and land principally occupied by agriculture, with significant areas of natural vegetation (1.28). Leaching potential demonstrate a wide range of variation for all the five land cover types, thus indicating that either very low or very leaching potential areas are identified.

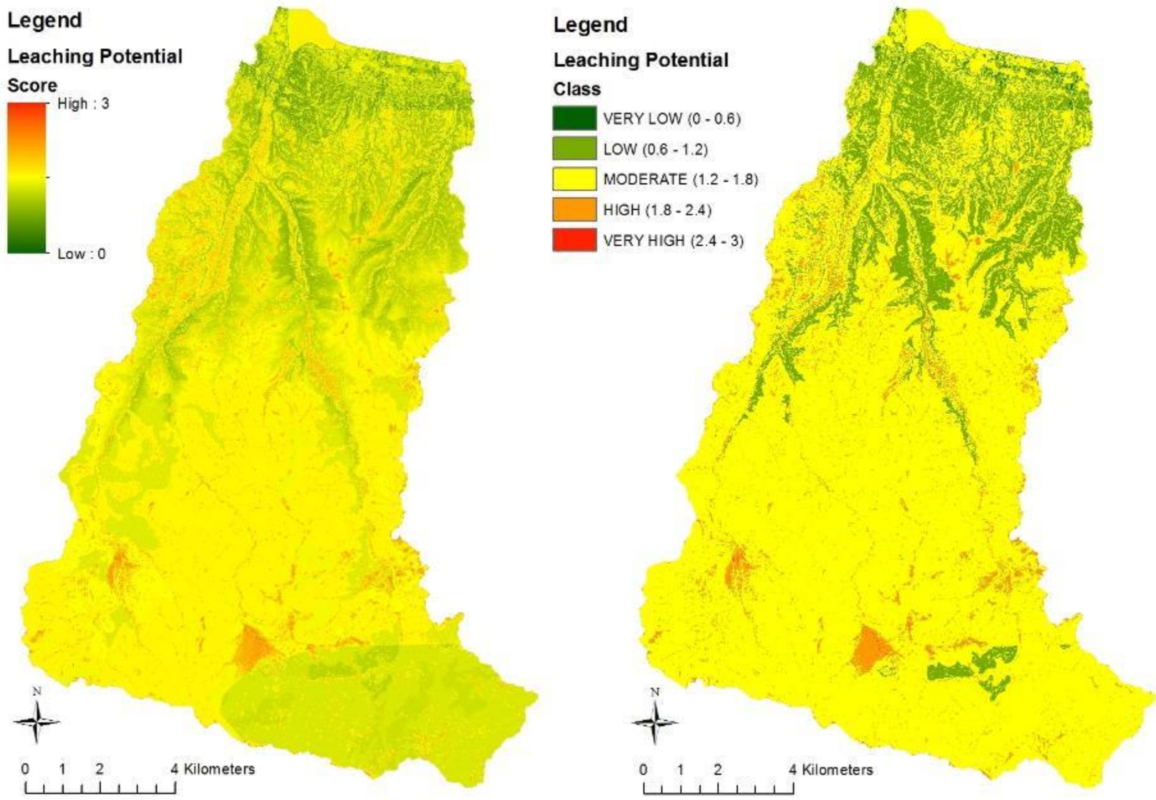

Fig. 53: Spatial distribution of leaching potential score and classes in Tavronitis basin

The spatial distribution of groundwater bodies in Tavronitis River basin is demonstrated in Fig. 54. Six groundwater bodies were identified in Tavronitis River basin but two bodies are dominating, namely Fractured System of Chania (southern part) and Porous System of Campos Chanion, since they cover the major part of the basin. Leaching potential statistics of agricultural lands met in each groundwater body are presented in Table 18. Agricultural lands are established in 5 out of the 6 groundwater bodies found in Tavronitis River basin.

Table 17: Leaching potential statistics for the agricultural lands of Tavronitis basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km²)	(%)	Score	Class	Score	Class	Score	Class
221	Non-irrigated arable land	0.26	0.16	1.49	Moderate	2.49	Very High	2.00	High
222	Fruit trees and berry plantations	7.86	4.76	0.55	Very Low	2.23	High	1.31	Moderate
223	Olive groves	53.41	32.34	0.54	Very Low	2.49	High	1.40	Moderate
242	Complex cultivation patterns	2.95	1.79	0.46	Very Low	1.97	High	1.22	Moderate

243	Land principally occupied by agriculture, with significant areas of natural vegetation	17.08	10.34	0.74	Very Low	2.32	High	1.28	Moderate

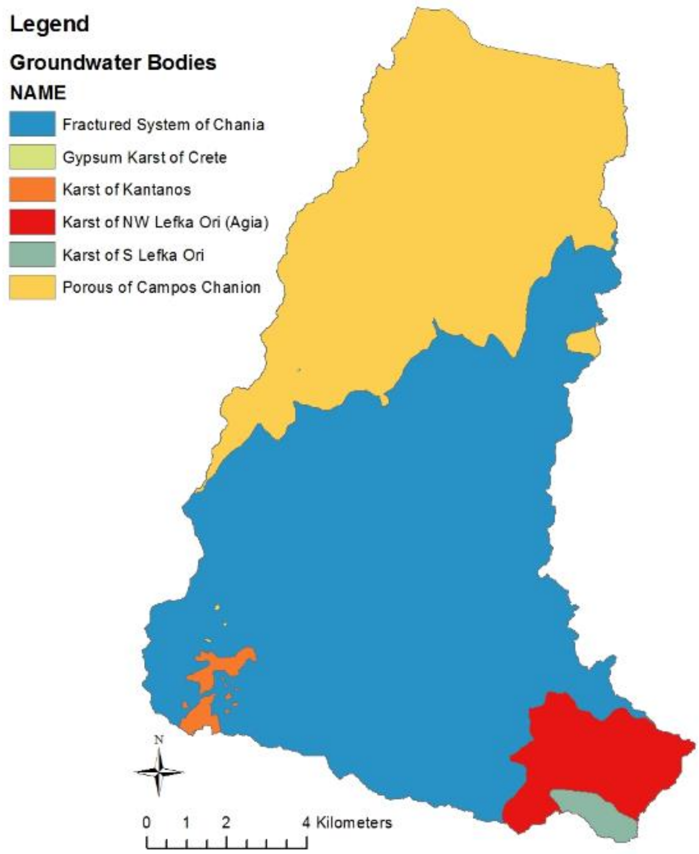

Fig. 54: Spatial distribution of groundwater bodies located in Tavronitis basin

The major part of agricultural land (more than 99%) are found in Porous of Campos Chanion, followed by Fractured System of Chania. All groundwater bodies in which agricultural lands are met, demonstrate on the average moderate leaching potential, except from Karst of NW Lefka Ori (Agia) for which low average leaching potential was estimated. Porous of Campos Chanion groundwater body demonstrated a very wide range of leaching potential variation from very low to very high values, thus indicating significant leaching potential variability. Similar but not that wide was the range of leaching potential variation for the other significant groundwater body of Tavronitis River basin (Fractured System of Chania).

Table 18: Leaching potential statistics of agricultural lands for each groundwater body located in Tavronitis River basin

Groundwater Body	Area		Minimum		Maximum		Average	
	(km²)	(%)	Score	Class	Score	Class	Score	Class

Porous of Campos Chanion	53.05	32.12	0.46	Very Low	2.49	Very High	1.31	Moderate
Karst of NW Lefka Ori (Agia)	0.06	0.04	1.16	Low	2.16	High	1.18	Low
Karst of Kantanos	0.45	0.27	1.32	Moderate	2.49	Very High	1.49	Moderate
Fractured System of Chania	27.94	16.92	0.94	Low	2.58	Very High	1.46	Moderate
Gypsum Karst of Crete	0.03	0.02	1.06	Low	2.49	Very High	1.48	Moderate

With regard to the four pilot sub-basins (GR3901R000301006N, GR3901R000301007N, GR3901R000301057N and Maleme), which are both situated in the porous aquifer of Chanion, the leaching potential statistics are presented in Table 19. Leaching potential indicates a wide range of variation for both basin (from very low to high or very high). On the average, leaching potential for GR3901R000301006N sub-basin is presented as low, while for GR3901R000301007N, GR3901R000301057N and Maleme sub-basins the corresponding class is moderate.

Table 19: Leaching potential statistics of agricultural lands in the two pilot sub-basin located in Tavronitis basin

Sub-basin code	Area (km^2)	Minimum		Maximum		Average	
		Score	Class	Score	Class	Score	Class
GR3901R000301006N	7.09	0.46	Very low	2.24	High	1.18	Low
GR3901R000301007N	9.03	0.80	Low	2.49	Very high	1.45	Moderate
GR3901R000301057N	2.44	0.85	Low	2.49	Very high	1.43	Moderate
Maleme	12.59	0.46	Very low	2.46	Very high	1.24	Moderate

5.1.3. Agri sub-basin

The results of application of leaching risk assessment methodology in Agri sub-basin are presented in Fig. 55. Low leaching potential class dominates in Agri sub-basin, while medium leaching potential along the "beaches, sand, dunes" land cover type along Agri River course. A statistical overview of leaching potential of agricultural lands in Agri sub-basin is presented in Table 20. Low and moderate leaching potential classes are indicated for the seven agricultural land cover classes. Concerning non-irrigated arable land, annual crops associated with permanent crops and fruit trees and berry plantations which are the dominant agricultural land cover classes for Agri sub-basin, they indicated low, low and moderate leaching potential, respectively. For most land cover classes, leaching potential demonstrate a wide range of variations, thus indicating that either very low to high potential areas are identified.

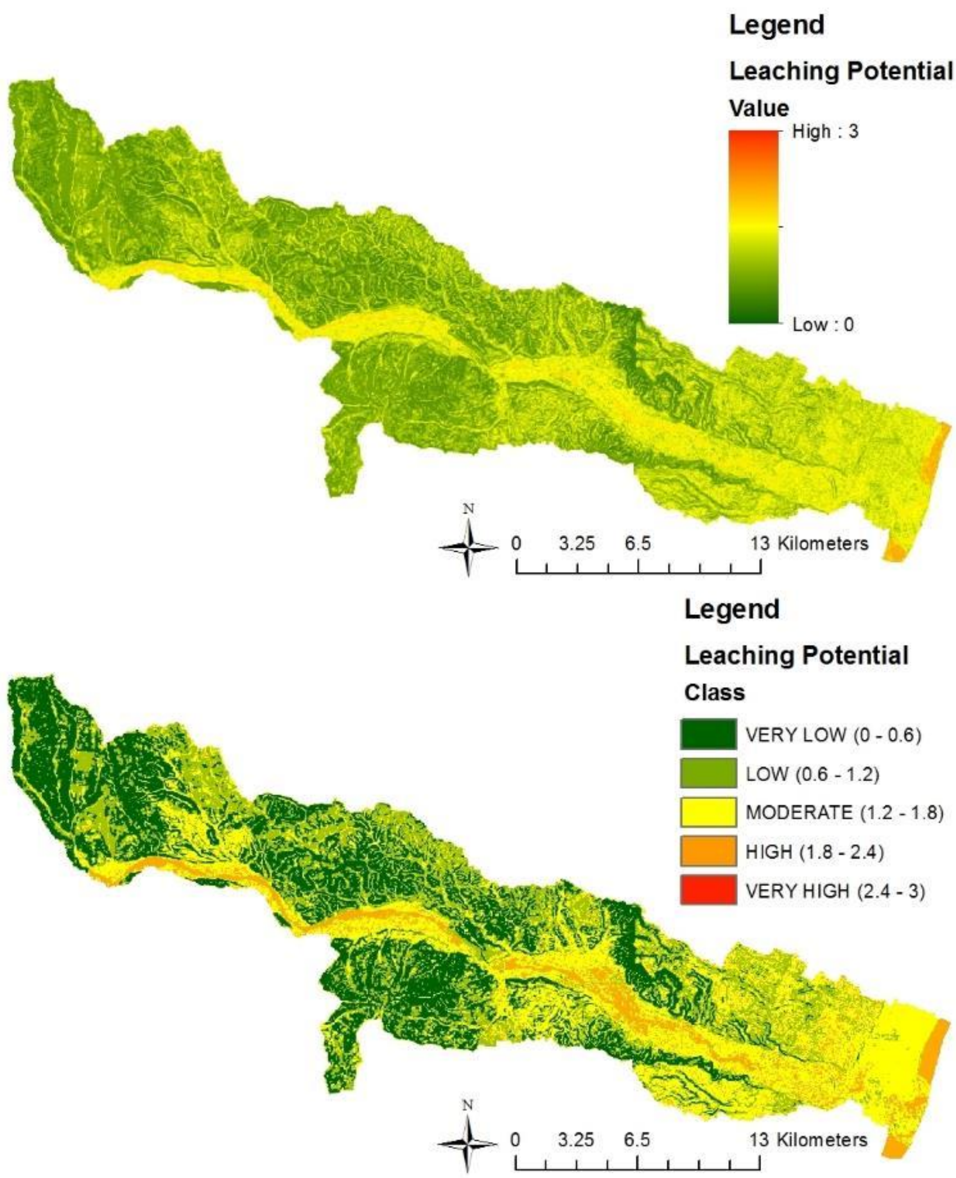

Fig. 55: Spatial distribution of leaching potential score and classes in Agri sub-basin

The spatial distribution of aquifers in Agri sub-basin is demonstrated in Fig. 56. Two groundwater systems were identified within Agri sub-basin. One aquifer system is extended along Agri river course and consists of alluvial depositions, while the other aquifer system is extended along the coast.

Table 20: Leaching potential statistics for the agricultural lands of Agri sub-basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km²)	(%)	Score	Class	Score	Class	Score	Class
211	Non/irrigated arable land	151.22	36.58	0.41	Very Low	1.87	High	0.94	Low
221	Vineyards	0.26	0.06	0.85	Low	1.65	Moderate	1.24	Moderate

222	Fruit trees and berry plantations	38.15	9.23	0.50	Very Low	1.90	High	1.35	Moderate
223	Olive groves	7.34	1.78	0.38	Very Low	1.84	High	1.04	Low
241	Annual crops associated with permanent crops	39.35	9.52	0.36	Very Low	1.88	High	1.16	Low
242	Complex cultivation patterns	28.79	6.97	0.48	Very Low	1.69	Moderate	1.21	Moderate
243	Land principally occupied by agriculture, with significant areas of natural vegetation	29.65	7.17	0.41	Very Low	1.66	Moderate	0.88	Low

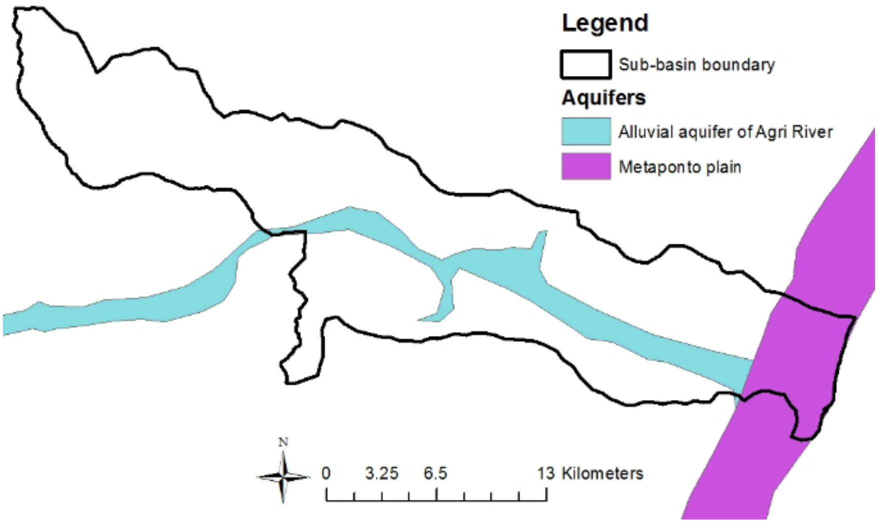

Fig. 56: Spatial distribution of groundwater bodies located within Agri sub-basin

Leaching potential statistics of agricultural lands for each of the two groundwater body located in Agri sub-basin are presented in Table 21. Leaching potential for both groundwater bodies presented a wide range of variation (from very low to high), thus indicating significant leaching potential variability. On the average, leaching potential for both groundwater bodies was estimated to be moderate.

Table 21: Leaching potential statistics of agricultural lands for each groundwater body located in Agri sub-basin

Groundwater Body	Area (km^2)	Minimum		Maximum		Average	
		Score	Class	Score	Class	Score	Class
Alluvial aquifer of Agri River	37.12	0.42	Very low	1.90	High	1.33	Moderate

Metaponto plain	22.61	0.65	Low	2.13	High	1.31	Moderate

5.2. *FOR REGISTERED FARMS*

5.2.1. Havgas – Milatos Sub-basin

The location of registered farms in Havgas - Milatos sub-basin and their distribution in the leaching potential classes map are presented in Fig. 57. The majority of the farms are located at the southern part of the basin, while a significant number of farms are found at the northern part. Either for the farms located at the northern or the southern part of the basin, their majority indicates low to moderate leaching potential.

The distribution of registered farms in the five leaching potential classes is presented in Fig. 58. The majority of the farms are found in low leaching potential class (80 farms or 79.2%), while 17 farms (or 16.8%) are found in moderate leaching potential class. Two farms indicated very low leaching potential and one farm indicated high leaching potential, while none of the 101 registered farms was found to be classified as of very high leaching potential.

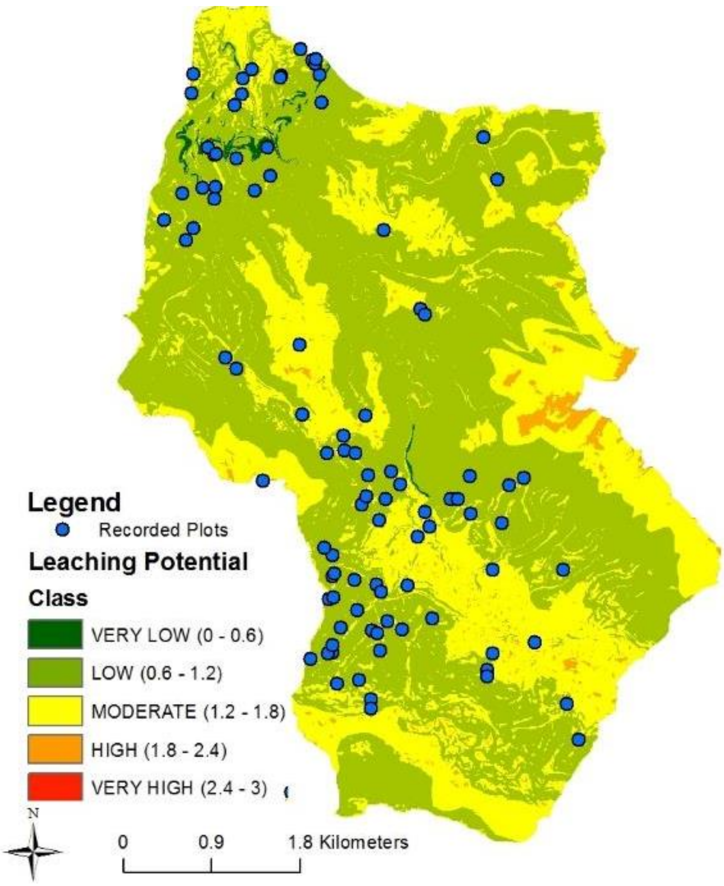

Fig. 57: Location and leaching potential of registered farms at Havgas - Milatos sub-basin

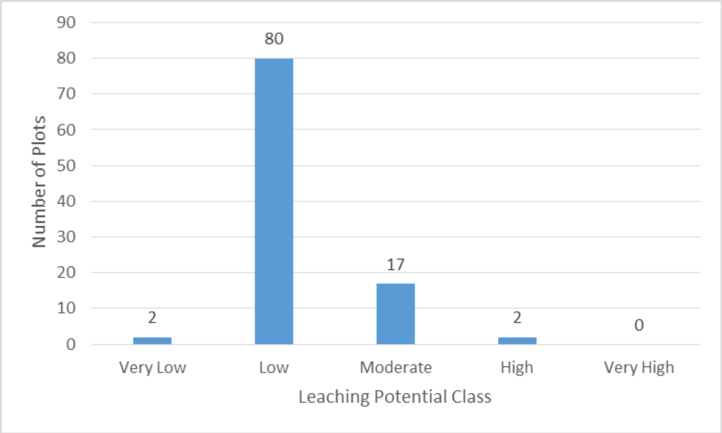

Fig. 58: Distribution of leaching potential of the registered farms located within Havgas - Milatos sub-basin into the five classes

5.2.2. Tavronitis basin

The location of registered farms within Tavronitis River basin and their distribution in the leaching potential classes map are presented in Fig. 59. As mentioned above, the majority of the farms are located at the northern part of the basin and this fact comes in agreement to the pilot basin boundaries. From a first view, the majority of the farms are indicating low to moderate leaching potential.

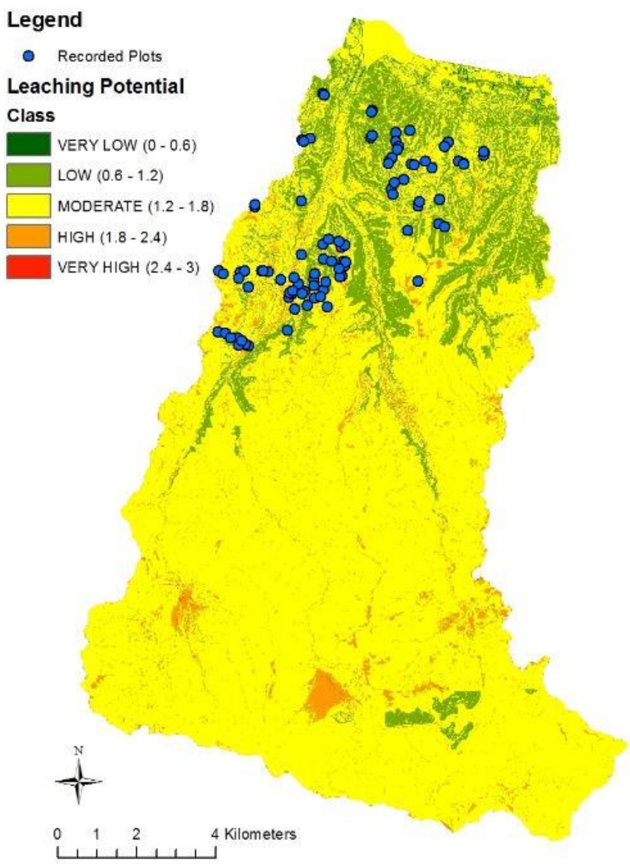

Fig. 59: Location and leaching potential of registered farms at Tavronitis basin

The distribution of registered farms in the five leaching potential classes is presented in Fig. 60. The majority of the farms are found in moderate leaching potential class (62 farms or 62%), while 30 farms (or 30%) are found in low leaching potential class. Only 8 farms indicated high leaching potential, while none of the 100 registered farms was found to be classified as of either very low or very high leaching potential.

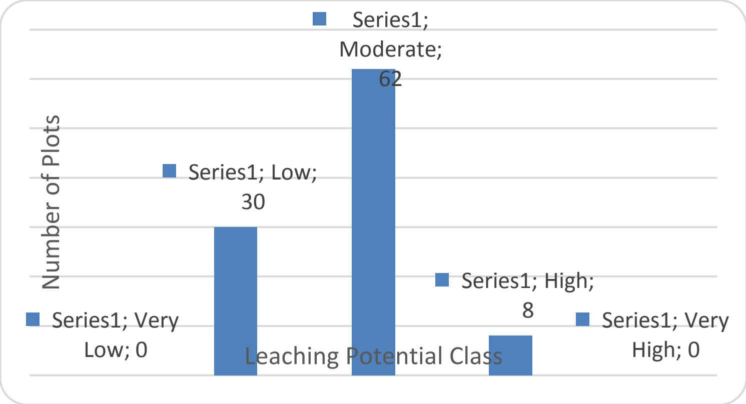

Fig. 60: Distribution of leaching potential of the registered farms located in Tavronitis basin into the five classes

5.2.3. Agri sub - basin

The location of registered farms within Agri sub-basin and their distribution in the leaching potential classes map are presented in Fig. 61. The majority of the farms are located at the eastern part of the basin and this fact comes in agreement to the pilot basin boundaries (4MAa basin). From a first view, the majority of the farms located at the central part of the basin are indicating low to moderate leaching potential, while the farms located at the eastern part of the basin are indicating moderate leaching potential.

The distribution of registered farms in the five leaching potential classes is presented in Fig. 62. The majority of the farms are found in moderate leaching potential class (57 farms or 57%), while 42 farms (or 42%) are found in low leaching potential class. Only 1 farm indicated high leaching potential, while none of the 100 registered farms was found to be classified as of either high or very high leaching potential.

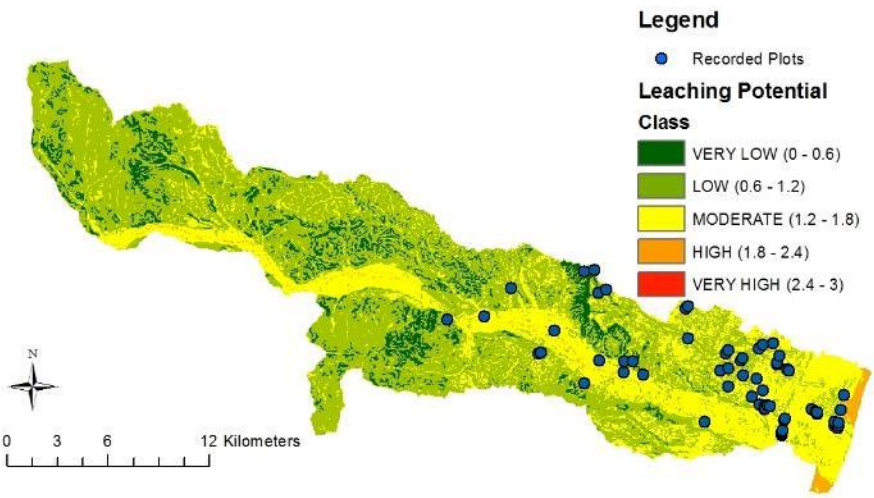

Fig. 61: Location and leaching potential of registered farms at Agri sub-basin

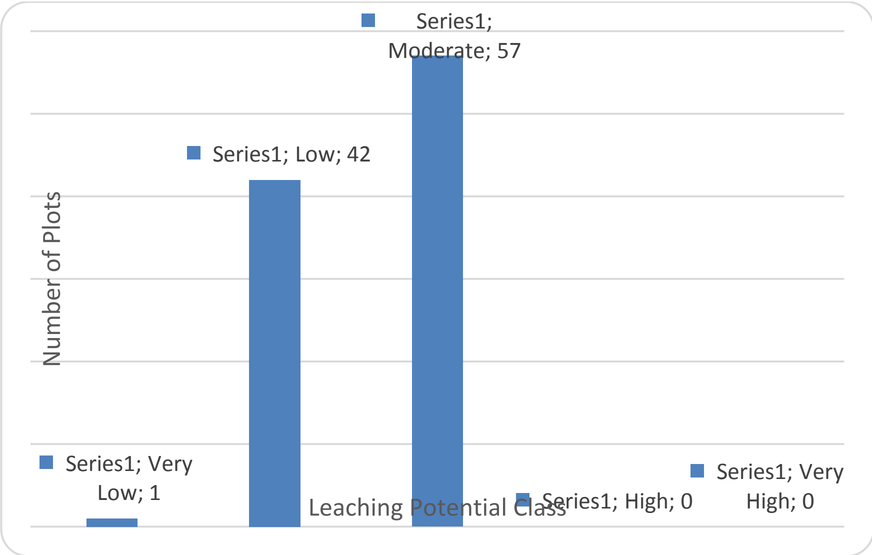

Fig. 62: Distribution of leaching potential of the registered farms located in Agri sub-basin into the five classes

6. SOIL EROSION RISK ASSESSMENT RESULTS

6.1. *FOR THE STUDIED AREAS*

6.1.1. Havgas – Milatos sub-basin

The results of application of USLE in Havgas - Milatos sub-basin are presented in Fig. 63, in which the spatial distribution of average annual soil erosion classes is also presented. Low and moderate erosion classes are dominating in the northern part of Havgas - Milatos sub-basin, while very high erosion class is the dominant one in the southern part. A statistical overview of average annual soil erosion of agricultural lands in Havgas - Milatos sub-basin is presented in Table 22.

On the average, high average annual erosion class was determined for olive groves (28.71 t/ha year^{-1}) and land principally occupied by agriculture, with significant areas of natural vegetation (27.68 t/ha year^{-1}), while moderate average annual erosion rates were determined for complex cultivation patterns (13.68 t/ha year^{-1}). Average annual erosion rates demonstrate a wide range of variation for all the three land cover types, thus indicating there are areas of all agricultural land cover classes which are highly exposed in soil erosion.

Average annual erosion rates of agricultural lands for each sub-basin is presented in Table 23. A wide range of average annual erosion is presented for all sub-basin, varying between very low and very high. On the average, the highest average annual erosion rate is presented for HM-6 and classified as high. This is attributed mainly to the higher slopes presented in this sub-basin. All the other sub-basins indicate moderate average annual erosion rates, except from HM-1 for which very low class was estimated.

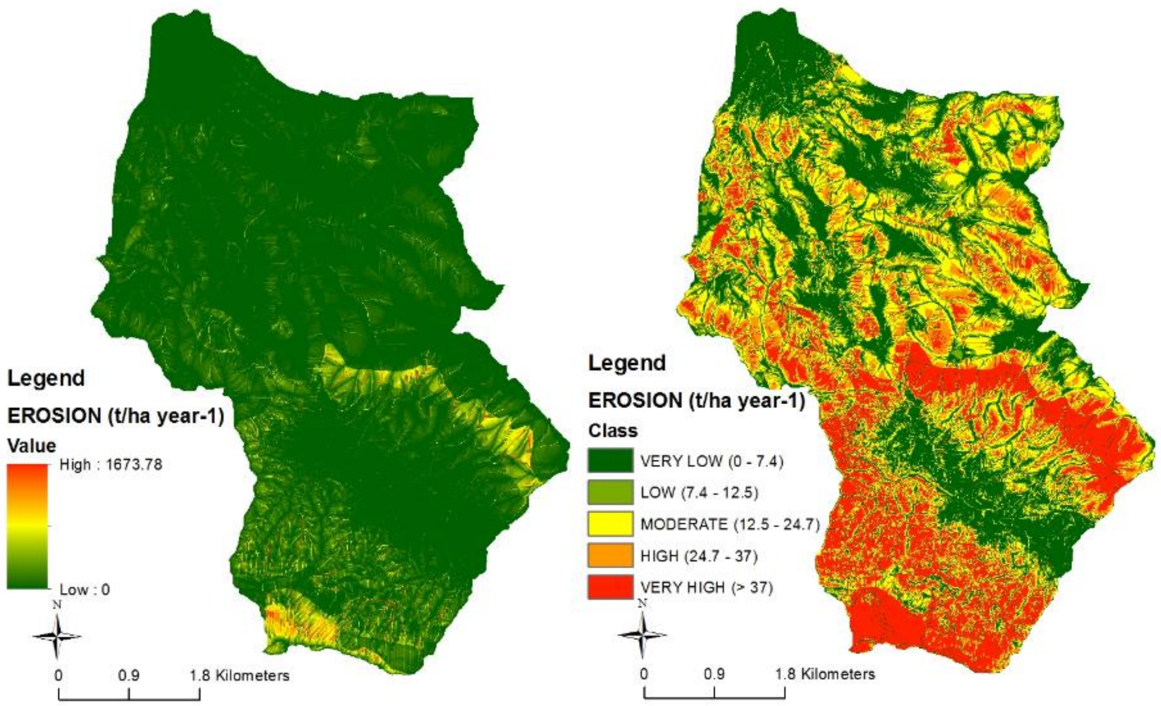

Fig. 63: Spatial distribution of average annual soil erosion rates and classes in Havgas - Milatos sub-basin

Table 22: Average annual erosion statistics for the agricultural lands of Havgas - Milatos sub-basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km^2)	(%)	t/ha year^{-1}	Class	t/ha year^{-1}	Class	t/ha year^{-1}	Class
223	Olive groves	10.99	36.52	0.00	Very Low	1673.78	Very High	28.71	High
242	Complex cultivation patterns	1.74	5.79	0.00	Very Low	447.52	Very High	13.68	Moderate
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1.38	4.57	0.00	Very Low	657.75	Very High	27.68	High

Table 23: Average annual erosion statistics for the agricultural areas in each sub-basin of Havgas - Milatos sub-basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km^2)	(%)	t/ha year^{-1}	Class	t/ha year^{-1}	Class	t/ha year^{-1}	Class
HM-1	1.22	8.62	0.00	Very low	189.82	Very high	3.62	Very low
HM-2	1.19	8.46	0.00	Very low	208.56	Very high	16.68	Moderate
HM-3	0.31	2.23	0.00	Very low	447.52	Very high	12.58	Moderate
HM-4	0.48	3.42	0.00	Very low	303.86	Very high	16.82	Moderate
HM-5	2.24	15.89	0.00	Very low	545.53	Very high	22.51	Moderate
HM-6	8.66	61.36	0.00	Very low	1673.78	Very high	33.53	High

6.1.2. Tavronitis basin

The results of application of USLE in Tavronitis River basin are presented in Fig. 64, in which the spatial distribution of average annual soil erosion classes is also presented. Low and moderate average annual erosion classes are dominating in the northern part of Tavronitis River basin, while very high erosion class is the dominant one in the southern part interrupted by very low erosion zones in forested areas.

A statistical overview of average annual erosion of agricultural lands in Tavronitis River basin is presented in Table 24. On the average, very high average annual erosion class was determined for olive groves (43.07 t/ha year^{-1}), which is the dominant agricultural land cover class for Tavronitis River basin. Very high erosion class was also calculated for land principally occupied by agriculture, with significant areas of natural vegetation (57.82 t/ha year^{-1}) and non-irrigated arable land (48.40 t/ha year^{-1}). On the contrary, fruit trees and berry plantations and complex cultivation patterns land cover classes demonstrated low (10.21 t/ha year^{-1}) and very low (3.76 t/ha year^{-1}) erosion rate, respectively.

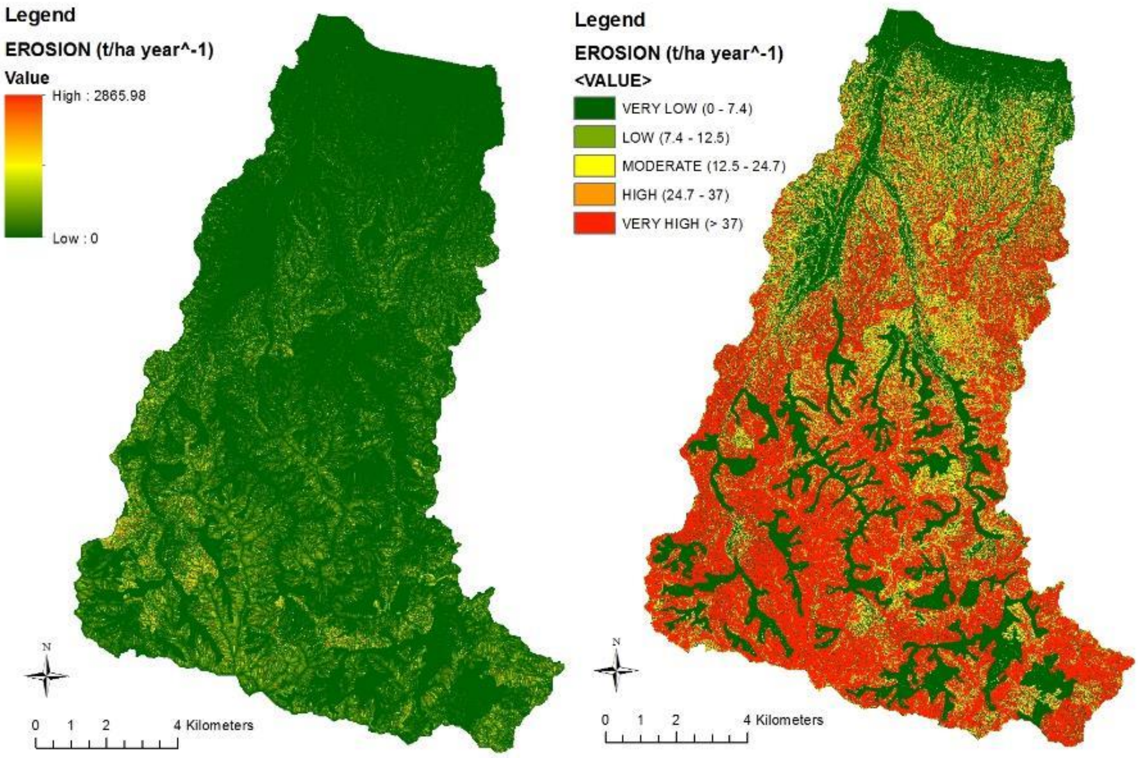

Fig. 64: Spatial distribution of average annual soil erosion rates and classes in Tavronitis basin

Table 24: Average annual erosion statistics for the agricultural lands of Tavronitis basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km^2)	(%)	t/ha year^{-1}	Class	t/ha year^{-1}	Class	t/ha year^{-1}	Class
221	Non-irrigated arable land	0.26	0.16	0.00	Very Low	1864.21	Very High	48.40	Very High

222	Fruit trees and berry plantations	7.86	4.76	0.00	Very Low	689.82	Very High	10.21	Low
223	Olive groves	53.41	32.34	0.00	Very Low	2865.98	Very High	43.07	Very High
242	Complex cultivation patterns	2.95	1.79	0.00	Very Low	295.67	Very High	3.76	Very Low
243	Land principally occupied by agriculture, with significant areas of natural vegetation	17.08	10.34	0.00	Very Low	2745.59	Very High	57.82	Very High

Average annual erosion rates of agricultural lands for each sub-basin is presented in Table 25. A wide range of average annual erosion rate variation is presented for all sub-basin, ranging between very low and very high. On the average, four out of the 9 sub-basins indicated very high average annual erosion rates, while two sub-basins indicated high rates and three sub-basin indicated moderate erosion rates. Very high erosion rates are indicated in the sub-basins that are situated on the steep-slope, southern part of the study area, which is mountainous and precipitation amount is much higher than the northern part.

Table 25: Average annual erosion statistics for the agricultural areas in each sub-basin of Tavronitis basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km^2)	(%)	t/ha $year^{-1}$	Class	t/ha $year^{-1}$	Class	t/ha $year^{-1}$	Class
GR3901R000301006N	7.08	8.72	0.00	Very low	560.19	Very high	15.47	Moderate
Maleme	12.60	15.51	0.00	Very low	595.54	Very high	13.83	Moderate
Other sub-basin 2	15.16	18.67	0.00	Very low	1120.95	Very high	36.25	High
GR3901R000301007N	9.03	11.11	0.00	Very low	894.14	Very high	20.43	Moderate
GR3901R000303110N	15.62	19.22	0.00	Very low	2706.10	Very high	49.40	Very high
GR3901R000301057N	2.44	3.01	0.00	Very low	650.47	Very high	27.19	High
GR3901R000301008N	12.77	15.72	0.00	Very low	2745.59	Very high	90.26	Very high
GR3901R000302009N	3.66	4.51	0.00	Very low	2865.98	Very high	58.47	Very high
Other sub-basin 1	2.88	3.55	0.00	Very low	1008.64	Very high	56.01	Very high

6.1.3. Agri sub-basin

The results of application of USLE in Agri sub-basin are presented in Fig. 65, in which the spatial distribution of average annual soil erosion classes is also presented. Low erosion classes are identified in the major part of Agri sub-basin, while moderate to very high erosion classes cover a significant area of the western part of Agri sub-basin.

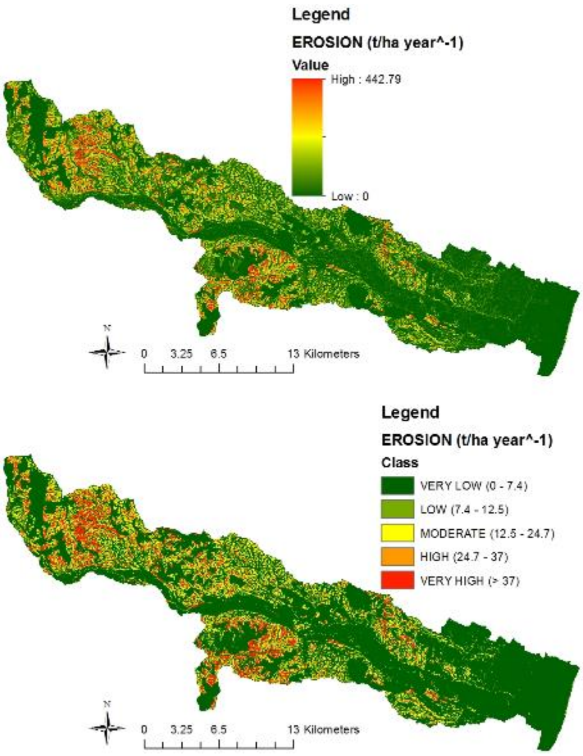

Fig. 65: Spatial distribution of average annual soil erosion rates and classes in Agri sub-basin

A statistical overview of average annual erosion of agricultural lands in Agri sub-basin is presented in Table 26. Non-irrigated arable land, which constitutes the dominant agricultural land cover class for Agri sub-basin demonstrated on the average moderate soil erosion class (17.17 t/ha year^{-1}). Average annual erosion rates for fruit trees and berry plantations and annual crops associated with permanent crops, which cover a significant part of Agri sub-basin, are classified as of very low, while vineyards and complex cultivation patterns were also classified as of very low average annual erosion rates. Average annual erosion rates demonstrate a wide range of variation for all land cover classes, thus indicating there are areas of all agricultural land cover classes which are highly exposed in soil erosion.

Table 26: Average annual erosion statistics for the agricultural lands of Agri sub-basin

Land Cover Code	Land Cover Description	Area		Minimum		Maximum		Average	
		(km^2)	(%)	t/ha year^{-1}	Class	t/ha year^{-1}	Class	t/ha year^{-1}	Class
211	Non/irrigated arable land	151.22	36.58	0.00	Very Low	369.71	Very High	17.17	Moderate
221	Vineyards	0.26	0.06	0.00	Very Low	33.69	High	6.67	Very Low
222	Fruit trees and berry plantations	38.15	9.23	0.00	Very Low	107.21	Very High	2.42	Very Low
223	Olive groves	7.34	1.78	0.00	Very Low	293.71	Very High	17.15	Moderate
241	Annual crops associated with permanent crops	39.35	9.52	0.00	Very Low	260.08	Very High	5.51	Very Low

242	Complex cultivation patterns	28.79	6.97	0.00	Very Low	108.32	Very High	1.43	Very Low
243	Land principally occupied by agriculture, with significant areas of natural vegetation	29.65	7.17	0.00	Very Low	143.17	Very High	8.22	Low

Average annual erosion rates of agricultural lands for each sub-basin of Metapontino is presented in Table 27. A wide range of average annual erosion rate variation is presented for all sub-basin, ranging between very low and very high. On the average, Agri 6 sub-basin indicated high average annual erosion rate, while six sub-basins indicated moderate rates and two sub-basin indicated low erosion rates. Finally, 5 sub-basin were found to present very low average annual erosion rate, which are located at the eastern part of the basin.

Table 27: Average annual erosion statistics for the agricultural areas in each sub-basin of Agri sub-basin

Sub-basin Code	Area		Minimum		Maximum		Average	
	(km²)	(%)	t/ha year⁻¹	Class	t/ha year⁻¹	Class	t/ha year⁻¹	Class
Agri 1	15.33	5.20	0.00	Very Low	180.14	Very high	13.59	Moderate
Agri 10	7.86	2.67	0.00	Very Low	19.35	Moderate	0.57	Very low
Agri 2	34.98	11.87	0.00	Very Low	144.43	Very high	11.83	Low
Agri 3	13.86	4.70	0.00	Very Low	255.00	Very high	17.24	Moderate
Agri 4	15.28	5.19	0.00	Very Low	125.39	Very high	6.01	Very low
Agri 5	21.53	7.31	0.00	Very Low	182.04	Very high	6.80	Very low
Agri 6	4.79	1.63	0.00	Very Low	369.71	Very high	27.18	High
Agri 7	15.95	5.41	0.00	Very Low	264.51	Very high	21.04	Moderate
Agri 8	45.85	15.56	0.00	Very Low	103.58	Very high	2.48	Very low
Agri 9	45.87	15.57	0.00	Very Low	189.68	Very high	4.98	Very low
Sauro 1	15.19	5.16	0.00	Very Low	224.24	Very high	20.47	Moderate
Sauro 2	21.31	7.23	0.00	Very Low	276.28	Very high	17.19	Moderate
Sauro 3	27.93	9.48	0.00	Very Low	298.90	Very high	22.14	Moderate
Sauro 4	8.94	3.03	0.00	Very Low	115.75	Very high	12.33	Low

6.2. *FOR REGISTERED FARMS*

6.2.1. Mirabello

The location of registered farms in Havgas - Milatos sub-basin and their distribution in the average annual erosion classes map are presented in Fig. 66. The majority of the farms are located at the southern part of the basin, while a significant number of farms are found at the northern part. The majority of farms located in the northern part are indicating very low to moderate average annual soil erosion, while the majority of farms located in the southern part are indicating high to very high average annual erosion.

The distribution of registered farms in the five average annual soil erosion classes is presented in Fig. 67. The majority of the farms are found in very low erosion class (30 farms or 29.7%), while 23 farms (or 22.8%) are found in very high erosion class.

Nineteen farms (or 18.8%) indicated high average annual soil erosion rate, while 12 farms (or 11.9%) presented low and 17 farms (or 16.8%) presented moderate average annual soil erosion.

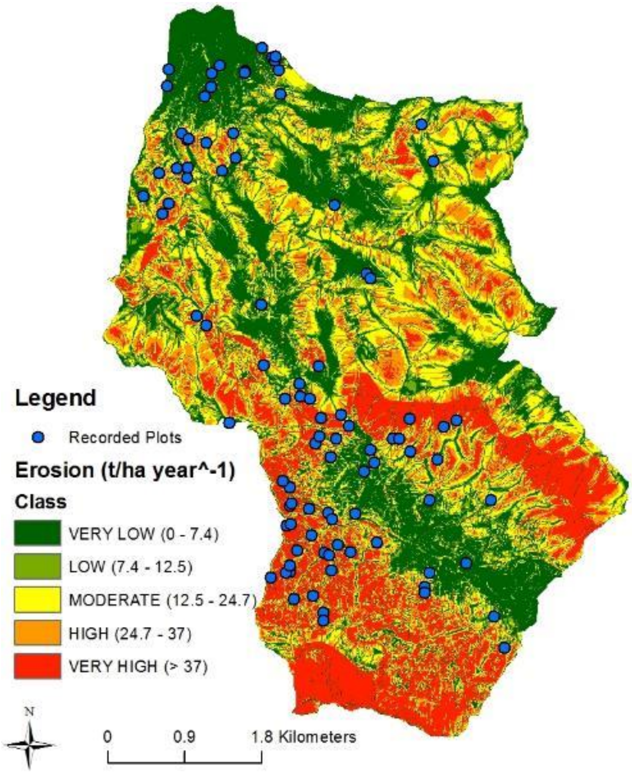

Fig. 66: Location and average annual soil erosion class of registered farms at Havgas - Milatos sub-basin

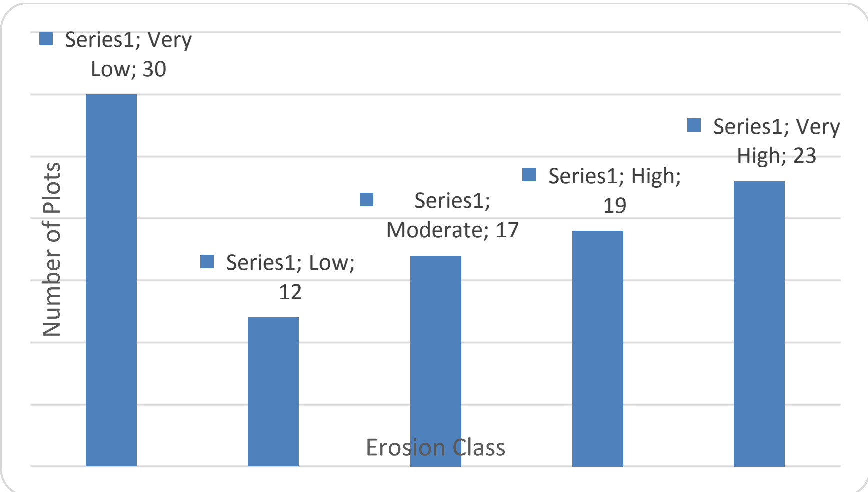

Fig. 67: Distribution of average annual soil erosion of the registered farms located within Havgas - Milatos sub-basin into the five classes

6.2.2. Tavronitis basin

The location of registered farms in Tavronitis River basin and their distribution in the average annual erosion classes map are presented in Fig. 68. Despite the fact that very low average annual soil erosion class dominates in the northern part of Tavronitis

River basin where the majority of the farms is located, it is hard to identify specific spatial patterns of farms distribution in the five soil erosion classes.

Therefore, the distribution of registered farms in the five average annual soil erosion classes is presented in Fig. 69. The majority of the farms are found in very low erosion class (34 farms or 34%), while 22 farms (or 22%) are found in moderate erosion class. Fifteen farms (or 15%) indicated very high average annual soil erosion rate, while 15 farms (or 15%) presented low and 14 farms (or 14%) presented high average annual soil erosion.

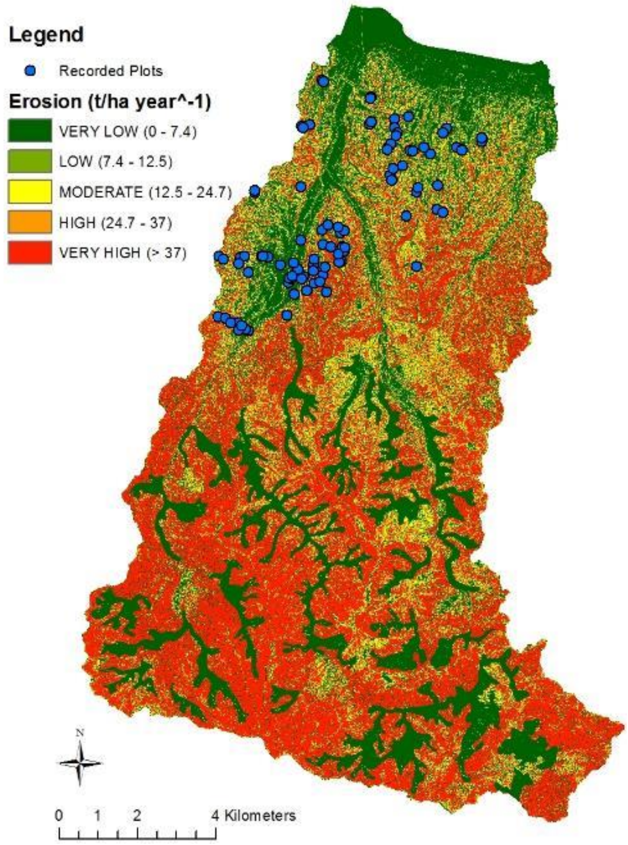

Fig. 68: Location and average annual soil erosion class of registered farms at Tavronitis basin

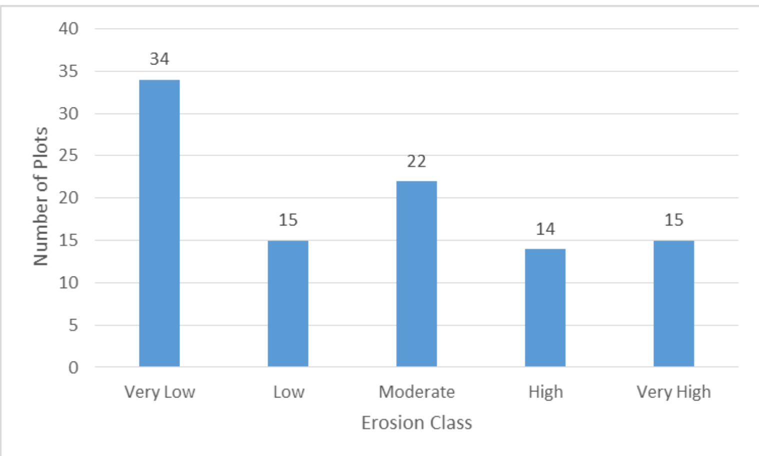

Fig. 69: Distribution of average annual soil erosion of the registered farms located within Tavronitis basin into the five classes

6.2.3. Agri sub-basin

The location of registered farms in Agri sub-basin and their distribution in the average annual erosion classes map are presented in Fig. 70. The majority of the registered farms are found in the very low average annual soil erosion class. This finding justified by the distribution of registered farms in the five average annual soil erosion classes, as presented in Fig. 71. The majority of the farms are found in very low erosion class (93 farms or 93%), while 4 farms (or 4%) were found in the low erosion class and 2 farms were found in the moderate erosion class. Finally, 1 farm (or 1.1%) was found to indicate high average annual soil erosion rate, while none of the registered farms indicated very high average annual soil erosion rate.

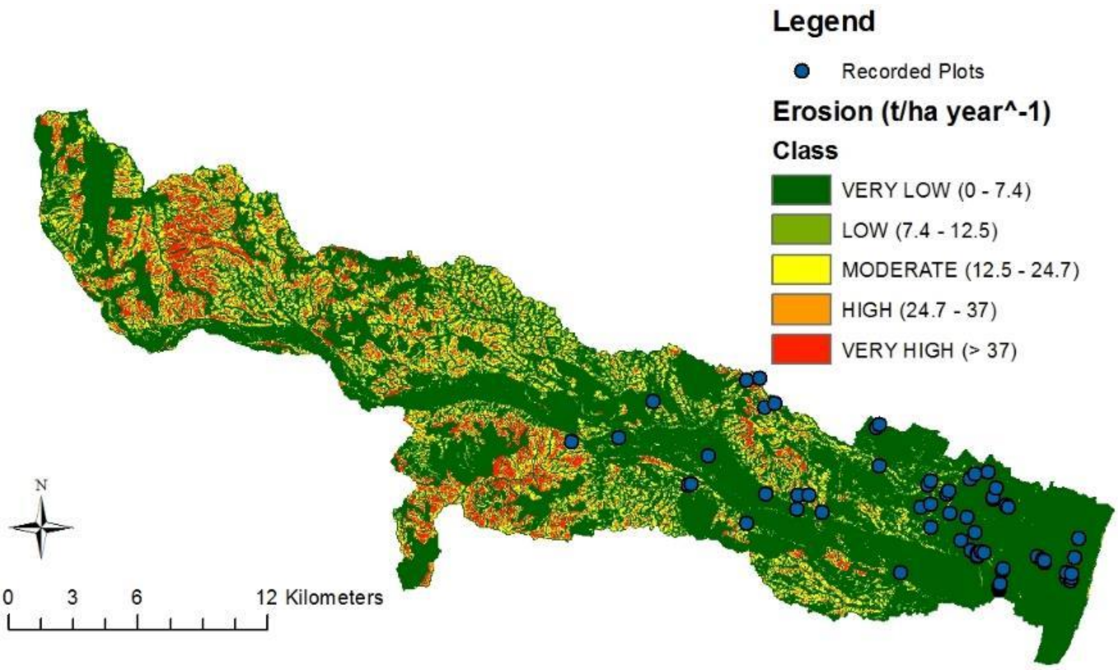

Fig. 70: Location and average annual soil erosion class of registered farms at Agri sub-basin

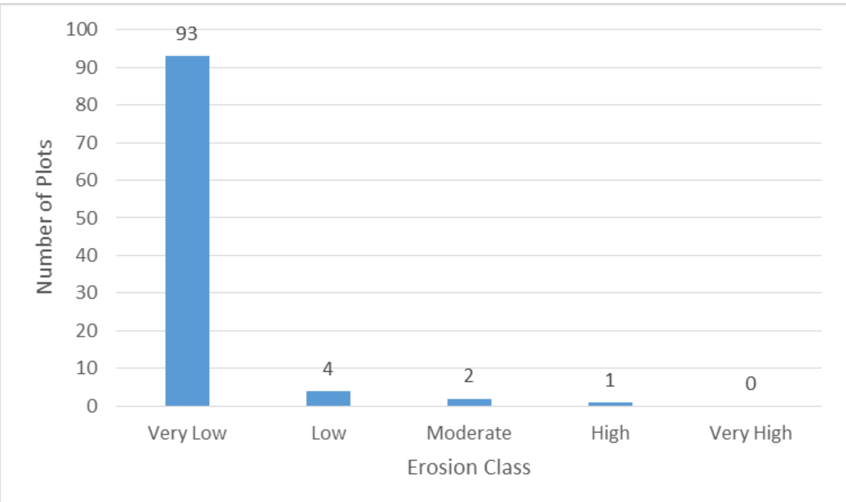

Fig. 71: Distribution of average annual soil erosion of the registered farms located within Agri sub-basin into the five classes

PART B – USE OF AGROCHEMICALS IN HIGH RISK AREAS

1 INTRODUCTION

The main scope of Part B of sub-deliverable C2.2 is the evaluation of use of agrochemicals in the registered orchards within the three pilot areas (Platanias, Mirabello and Metapontino) in terms of the potential to have an impact on the potentially affected destinations (water bodies and HCVAs) considering their hazardous to the aquatic environment and their localization in the risk classes

For the scope of this part not only the risk assessment of runoff, leaching and erosion, which were determined above, is taken into account but also the agrochemicals that are applied in each registered orchard and pilot sub-basin as a result of the data collected through the 1st AWMS form in reference to the agricultural practices that are applied in the three pilot areas. These data were analyzed and the results of their analyses which are presented in sub-deliverable C2.3 "Inventory of applied substances in the project's registered farms".

In the following chapters the project's scientific team analyses the agricultural practices that are applied per registered orchard which is located in areas with higher or equal to moderate runoff, erosion and leaching and then determines the sub-basins where potential pollution can de caused due to the agricultural sector in case of application of irrational agricultural practices. The result of this deliverable will be also used in deliverable C2 "Report on Assessment of Water efficiency of the participant F.ORs before LIFE AgroClimaWater" for the estimation and assessment of impacts both on water bodies' quality and on HCVAs that are included in the three pilot sub-basins and they are induced by agricultural activity.

2 AGROCHEMICALS AND RUNOFF RISK POTENTIAL

2.1 VOUKOLIES AND MALEME SUB-BASINS

As it has been mentioned in Part A the majority of the registered orchards in Platanias area is found in high runoff potential class (60 farms or 60%), 38 farms (or 38%) are found in moderate runoff potential class and only 2 farms indicated low runoff potential, while none of the 100 registered farms was found to be classified as of either very low or very high runoff potential.

According to the data collected through the 1st AWMS form and the statistical analysis from the 60 orchards which are found in high runoff potential areas 53 (or 88.3%) are fertilized (Table 28). The majority of these orchards (26 out of 53) is located in GR3901R000301007N sub-basin and especially in the south-eastern and south-western part (Fig. 72). There are also 14 fertilized orchards mainly in the eastern part of GR3901R000301006N and a small number equal to 7 and 6 in the southern part of Maleme and GR3901R000301057N sub-basins, respectively.

Table 28: Agrochemicals in orchards with high runoff potential Voukolies and Maleme sub-basins

Sub-basin		GR3901R000301006N	GR3901R000301007N	GR3901R000301057N	Maleme	Total
Fertilized Orchards		14	26	6	7	53
Orchards with PPP		13	28	6	6	53
Orchards with H400	**No**	0	0	0	0	0
	PPP	-	-	-	-	-
Orchards with H410	**No**	6	21	3	1	31
	PPP	Copper, Proteus, Decis, Pyrinex	Decis, Copper, Proteus, Pyrethron	Decis, Copper	Decis	Copper Decis Proteus Pyrethron Pyrinex
Orchards with specific pollutants	**No**	10	12	4	6	32
	PPP	Copper, Rogor	Copper, Rogor	Copper, Rogor	Rogor	Copper Rogor
	SP	Copper, Dimethoate	Copper, Dimethoate	Copper, Dimethoate	Dimethoate	Copper Dimethoate
Orchards with priority substances	**No**	1	0	0	0	1
	PPP	Pyrinex	-	-	-	Pyrinex
	PS	Chlorpyrifos-ethyl	-	-	-	Chlorpyrifos-ethy
Irrigated orchards		12	18	2	2	34

In addition, there are 53 out of 60 orchards in which PPPs are applied. The spatial distribution of these orchards is similar to the one which has been already described in the previous paragraph. The majority of these orchards (28 out of 53) is located in the south-eastern and south-western part of GR3901R000301007N, 13 in the eastern part of GR3901R000301006N, 6 in the central part of GR3901R000301057N and 6 in the southern part of Maleme sub-basins (Fig. 72).

While the PPPs which are used in all orchards fall into various categories (H400, H410, H411, H412 & H413) which are hazardous to the aquatic environment as they cause toxicity to the aquatic life, in this section only the PPPs classified as H400 (very toxic to aquatic life – acute toxicity) and H410 (very toxic to aquatic life with long lasting effects – chronic toxicity) will be analyzed as they are more hazardous to the aquatic environment. The rest of the PPPs are described in sub-deliverable C2.3.

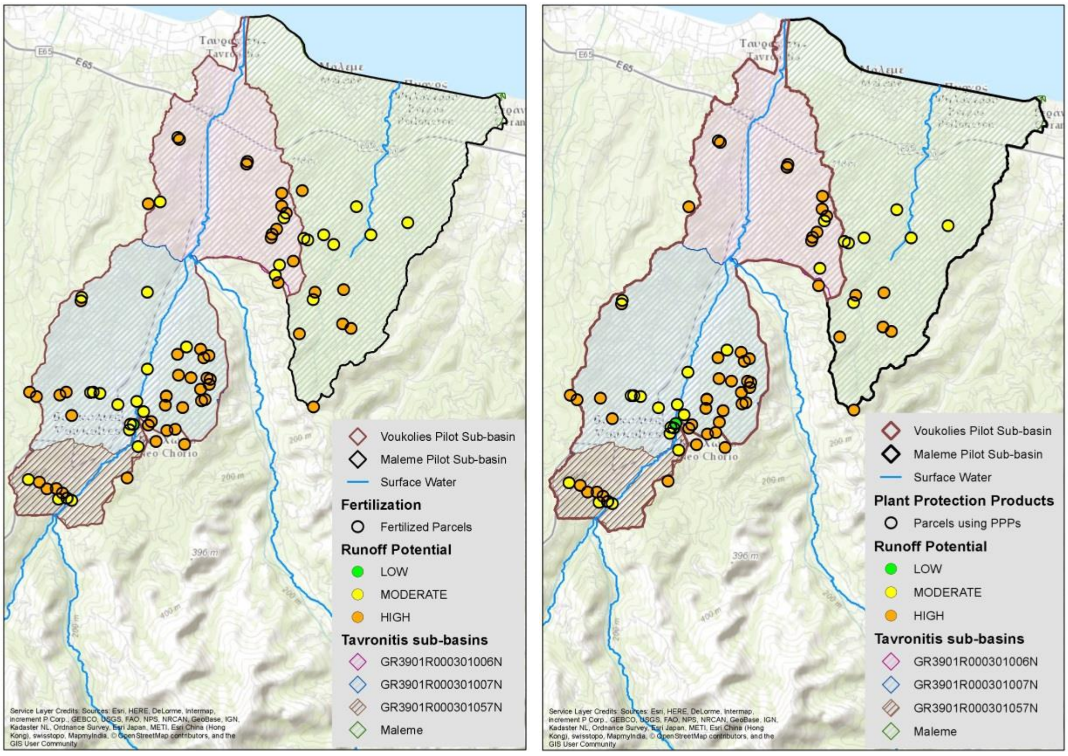

Fig. 72: Spatial distribution of orchards where fertilizers (left) and PPPs (right) are used and classification according to their runoff potential in Voukolies and Maleme sub-basins

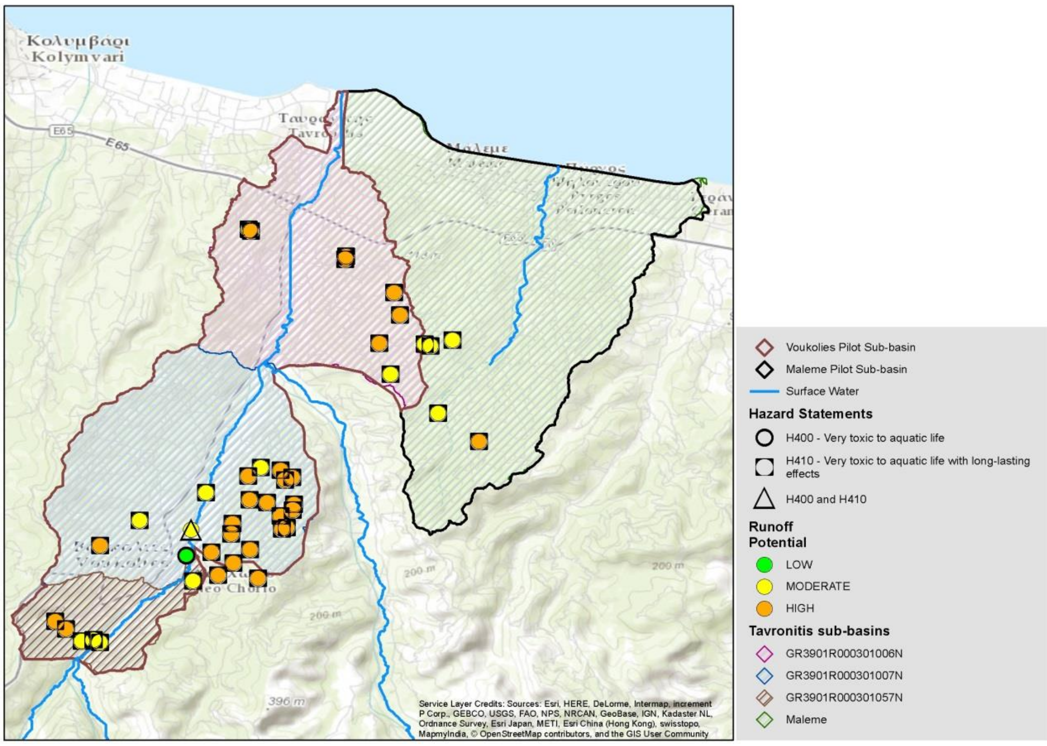

Fig. 73: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their runoff potential in Voukolies and Maleme sub-basins

Five PPPs classified as H410 (Copper, Decis, Proteus, Pyrethron & Pyrinex) are applied in 31 out of 53 orchards (51.7%), but in none of the 53 registered orchards PPPs classified as H400 are applied. As it is shown in Fig. 73 the majority of these orchards (21 out of 31) are located in the eastern – southeastern part of GR3901R000301007N, 6 in the eastern part of GR3901R000301006N and 4 in the south part of GR3901R000301057N and Maleme sub-basins (3 and 1, respectively).

From the statistical analysis of the registered orchards which are found in high runoff potential it was concluded that PPPs with substances that have been characterized as specific pollutants according to Greek legislation are used in almost half of them. More specific, in 32 out of 60 registered orchards (53.3%) at least one PPP (Rogor) which contains the specific pollutant of dimethoate was applied, while in 4 of them (4 out of 32) also a second specific pollutant (copper) was identified as a result of the copper containing in the fungicides (Table 52 in Appendix II).

The eastern part of sub-basins GR3901R000301007N and GR3901R000301006N include the majority of the orchards (12 and 10, respectively) in which PPPs which contains specific pollutants are used (Fig. 74), while a small number of 4 orchards are also located in the western and southern part of sub-basins GR3901R000301057N (4 orchards) and Maleme (6 orchards).

Also, within this group of registered orchards there is only one orchard (1 out of 60 or 1.7%) where PPP which contains priority substance is used (Table 28). This is an olive crop orchard in the eastern part of GR3901R000301006N, where Pyrinex, one of the main components of which is chlorpyrifos-ethyl (priority substance according to the European legislation) is used (Fig. 74).

Apart from the high runoff potential which characterize the orchards included in this group another important characteristic is that almost half of them (34 out of 60) are also irrigated (Table 28). This cause also the increase of the wash of substances that are contained in the fertilizers and PPPs that are used in the registered orchards and also the potential pollution of the surface waters of the pilot basins with higher quantities of pollutants.

From the 38 orchards which are found in moderate runoff potential areas 31 (81.6%) are fertilized (Table 29). The majority of these orchards (11 out of 31) is scattered in the western and southern part GR3901R000301007N, 9 are found in the central part of Maleme sub-basin and a small number of 6 and 5 orchards in the eastern and southern part of GR3901R000301006N and GR3901R000301057N sub-basins, respectively (Fig. 72).

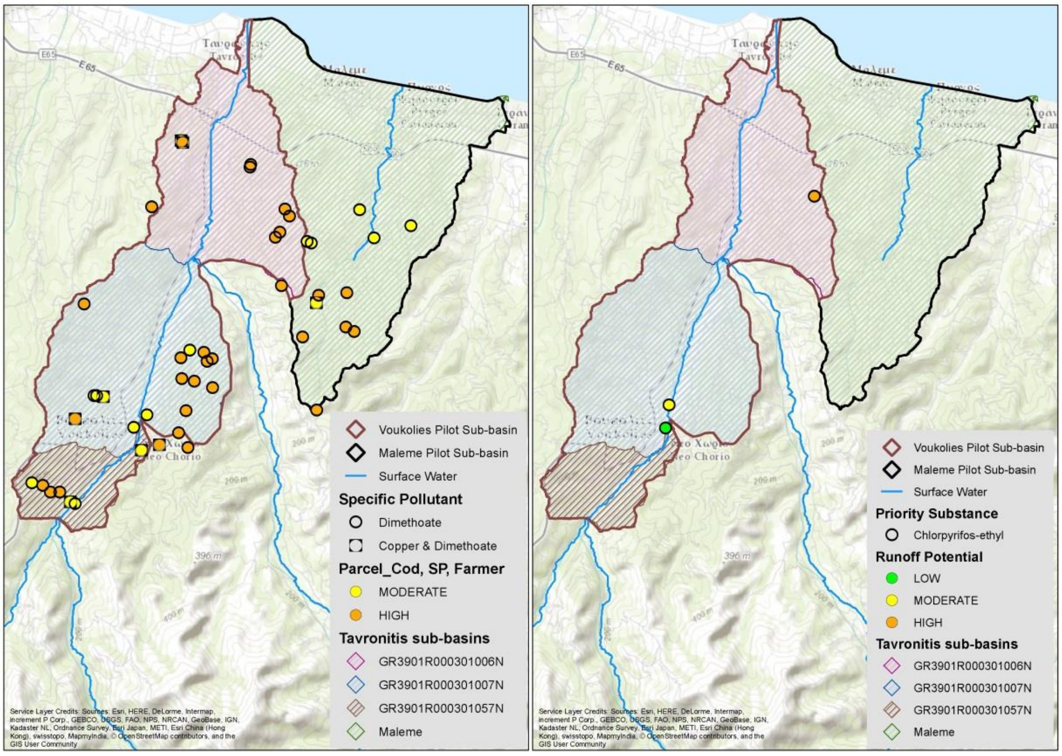

Fig. 74: Spatial distribution of parcels where PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their runoff potential in Voukolies and Maleme sub-basins

In 28 out of 31 registered orchards of this class PPPs are applied. The spatial distribution of these orchards is similar to the one described in high runoff area. 10 out of these orchards are located in the central and south-eastern part of GR3901R000301007N, 8 in the central part of Maleme, 6 southern part of GR3901R000301057N and 4 in the eastern part of GR3901R000301006N (Fig. 72).

As far as the hazardous PPPs are concerned only 1 PPP classified as H400 is applied in the area. More specific, Dursban (PPP classified as H400) is used in an olive orchard, located in the southern part of GR3901R000301007N sub-basin (Fig. 73, Table 29). Moreover, in this orchard Decis and Proteus (PPPs classified as H410) are also used. In this class of orchards a total of four PPPs classified as H410 (Copper, Decis, Proteus, Pyrethron) is applied in 16 out of 38 orchards. 3 of these orchards are located in the eastern part of GR3901R000301006N, 4 in the western part of Maleme, 5 in the southern part of GR3901R000301057N and 4 in the central part of GR3901R000301007N sub-basin (Fig. 73).

Table 29: Agrochemicals in orchards with moderate runoff potential Voukolies and Maleme sub-basins

Sub-basin		GR3901R000301006N	GR3901R000301007N	GR3901R000301057N	Maleme	Total
Fertilized Orchards		5	11	6	9	31
Orchards with PPP		4	10	6	8	28
Orchards with H400	**No**	-	1	-	-	1
	PPP	-	Dursban	-	-	Dursban
Orchards with H410	**No**	3	4	5	4	16
	PPP	Copper, Decis	Copper, Decis,	Copper, Decis,	Copper, Decis	Copper Decis

			Proteus	Pyrethron		Proteus Pyrethron
Orchards with specific pollutants	**No**	2	5	4	7	18
	PPP	Copper & Rogor	Copper & Rogor	Copper & Rogor	Copper & Rogor	Copper & Rogor
	SP	Copper & Dimethoate	Copper & Dimethoate	Copper & Dimethoate	Copper & Dimethoate	Copper & Dimethoate
Orchards with priority substances	**No**	0	1	0	0	1
	PPP	-	Durban	-	-	Durban
	PS	-	Chlorpyrifos-ethyl	-	-	Chlorpyrifos-ethyl
Irrigated orchards		4	4	3	8	19

In 18 out of 28 orchards with high runoff potential PPPs which contain specific pollutants according to Greek legislation are used. More specific, in 18 out of 28 registered orchards (53.3%) at least one PPP (Rogor) which contains the specific pollutant of dimethoate was applied, while in 6 of them (6 out of 28) also a second specific pollutant (copper) was identified as a result of the copper containing in the fungicides (Table 53 in Appendix II).
The spatial distribution of the above mentioned orchards is as follows: the central part of Maleme sub-basin includes 7 out of 18 orchards where PPPs with specific pollutants are applied, 5 orchards are located in the southern part of GR3901R000301007N, 4 in the southern and western part of GR3901R000301057N and 2 in GR3901R000301006N sub-basin (Fig. 74).
Also, within this group of orchards there is only one orchard (1 out of 28 or 1.7%) where PPP which contains priority substance is used (Table 29). This is an olive crop orchard in the southern part of GR3901R000301006N, where Pyrinex, one of the main components of which is chlorpyrifos-ethyl (priority substance according to the European legislation) is used (Fig. 74).
Moreover, 19 out of 28 orchards of this group not only included in areas with moderate runoff potential but also they are irrigated (Table 29). This increase the potential pollution of the surface waters of four pilot basins with higher quantities of pollutants.

2.2 HAVGAS – MILATOS SUB-BASIN

The majority of the registered orchards in Mirabello is found in high runoff potential class (71 out of 101 farms or 70.3%), 22 farms (or 21.8%) are found in moderate runoff potential class, 4 farms (4%) indicated low runoff potential and also 4 farms (4%) are found in very high runoff potential.
In 2 out of 4 orchards that are found in areas with very high runoff potential, which are located in the western part of HM-6 sub-basin, fertilizers are used (Table 30, Fig. 75). According to the statistical analysis of the data collected through the 1st AWMS form none of the orchards of this class neither PPPs are applied nor is irrigated. As a result, even if the impact of runoff is very high for these 4 orchards the fact that apart from fertilizers no other pollutant (PPPs, priority substances etc.) is used leads to the conclusion that the possibility of causing any significant impact in the surface water bodies which are indicated is rather low.

Table 30: Agrochemicals in orchards with very high runoff potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		0	0	0	0	0	2	2
Orchards with PPP		0	0	0	0	0	0	0
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with specific pollutants	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	SP	-	-	-	-	-	-	-
Orchards with priority substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		0	0	0	0	0	0	0

As far as the 71 orchards that are found in high runoff potential are concerned the situation is more complicated. A total of 30 out of 70 orchards (42.3%) that are found in high runoff potential areas are fertilized (Table 31). From these the 86.7% (26 out of 30) is located in the central and western part of HM-6 sub-basin, 10% (3 out of 30) is found in the southern part of HM-5 and only 3.3% (1 out of 30) in the central part of HM-1 sub-basin (Fig. 75).

Table 31: Agrochemicals in orchards with high runoff potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		1	0	0	0	3	26	30
Orchards with PPP		1	2	0	0	2	20	25
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	0	2	0	0	0	13	15
	PPP	-	Copper, Bulldoc k	-	-	-	Copper, Bulldoc k	Copper, Bulldock
Orchards with Specific pollutants	**No**	1	1	0	0	1	17	20
	PPP	Rogor	Copper			Rogor	Copper, Rogor	Copper, Rogor
	SP	Dimeth oate	Copper			Dimeth oate	Copper, Dimeth oate	Copper, Dimethoat e
Orchards with priority Substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		1	0	0	1	0	4	6

PPPs are applied in 35.2% (25 out of 71) of the registered orchards that are found in high runoff potential. The 25 orchards mainly are found in the central and eastern part of HM-6 sub-basin (20 out of 25), a small number (4 out of 25 orchards) is also found in the central part of HM-5 and HM-2 sub-basins and only 1 orchard is located in the eastern part of HM-1 sub-basin (Fig. 76). While in none of the 25 orchards PPPs classified as H400 are used, there are 15 orchards where PPPs classified as H410 are utilized (Table 31). The pattern of the spatial distribution of these orchards is very similar to the one described above as 13 of them are located in the central-western part of HM-6 and only 2 in the central part of HM-2 (Fig. 76). Two different PPPs classified as H410, Copper and Bulldock, are used in these orchards (Table 60 in Appendix II). In 11 out of the 13 orchards of HM-6 both Copper and Bulldock are used, while in the rest of them (2 out of the 13) the only PPP which is used is Bulldock. As far as the 2 orchards of HM-2 is concerned, either Copper or Bulldock is applied in each of them.

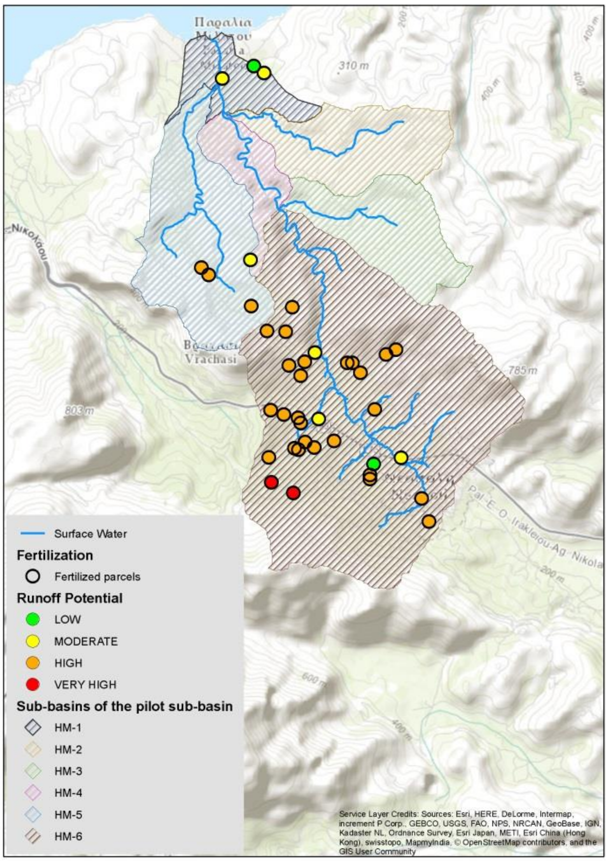

Fig. 75: Spatial distribution of fertilized orchards and classification according to their runoff potential in Havgas - Milatos sub-basin

Only 20 out of 71 orchards that are found in high runoff potential contain substances that have been characterized as specific pollutants according to the Greek legislation. The majority of the above mentioned orchards (85% or 17 out of 20) are located in the central and western part of HM-6 sub-basin (Fig. 77). From these, Copper which contains the specific pollutant of copper, is used in 11 orchards while Rogor which contains the specific pollutant of dimethoate is applied in the rest 6 orchards. The rest 3 orchards where PPPs classified as H410 are applied are located in the eastern part of HM-1 and HM-2 (2 orchards) and in the western part of HM-5 (1 orchards) and none PPP which contains specific pollutants is applied in any of them.
In reference to the priority substances that are used in the registered orchards in Havgas - Milatos pilot sub-basin in none of the 71 orchards with high runoff potential is used PPPs with priority substances according to the European legislation.

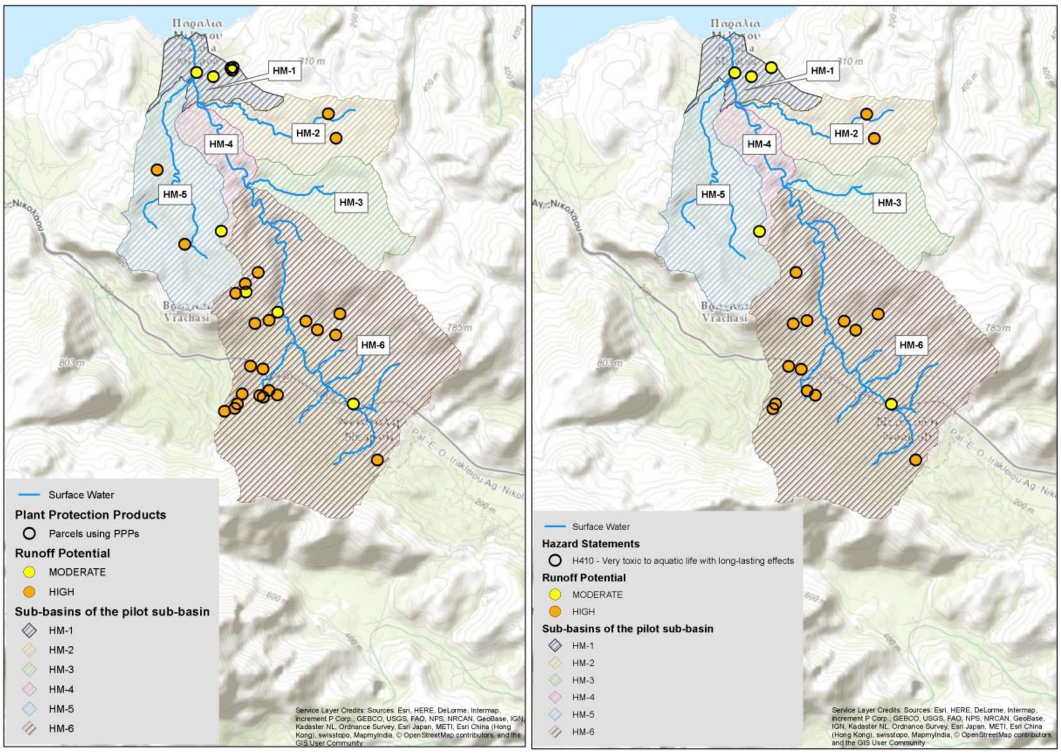

Fig. 76: Spatial distribution of parcels where PPPs (left) and H410 (right) are used and classification according to their runoff potential in Havgas - Milatos sub-basin

In general, the majority of the registered orchards in Havgas – Milatos sub-basins are not irrigated. As a result from the total of 71 orchards of this class only the 8.5% (6 out of 71 orchards) is irrigated. From these 4 orchards are located in HM-6 sub-basin and 2 in HM-1 and HM-4 sub-basins, respectively.

From the 22 registered orchards that are found in moderate runoff potential 16 are located in HM-1 and HM-6 sub-basins (8 and 8, respectively), 3 in HM-5, 2 in HM-4 and only 1 in HM-4. 6 out of 22 orchards (or 27.3%) are fertilized, from which 3 are located in the central part of HM-6, 2 in the central and eastern part of HM-1 and 1 in the southern part of HM-4 sub-basin (Fig. 75).

Table 32: Agrochemicals in orchards with moderate runoff potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		2	0	0	1	0	3	6
Orchards with PPP		4	0	0	1	0	3	8
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	3	0	0	1	0	1	5
	PPP	Reldan	-	-	Bulldock & Copper	-	Bulldock & Copper	Bulldock & Copper
Orchards with Specific pollutants	**No**	1	0	0	1	0	2	4
	PPP	Rogor	-	-	Copper	-	Copper, Rogor	Copper, Rogor
	SP	Dimethoate	-	-	Copper	-	Copper, Dimethoate	Copper, Dimethoate

Orchards with priority Substances	**No**	3	0	0	0	0	0	3
	PPP	Reldan	-	-	-	-	-	Reldan
	PS	Naphthalene & Chlorpyrifos-ethyl	-	-	-	-	-	Naphthalene & Chlorpyrifos-ethyl
Irrigated orchards		4	0	0	1	0	0	5

Also, in 8 out of the 22 orchards with moderate runoff potential PPPs are applied. As it has been concluded from the statistical analysis none of these PPPs is classified as H400. However, there are PPPs which have been classified as H410 and used in 5 out of 8 orchards (1 in HM-6, 1 in HM-4 and 3 in HM-1). More specific, three different PPPs classified as H410 (Reldan, Copper & Bulldock) are used in these orchards (Table 61 in Appendix II). Copper and Bulldock are both used in the 2 orchards which are located in the southern part of HM-4 and HM-6 sub-basins, while Reldan is used in 3 orchards in the central and eastern part of HM-1 (Fig. 76).

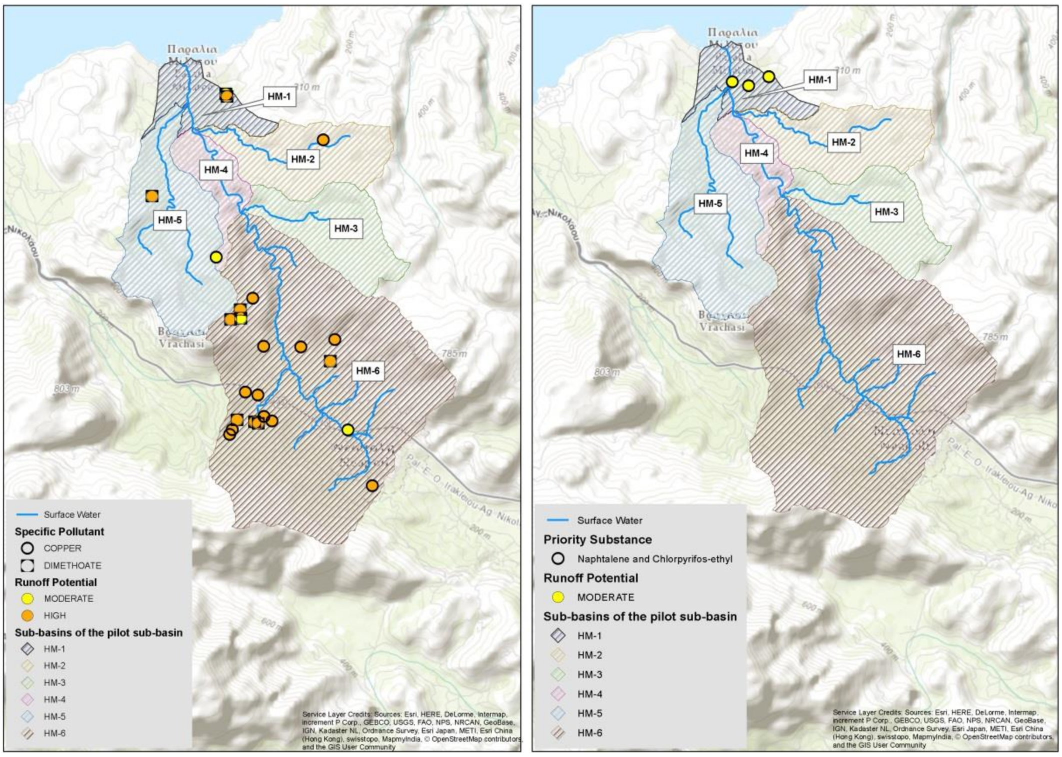

Fig. 77: Spatial distribution of parcels where PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their runoff potential in Havgas - Milatos sub-basin

Only 4 out of 22 registered orchards that are found in moderate runoff potential contain substances that have been characterized as specific pollutants according to the Greek legislation and only two specific pollutants copper due to Copper and dimethoate due to Rogor are used. 2 out of these 4 orchards are located in the north-western and south-eastern part of HM-6 sub-basin and Rogor and Copper are applied respectively, 1 is located in the southern part of HM-4 where Copper is applied and 1 is found in the eastern part of HM-1 where Rogor is used. Also, in 3 orchards (in the central and eastern part of HM-1) priority substances are detected as Reldan, which contains both naphthalene and chlorpyrifos-ethyl, is utilized (Fig. 77).

Moreover, from the 22 orchards which are found in moderate runoff potential only 5 are irrigated, 4 in HM-1 and 1 in HM-1 sub-basins.

2.3 AGRI SUB-BASIN

The majority of the registered orchards in Agri pilot sub-basin area are found in moderate runoff potential class (56 farms or 56%), 42 farms (or 42%) are found in low runoff potential class and only 2 farms (or 2%) indicated high runoff potential, while none of the 100 registered farms was found to be classified as of either very low or very high runoff potential.

From the 2 orchards that are included in the class of high runoff potential the first one is located in the eastern part of Agri3 sub-basin and the second one in the western part of Agri4 sub-basin. From these 2 orchards only the one which is located in Agri4 sub-basin is fertilized (Table 33, Fig. 78), however both of them use PPPs (Fig. 79).

Table 33: Agrochemicals in orchards with high runoff potential Agri pilot sub-basin

<table>
<tr><th colspan="2">Sub-basin</th><th>Agri3</th><th>Agri4</th><th>Agri5</th><th>Agri8</th><th>Agri9</th><th>Agri10</th><th>Total</th></tr>
<tr><td colspan="2">Fertilized Orchards</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="2">Orchards with PPP</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td rowspan="2">Orchards with H400</td><td>No</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>PPP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Orchards with H410</td><td>No</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>PPP</td><td>Pyrethrum Nature, Cupravit</td><td>Trebon Up, Cupravit</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Pyrethrum Nature, Cupravit, Trebon Up</td></tr>
<tr><td rowspan="3">Orchards with Specific pollutants</td><td>No</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>PPP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>SP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Orchards with Priority Substances</td><td>No</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>PPP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>PS</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Irrigated orchards</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
</table>

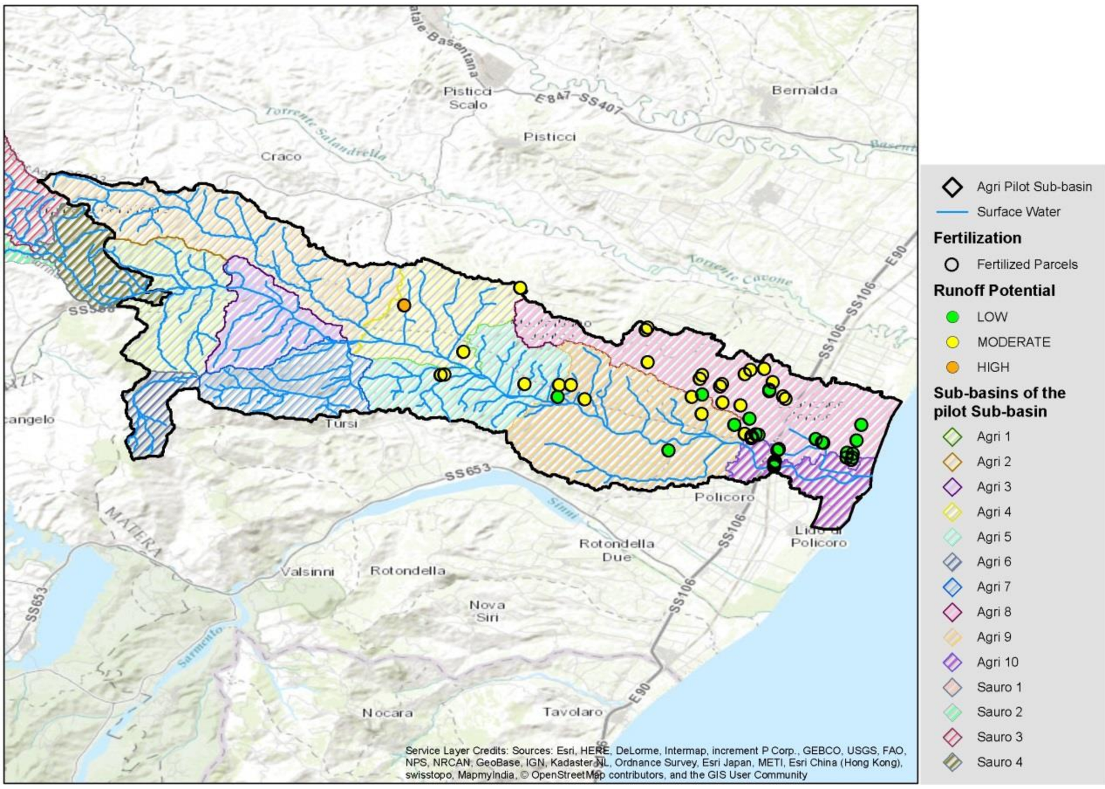

Fig. 78: Spatial distribution of fertilized orchards and classification according to their runoff potential in Agri pilot sub-basin

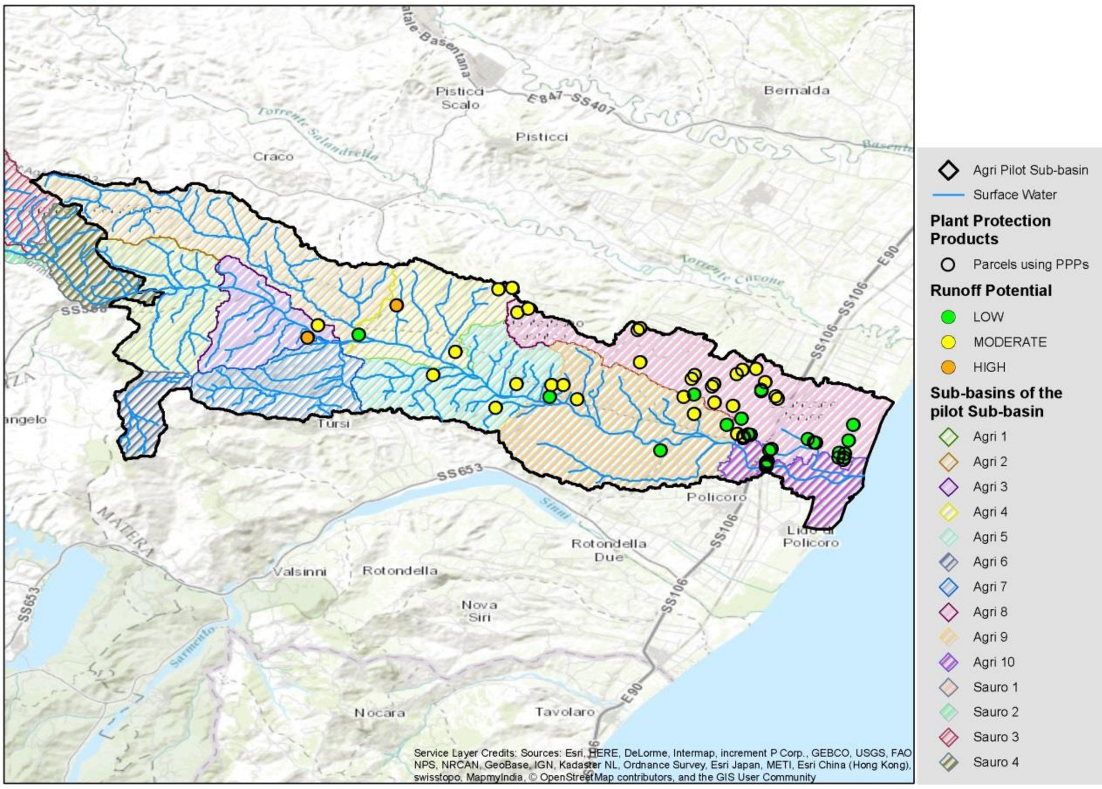

Fig. 79: Spatial distribution of orchards where PPPs are used and classification according to their runoff potential in Agri pilot sub-basin

According to the data collected through the 1st AWMS form 3 PPPs (Pyrethrum Nature, Cupravit and Trebon Up) are applied in these 2 orchards. Pyrethrum Nature and Cupravit are the PPPs which are used in the orchard located in the eastern part of Agri3 sub-basin and Trebon Up and Cupravit are used in the second orchard in the western part of Agri4 sub-basin (Table 67 in Appendix II). While none of these PPPs is classified as H400, all of them are classified as H410 (Table 33, Fig. 80).
Another important characteristic of the PPPs that are used in these orchards is that none of them contains either priority substances or specific pollutants according to the European and the Italian National legislation (Table 33), respectively.
Moreover, both orchards are irrigated. This in combination with the fact that in these orchards fertilizers and PPPs classified as H410 (very toxic to aquatic life with long lasting effects) are used lead to the conclusion that the agricultural activity that takes place in these 2 orchards is expected to impact significantly the water quality of the surface water bodies and the HCV areas that are located in Agri3 and Agri4 sub-basins.

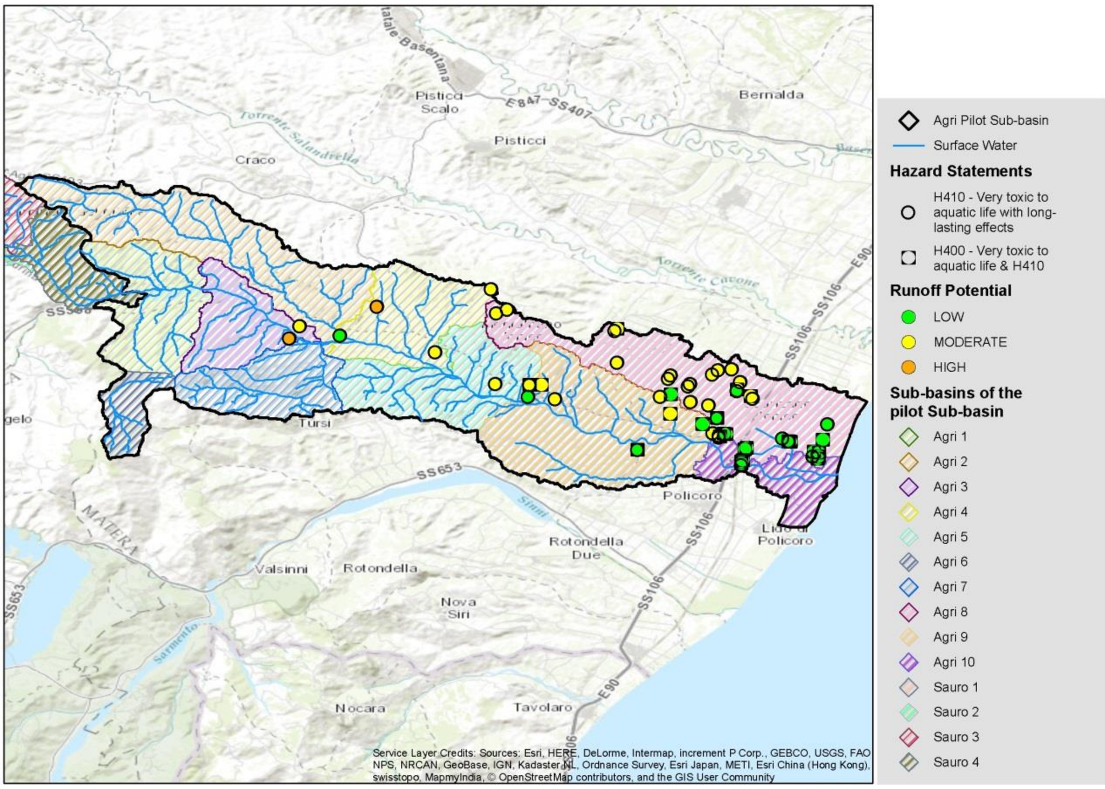

Fig. 80: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their runoff potential in Agri pilot sub-basin

The situation in class of moderate runoff potential is much more complicated than the one described above. 50 out of 56 (or 89.3%) registered orchards of this class are fertilized. The majority of these orchards (32 out of 50) is located in the central part of Agri8 sub-basin, 9 are located in the north-eastern and western part of Agri9, 5 in the north-western part of Agri 10, 2 in the western part of Agri5 and 2 orchards in the eastern part of Agri4 sub-basin (Table 34, Fig. 78).

Table 34: Agrochemicals in orchards with moderate runoff potential Agri pilot sub-basin

Sub-basin		Agri3	Agri4	Agri5	Agri8	Agri9	Agri10	Total
Fertilized Orchards		0	2	2	32	9	5	50
Orchards with PPP		1	3	3	34	9	4	54
Orchards with H400	**No**	0	0	0	4	4	1	9
	PPP	-	-	-	Signum	Signum	Signum	-
Orchards with H410	**No**	1	3	3	34	9	4	54
	PPP	Pyrethrum Nature, Cupravit	Trebon Up Cupravit Pyrethrum Nature	Pyrethrum Nature, Cupravit	Vertimec Laser Confidor Cobre Nordox Epik Pomarsol Pyrethrum Nature Trebon Up Calypso Cupravit Reldan Chorus Zelig Signum Poltiglia Dispress Karate Zeon Protil EC Mezene WG	Calypso Chorus Confidor Cupravit Epik Karate Zeon Laser Mezene WG Pomarsol Reldan Signum Trebon Up Vertimec Zelig	Confidor Cupravit Epik Karate Zeon Laser Mezene WG Pomarsol Reldan Signum Trebon Up Vertimec Zelig	Calypso Chorus Cobre Nordox Confidor Cupravit Epik Karate Zeon Laser Mezene WG Poltiglia Dispress Pomarsol Protil EC Pyrethrum Nature Reldan Signum Trebon Up Vertimec Zelig
Orchards with Specific pollutants	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Orchards with Priority Substances	**No**	0	0	0	7	7	4	18
	PPP	-	-	-	Reldan, Zelig	Reldan, Zelig	Reldan, Zelig	Reldan, Zelig
	SP	-	-	-	Napthalene, Chlorpyrifos-ethyl	Napthalene, Chlorpyrifos-ethyl	Napthalene, Chlorpyrifos-ethyl	Napthalene, Chlorpyrifos-ethyl
Irrigated orchards		0	3	3	33	9	5	53

Also, PPPs are used in a significant number of orchards of this class. More specific, almost all registered orchards (54 out of 56 or 96.4%) that are found in moderate runoff potential areas use PPPs (Table 33). A total of 18 PPPs are used in 54 out of 56 (96.4%) orchards of this group. From these PPPs only one, Signum, is classified as H400. Signum is used in 9 orchards which are located in the eastern and western part of Agri9 (4 orchards), in the central and northern part of Agri8 (4 orchards) and in the north-western part of Agri10 sub-basin. Also, in this class 18 PPPs classified as H410 are used in 54 orchards. These orchards are scattered in almost all sub-basins (Agri3, Agri4, Agri5, Agri8, Agri9 and Agri10) but their majority is located in Agri8 (34 out of 54 or 62.9%) (Fig. 80, Table 68 in Appendix II).

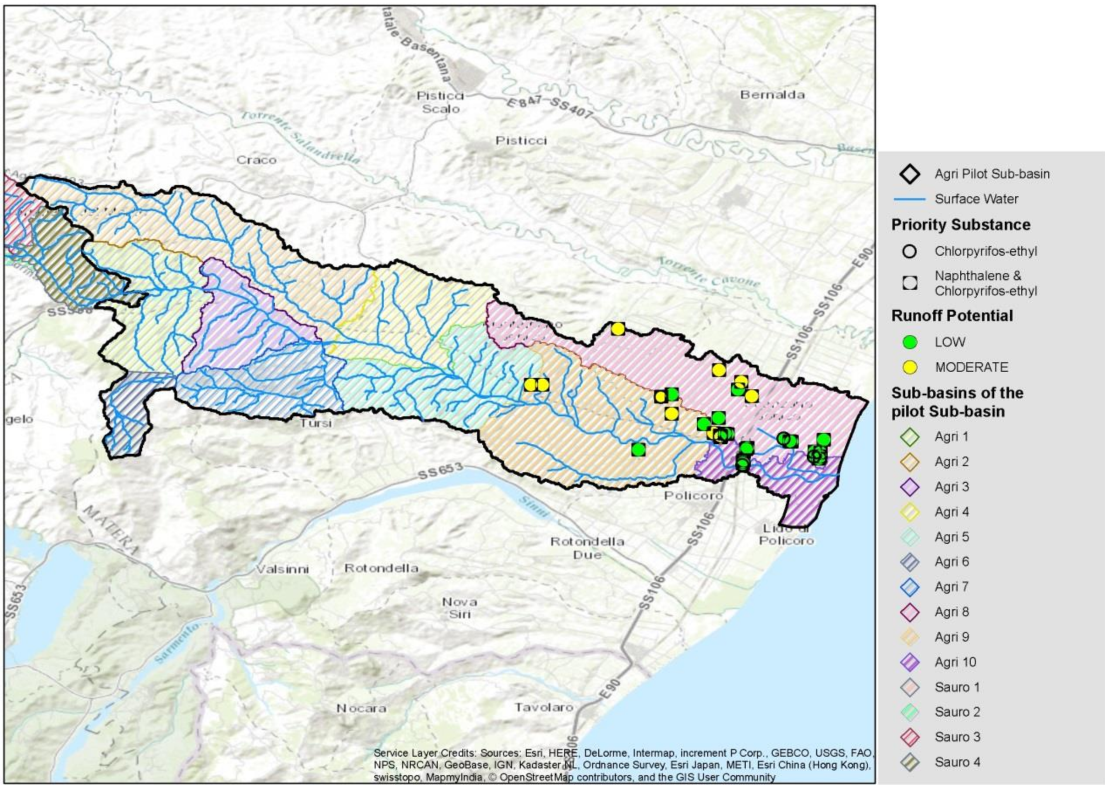

Fig. 81: Spatial distribution of parcels where PPPs with priority substances are used and classification according to their runoff potential in Agri pilot sub-basin

In 30.4% of orchards of this class PPPs which contain priority substances are used. More specific, Reldan and Zelig, which contain the priority substances of Napthalene and Chlorpyrifos-ethyl, are used in 18 out of 56 registered orchards. According to their spatial distribution (Fig. 81) 7 of these orchards are located in the southern part of Agri8, 7 in the north-eastern and north-western part of Agri9 and 4 in the north-western part of Agri10. As far as specific pollutants are concerned it should be mentioned that none of the PPPs applied in these orchards contain specific pollutants.

Also, 53 out of 56 (or 94.6%) orchards of this class are irrigated. The pattern of their spatial distribution is similar to the one described above in reference to the orchards where PPPs are used (Table 34).

3 AGROCHEMICALS AND EROSION RISK POTENTIAL

3.1 VOUKOLIES AND MALEME SUB-BASINS

34 farms out of the total registered orchards in Platanias are found in very low erosion potential class (or 34%), 22 farms (or 22%) are found in moderate erosion potential class, 15 in low erosion potential class (or 15%), 15 in very high erosion potential class (or 14%) and 14 farms indicated high erosion potential.
From the 15 orchards which are found in very high erosion potential areas in Platanias all orchards are fertilized (Table 35). The majority of these orchards (12 out of 15) are located in the eastern and western part of GR3901R000301007N sub-basin. Also, there are other 2 fertilized orchards in the central part of GR3901R000301006N and 1 in the southern part of Maleme sub-basin (Fig. 82).

Table 35: Agrochemicals in orchards with very high erosion potential Voukolies and Maleme sub-basins

Sub-basin		GR3901R000 301006N	GR3901R000 301007N	GR3901R000 301057N	Maleme	Total
Fertilized Orchards		2	12	0	1	15
Orchards with PPP		2	12	0	1	15
Orchards with H400	**No**	0	0	0	0	0
	PPP	-	-	-	-	
Orchards with H410	**No**	0	7	0	0	7
	PPP	-	Decis, Proteus, Pyrethron	-	-	-
Orchards with Specific pollutants	**No**	1	4	0	1	6
	PPP	Rogor	Rogor	-	Rogor	-
	SP	Dimethoate	Dimethoate	-	Dimethoate	-
Orchards with priority Substances	**No**	0	0	0	0	0
	PPP	-	-	-	-	-
	PS	-	-	-	-	-
Irrigated orchards		1	3	0	0	4

From the statistical analysis of the data collected through the 1st AWMS form it was concluded that in all orchards that are found in very high erosion potential areas PPPs are applied. Their spatial distribution is similar to the one described in the previous paragraph in reference to the fertilized orchards.
Almost half of the 15 orchards (7 out of 15 or 46.6%) where PPPs are applied use PPPs classified as H410. A total of three PPPs (Decis, Proteus &Pyrethron) are used in these 7 orchards (Table 35) which are located only in the eastern part of GR3901R000301007N sub-basin (Fig. 83). More specific, Decis is used in 13.3% (or 2 out of 15 orchards), Proteus is used in 20% (3 out of 15 orchards) and Pyrethron in 13.3% (or 2 out of 15 orchards) of the registered orchards of this class (Table 54 in Appendix II). Also, it should be noticed that in none of the above mentioned orchards any PPP classified as H400 is used.
PPPs which contain specific pollutants according to Greek legislation are used in 6 out of the 15 orchards (40%). 4 out of 6 orchards are located in the eastern part of GR3901R000301007N and 2 in the eastern and western part of GR3901R000301006N and Maleme sub-basin, respectively. As it is shown in Table 54 (Appendix II) in these orchards only Rogor which contains the specific pollutant of dimethoate is applied (in

olive and avocado crops). As far as priority substances are concerned none of the PPPs applied in the orchards of this group contain priority substances according to the European legislation.

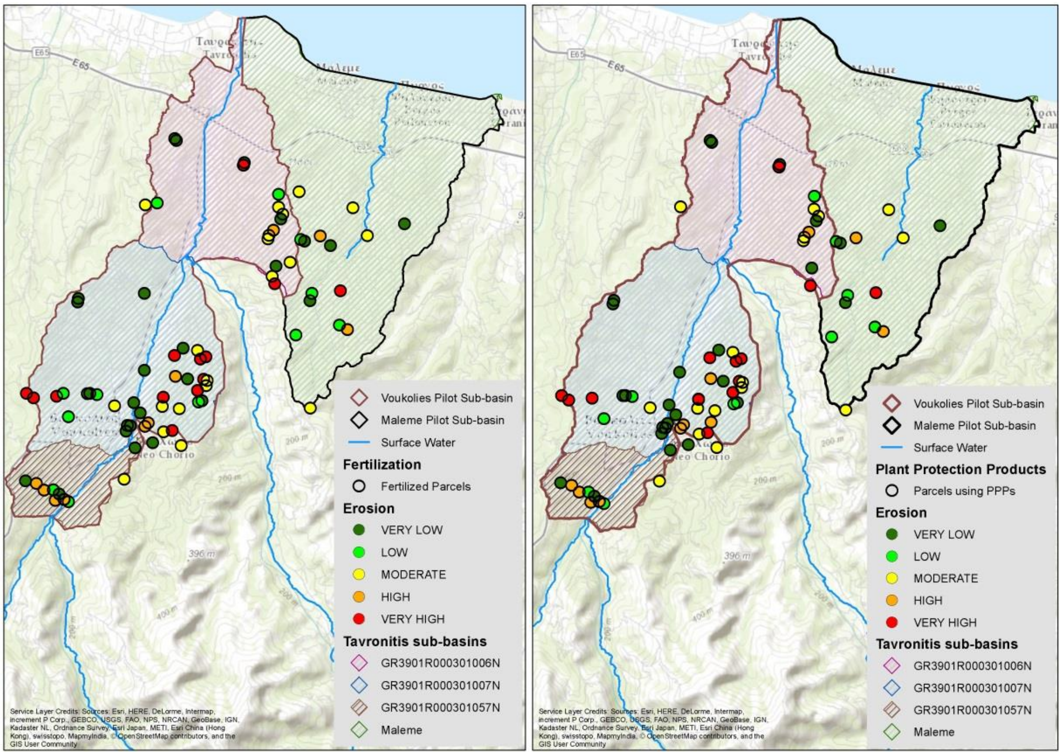

Fig. 82: Spatial distribution of orchards where fertilizers (left) and PPPs (right) are used and classification according to their erosion potential in Voukolies and Maleme sub-basins

Apart from the very high erosion potential which characterize the 15 orchards of this group another important characteristic is that 4 out of them are also irrigated. 3 out of these 4 orchards are allocated in GR3901R000301007N and 1 in GR3901R000301006N. This also enhance the potential pollution of the surface waters and the HCV areas within these pilot sub-basins with higher quantities of pollutants due to the fact that the substances that are contained in the fertilizers and the PPPs which are applied in these 4 registered orchards will be moved to the surface waters through the erosion.

As far as the orchards that are found in high erosion potential areas are concerned 11 out of 14 (or 78.6%) that are included in this class are fertilized (Table 36). 5 out of these 11 orchards are located in the central and southern part of GR3901R000301057N, 4 in the eastern part of GR3901R000301006N and GR3901R000301007N sub-basins and 2 in the central and southern part of Maleme sub-basins.

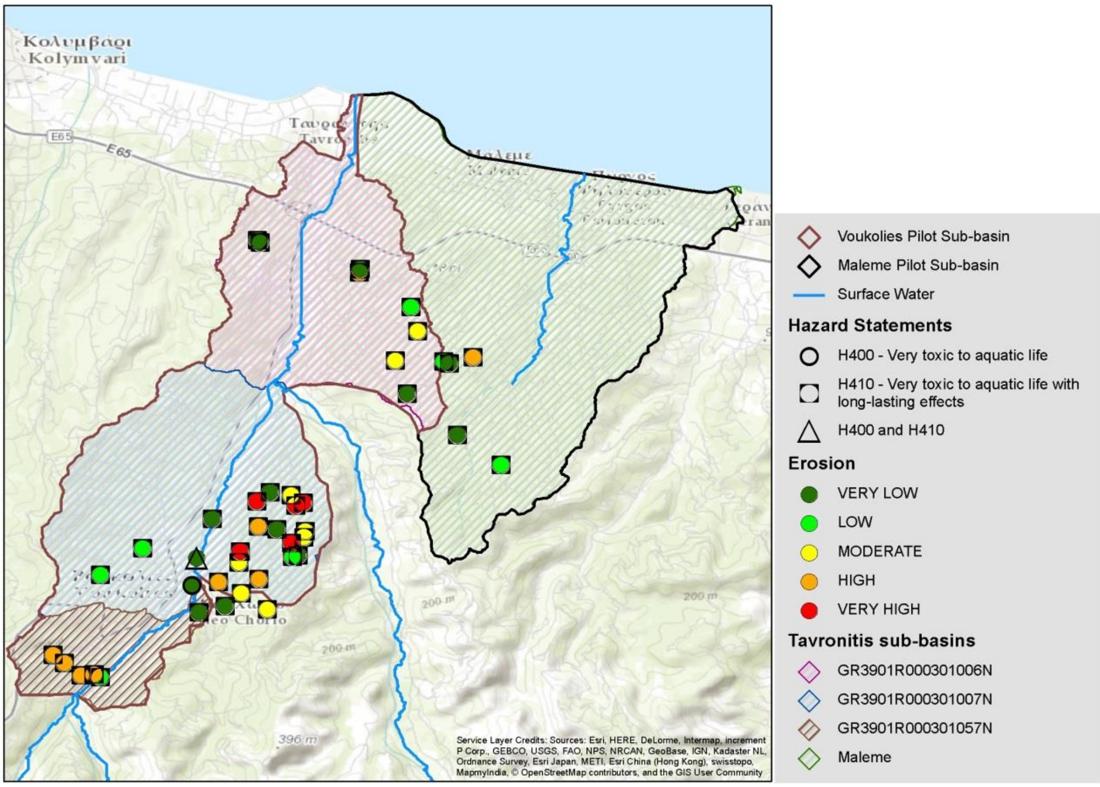

Fig. 83: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their erosion potential in Voukolies and Maleme sub-basins

Table 36: Agrochemicals in orchards with high erosion potential Voukolies and Maleme sub-basins

Sub-basin		GR3901R000 301006N	GR3901R000 301007N	GR3901R000 301057N	Maleme	Total
Fertilized Orchards		2	2	5	2	11
Orchards with PPP		2	4	5	2	13
Orchards with H400	**No**	0	0	0	0	0
	PPP	-	-	-	-	-
Orchards with H410	**No**	1	3	5	1	10
	PPP	Proteus	Decis, Proteus	Decis, Copper, Pyrethron	Decis	Copper Decis Proteus Pyrethron
Orchards with Specific pollutants	**No**	2	1	3	1	3
	PPP	Rogor	Rogor	Copper, Rogor	Rogor	Copper Rogor
	SP	Dimethoate	Dimethoate	Copper, Dimethoate	Dimethoate	Copper Dimethoate
Orchards with priority Substances	**No**	0	0	0	0	0
	PPP	-	-	-	-	-
	PS	-	-	-	-	-
Irrigated orchards		2	3	1	1	7

Also, in almost all orchards (13 out of 14 or 92.8%) of this class PPPs are applied following the same pattern of spatial distribution with the fertilized orchards. While in none of the 13 orchards PPPs classified as H400 are applied, there are 10 orchards where PPPs classified as H410 are used. Half of these orchards (5 out of 10) are located in the central and southern part of GR3901R000301057N (Fig. 83). From these, there are 2 orchards where Decis is used, 2 where Pyrethron is used and 1 where Copper is used (Table 55 in Appendix II). Moreover, 3 out of 10 orchards are located in the eastern part of GR3901R000301007N where Decis is used in 2 out of them and Proteus is used in the last orchard.

While none of the PPPs applied in the group of high erosion potential orchards contain priority substances there are 2 PPPs Copper and Rogor which are used in 7 orchards and contain the specific pollutants of copper and dimethoate, respectively. Rogor is applied in a total of 6 orchards from which 2 are located in the eastern part of GR3901R000301006N, 1 in the eastern part of GR3901R000301007N and 1 in the southern part of Maleme sub-basin. However, there is 1 orchard which is located in the eastern part of GR3901R000301007N sub-basin where both Copper and Rogor are applied (Fig. 84, Table 55 in Appendix II).

From the 14 orchards which are found in high erosion potential 7 (46.7%) are irrigated (2 in GR3901R000301006N, 3 in GR3901R000301007N and 2 in GR3901R000301057N and Maleme sub-basins, respectively).

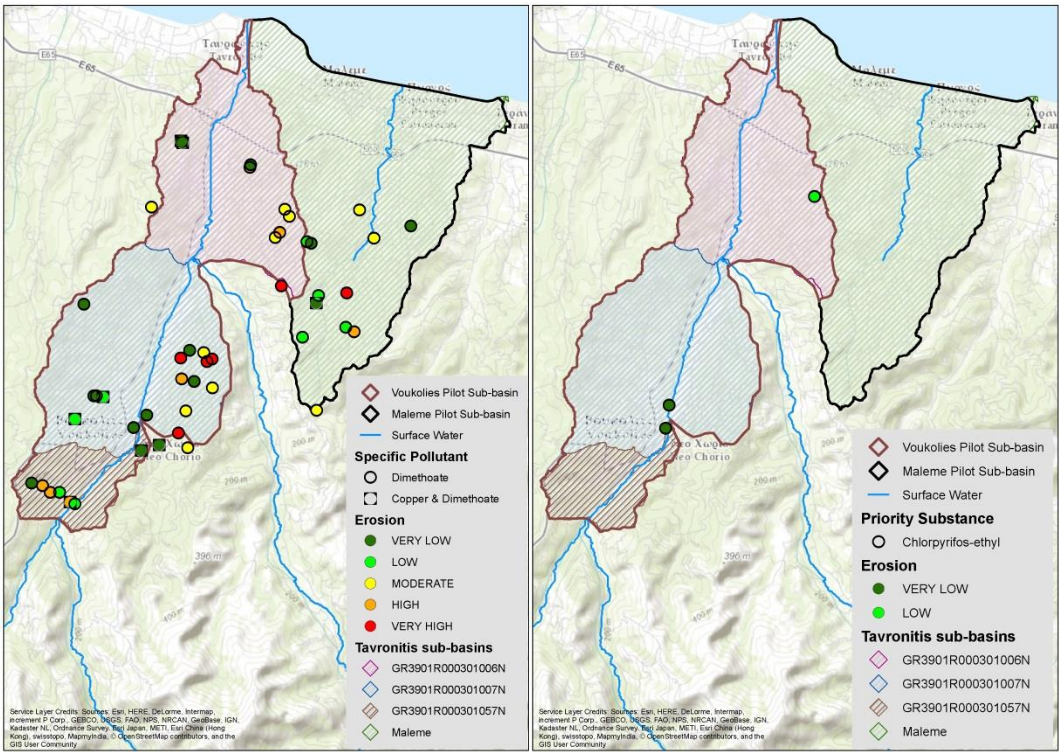

Fig. 84: Spatial distribution of parcels where PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their erosion potential in Voukolies and Maleme sub-basins

The group of moderate erosion potential in Platanias contains 22 orchards from which 90.1% (22 out of 20) are fertilized (Table 37). The majority of the fertilized orchards (15) is located in the eastern parts of sub-basin GR3901R000301006N (8 orchards) and GR3901R000301007N (7 orchards). Also, there are other 4 fertilized orchards in the central and southern part of Maleme sub-basin and 1 more in the western part of GR3901R000301057N sub-basin.

Table 37: Agrochemicals in orchards with moderate erosion potential Voukolies and Maleme sub-basins

<table>
<tr><th colspan="2">Sub-basin</th><th>GR3901R000301006N</th><th>GR3901R000301007N</th><th>GR3901R000301057N</th><th>Maleme</th><th>Total</th></tr>
<tr><td colspan="2">Fertilized Orchards</td><td>8</td><td>7</td><td>1</td><td>4</td><td>20</td></tr>
<tr><td colspan="2">Orchards with PPP</td><td>6</td><td>7</td><td>1</td><td>3</td><td>17</td></tr>
<tr><td rowspan="2">Orchards with H400</td><td>No</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>PPP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Orchards with H410</td><td>No</td><td>2</td><td>6</td><td>0</td><td>0</td><td>8</td></tr>
<tr><td>PPP</td><td>Decis</td><td>Decis, Proteus, Pyrethron</td><td>-</td><td>-</td><td>Decis Proteus Pyrethron</td></tr>
<tr><td rowspan="3">Orchards with Specific pollutants</td><td>No</td><td>5</td><td>3</td><td>0</td><td>3</td><td>11</td></tr>
<tr><td>PPP</td><td>Rogor</td><td>Rogor</td><td>-</td><td>Rogor</td><td>Rogor</td></tr>
<tr><td>SP</td><td>Dimethoate</td><td>Dimethoate</td><td>-</td><td>Dimethoate</td><td>Dimethoate</td></tr>
<tr><td rowspan="3">Orchards with priority Substances</td><td>No</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>PPP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>PS</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Irrigated orchards</td><td>5</td><td>6</td><td>0</td><td>2</td><td>13</td></tr>
</table>

In 77.3% (17 out of 22) of registered orchards of this group PPPs are applied (Table 37). From the 17 orchards 7 are located in GR3901R000301007N, 6 in GR3901R000301006N, 3 in Maleme and 1 in GR3901R000301057N sub-basin following the same spatial distribution pattern as the one described above in reference to the fertilized orchards. For one more time, none of the PPPs applied in these orchards is classified as H400, whoever there are 3 PPPs classified as H410 (Decis, Proteus, Pyrethron) which are applied in a total of 8 orchards. Decis is applied in 5 orchards from which 2 orchards are located in the eastern part of GR3901R000301006N sub-basin and 3 in the eastern part of GR3901R000301007N. Proteus and Pyrethron are applied only in orchards within the sub-basin of GR3901R000301007N and especially in 2 and 1 orchards, respectively (Table 56 in Appendix II).

From the PPPs which are used in moderate erosion potential areas none of them contains priority substances but only 1, Rogor, contains the specific pollutant of dimethoate and it is applied in 11 orchards. 5 out of these 11 orchards are located in the western and eastern part of GR3901R000301006N, 3 in the eastern part of GR3901R000301007N and 3 in the central and southern part of Maleme sub-basin (Fig. 84).

Also, 13 out of 22 orchards of this group are irrigated and the majority of them are located in GR3901R000301007N (6 orchards) and GR3901R000301006N (5 orchards), while there are 2 more irrigated orchards in Maleme sub-basin.

3.2 HAVGAS-MILATOS SUB-BASIN

The majority of the registered orchards in Mirabello are found in very high erosion potential class (23 farms or 22.8%), 19 farms (or 18.8%) are found in high erosion potential class, 17 farms (16.8%) indicated moderate erosion potential, 12 (or 11.9%) are found in low erosion potential areas and 30 of them (29.7%) are also found in very low erosion potential.

From the 23 orchards that are found in areas with very high erosion potential 21 orchards (91.3%) are located in HM-6 sub-basin and 2 (8.6%) in HM-1 and HM-5 sub-basins. In 56.5% of these orchards (or 13 out of 23) fertilizers are applied (Table 38). The majority of these orchards (12 out of 13) are located in the western and central part of HM-6 sub-basin and only 1 is located in the central part of HM-5 sub-basin (Fig. 85).

Table 38: Agrochemicals in orchards with very high erosion potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		0	0	0	0	1	12	13
Orchards with PPP		1	0	0	0	1	11	13
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	0	0	0	0	0	8	8
	PPP	-	-	-	-	-	Copper, Bulldock	Copper Bulldock
Orchards with Specific pollutants	**No**	1	0	0	0	0	10	11
	PPP	Rogor	-	-	-	-	Copper, Rogor	Copper Rogor
	SP	Dimethoate		-	-	-	Copper, Dimethoate	Copper Dimethoate
Orchards with priority Substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		1	0	0	0	0	1	2

PPPs are applied in 13 out of 23 orchards (or 56.6%) with very high erosion potential. From these 11 orchards are found in the central and western part of HM-6 sub-basin, 1 in the central part of HM-1 and 1 in the eastern part of HM-2 sub-basin. From the PPPs that are applied in these orchards while none is classified as H400 there are 2 PPPs, Copper and Bullock, which are classified as H410 and they are used in 8 orchards (34.8%) which are located only in the central and western part of HM-6 sub-basin (Table 38, Fig. 86). Bulldock is applied in all 8 orchards, while in 7 of them (30.4% of all orchards) not only Bulldock is applied but also Copper (Table 62 in Appendix II).

From the 23 orchards of this group while in none of them priority substances are applied, there are 11 orchards (47.8%) where 2 PPPs (Copper and Rogor) which contain specific pollutants (copper and dimethoate) are applied. More specific, the specific pollutant of copper is applied in 7 out of the 23 total orchards (30.4%) which are located in the central and western part of HM-6 sub-basin, while the specific pollutant of dimethoate is applied in 4 out of the total orchards (17.4%), 3 of which are located in the western part of HM-6 and 1 in the eastern part of HM-1 sub-basin (Fig. 87, Table 62 in Appendix II).

Also, according to the data collected through the 1st AWMS form only the 8.7% of the total orchards (2 out of 23) of this group are irrigated (1 in HM-1 and 1 in HM-6 sub-basin).

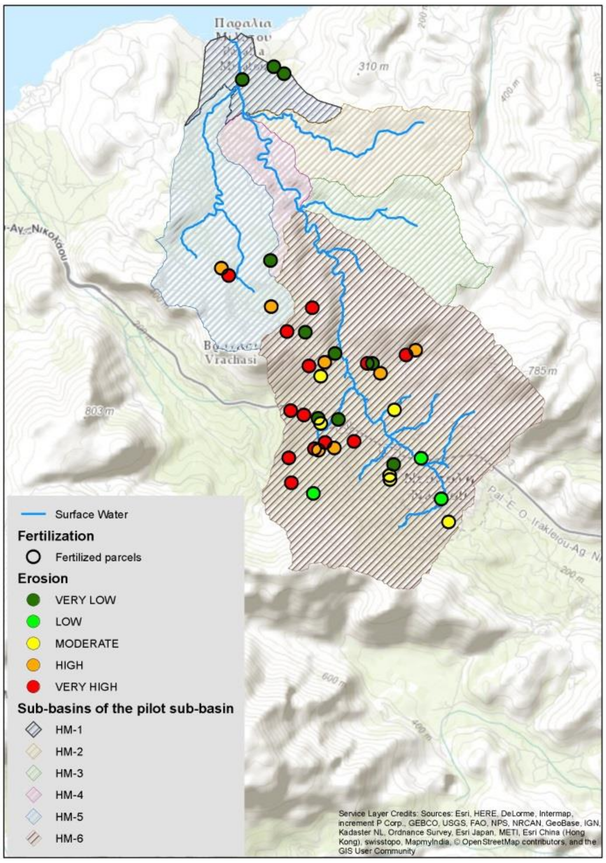

Fig. 85: Spatial distribution of fertilized orchards and classification according to their erosion potential in Havgas - Milatos sub-basin

Table 39: Agrochemicals in orchards with high erosion potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		0	0	0	0	2	5	7
Orchards with PPP		0	1	0	0	1	7	9
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP							
Orchards with H410	**No**	0	1	0	0	0	3	4
	PPP	-	Copper	-	-	-	Copper, Bulldock	Copper Bulldock
Orchards with Specific pollutants	**No**	0	1	0	0	1	5	7
	PPP	-	Copper	-	-	Rogor	Copper, Rogor	Copper Rogor
	SP	-	Copper	-	-	Dimethoate	Copper, Dimethoate	Copper, Dimethoate
Orchards with priority Substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		0	0	0	0	0	2	2

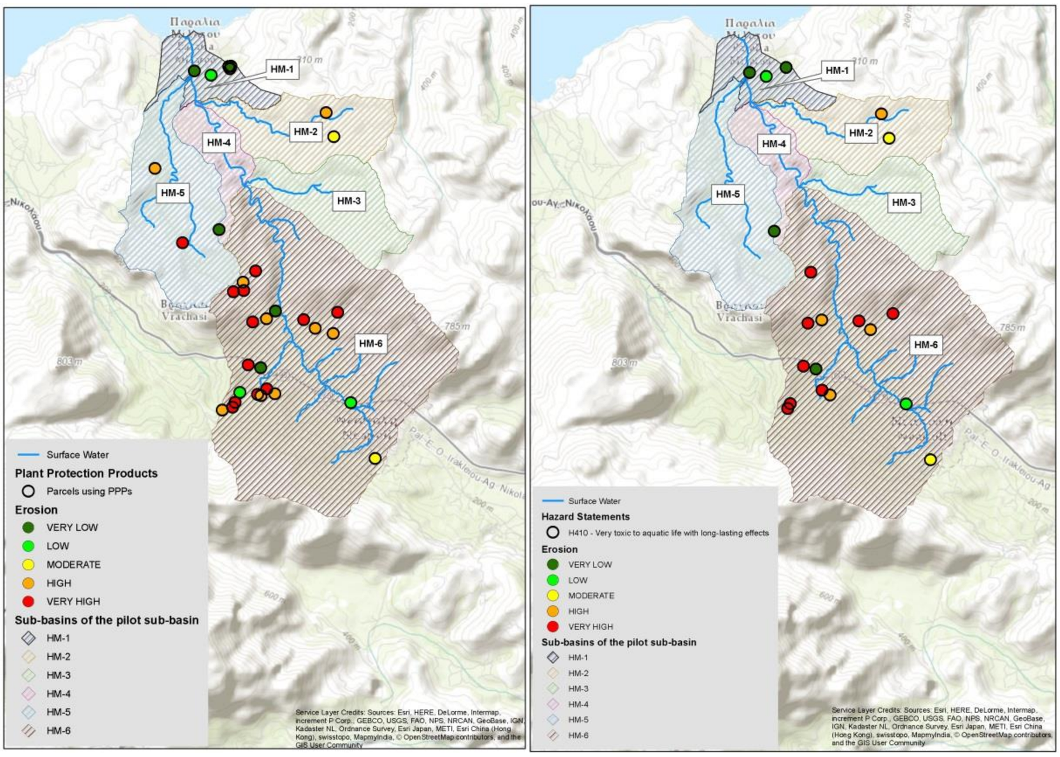

Fig. 86: Spatial distribution of parcels where PPPs (left) and H410 (right) are used and classification according to their erosion potential in Havgas - Milatos sub-basin

From the 19 orchards that are found in high erosion potential areas in Havgas - Milatos sub-basin 7 are fertilized (36.8%). From these 7 orchards 5 are located in the central part of HM-6 and 2 in the southern part of HM-5 (Table 39, Fig. 85).
In 9 out of 19 orchards (47.4%) with high erosion potential PPPs are applied. 7 out of 9 orchards are located in the central and western part of HM-6 sub-basin, 1 in the western part of HM-5 sub-basin and another 1 in the northern part of HM-2 sub-basin (Fig. 86). As far as PPPs classified as H400 are concerned it should be mentioned that they are not used in any of the above mentioned orchards. However, 2 PPPs classified as H410 (Copper and Bulldock) are used in 4 out of 19 (21%) orchards (Table 39). From these, there are 2 orchards where both Copper and Bulldock are applied and 1 where only Bulldock is applied. All these orchards are located in the central part of HM-6 sub-basin. Also, there is another 1 orchard, in the northern part of HM-2 sub-basin, where only Copper is applied (Fig. 86, Table 63 in Appendix II).
As far as priority substances are concerned in none of the registered orchards of this group any PPP which contain priority substances is applied. On the other hand in 7 out of 19 (36.8%) orchards 2 PPPs (Copper and Rogor) with specific pollutants (copper and dimethoate) are used (Table 63 in Appendix II). The specific pollutant of copper is used in 3 orchards from which 2 are located the central part of HM-6 sub-basin and in 1 orchards in northern part of HM-2 sub-basin. As far as dimethoate is concerned it is used in 4 orchards, 3 of which are found in the central and western part of HM-6 and 1 in the western part of HM-5 sub-basin (Fig. 87).
From the 19 orchards of this group only 2 orchards (or 10.5%) are irrigated and both of them are located in HM-6 sub-basin.

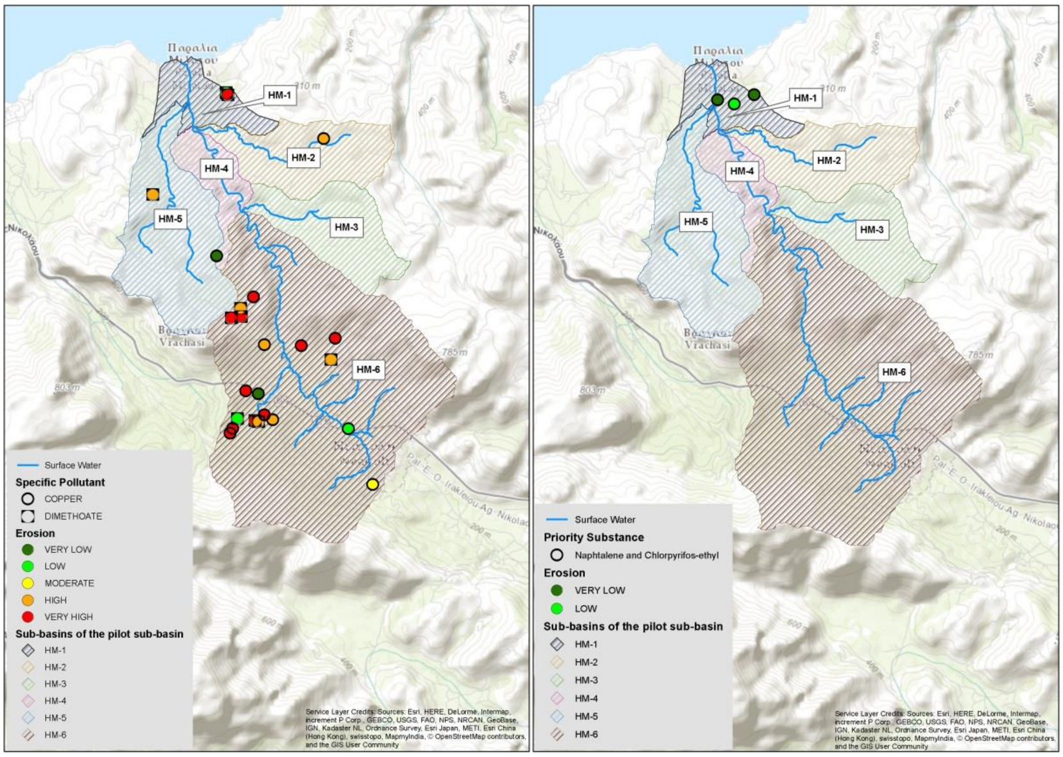

Fig. 87: Spatial distribution of parcels where PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their erosion potential in Havgas - Milatos sub-basin

From the 17 orchards which are characterized by moderate erosion potential 7 are fertilized (41.2%). From these 6 are found in the central and southern part of HM-6 and 1 in the eastern part of HM-1 sub-basin (Table 40, Fig. 85).

In contrast with the previous class of erosion from the 17 orchards which are included in the class of moderate erosion potential only in 2 orchards (11.8%), 1 in HM-6 and 1 HM-2 sub-basins, PPPs classified as H410 are applied. In the first orchard which is located in the southern part of HM-6 two PPPs classified as H410 are used, Copper and Bulldock, while in the second orchard in the central part of HM-2 sub-basin the only PPP which is applied is Bulldock (Fig. 86, Table 64 in Appendix II).

Table 40: Agrochemicals in orchards with moderate erosion potential in Havgas - Milatos sub-basin

Sub-basin		HM-1	HM-2	HM-3	HM-4	HM-5	HM-6	Total
Fertilized Orchards		1	0	0	0	0	6	7
Orchards with PPP		0	1	0	0	0	1	2
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	0	1	0	0	0	1	2
	PPP	-	Bulldoc k	-	-	-	Copper, Bulldoc k	Copper Bulldock
Orchards with Specific pollutants	**No**	0	0	0	0	0	1	1
	PPP	-	-	-	-	-	Copper	Copper
	SP	-	-	-	-	-	Copper	Copper
Orchards with	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-

priority Substances	PS	-	-	-	-	-	-	-
Irrigated orchards		0	0	0	0	0	0	0

According to the statistical analysis in none of the registered orchards which are found in moderate runoff potential areas priority substances are used. However, there is only 1 orchard, in the southern part of HM-6 where the specific pollutant of copper is detected as a result of the PPPs used in the area (Fig. 87). Also, none of the orchards which are included in this group is irrigated.

3.3 AGRI SUB-BASIN

The majority of the registered orchards in Metapontino area are found in very low erosion potential class (93 farms or 93%), 4 farms (or 4%) are found in low potential class, 2 farms (or 2%) indicated moderate erosion potential, 1 (or 1%) is found in high erosion potential areas, while none of the 100 registered farms was found to be classified as very high runoff potential.

The only orchard which is included in the class of high erosion potential is located in the western part of Agri4 sub-basin (Fig. 88). Apart from the fact that this orchard is fertilized and irrigated, also PPPs are used. More specific, 2 PPPs (Trebon Up and Cupravit) are used in this orchard but none of them is characterized neither as H400 nor H410 or contain specific pollutant or priority substances (Table 41).

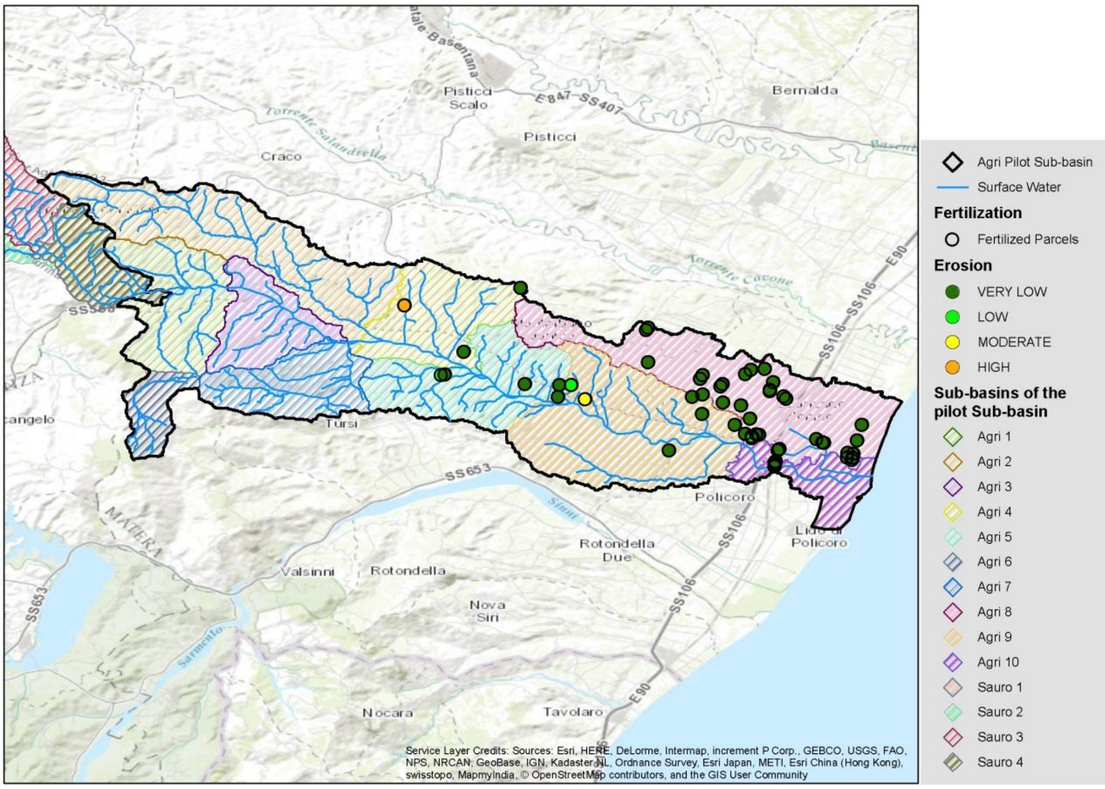

Fig. 88: Spatial distribution of fertilized orchards and classification according to their erosion potential in Agri pilot sub-basin

Table 41: Agrochemicals in orchards with high erosion potential in Agri pilot sub-basin

Sub-basin		Agri3	Agri4	Agri5	Agri8	Agri9	Agri10	Total
Fertilized Orchards		0	1	0	0	0	0	1
Orchards with PPP		0	1	0	0	0	0	1
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards with H410	**No**	0	1	0	0	0	0	1
	PPP	-	Trebon Up, Cupravit	-	-	-	-	Trebon Up, Cupravit
Orchards with Specific pollutants	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	SP	-	-	-	-	-	-	-
Orchards with priority Substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		0	1	0	0	0	0	1

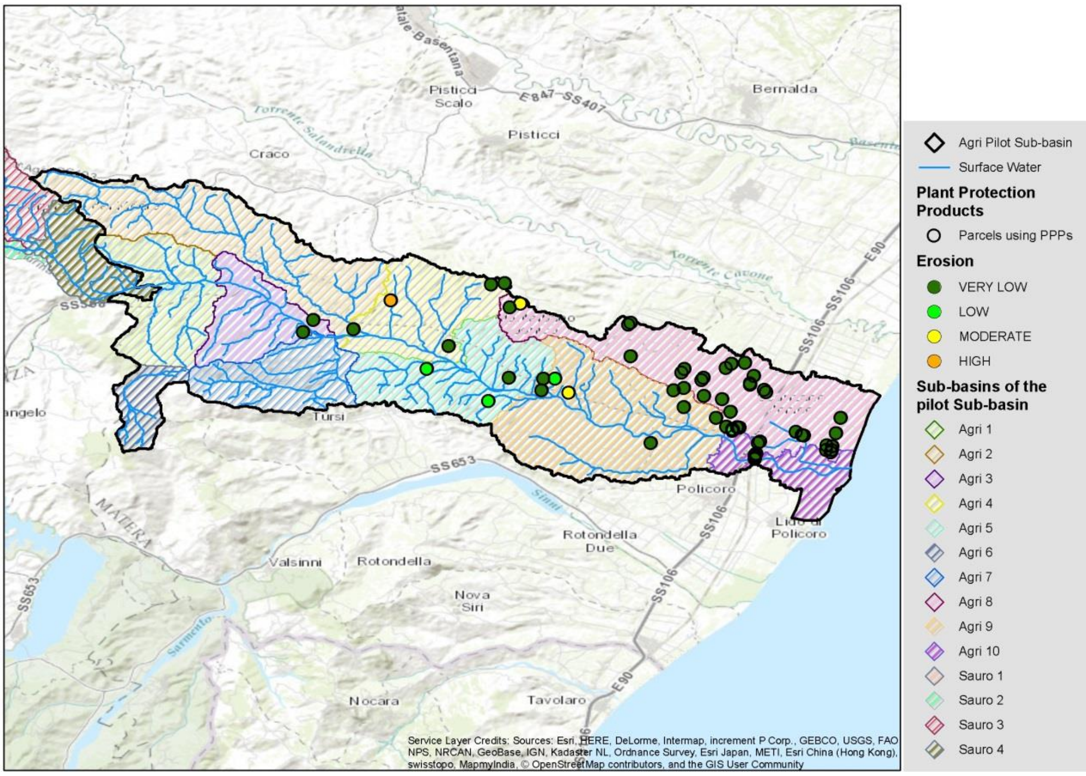

Fig. 89: Spatial distribution of orchards where PPPs are used and classification according to their erosion potential in Agri pilot sub-basin

Table 42: Agrochemicals in orchards with moderate erosion potential in Agri pilot sub-basin

Sub-basin		Agri3	Agri4	Agri5	Agri8	Agri9	Agri10	Total
Fertilized Orchards		0	0	0	0	1	0	1
Orchards with PPP		0	0	0	1	1	0	2
Orchards with H400	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
Orchards	**No**	0	0	0	1	1	0	2

with H410	**PPP**	-	-	-	Cupravit Pyrethron Nature	Trebon Up, Cupravit	-	Cupravit Pyrethron Nature, Trebon Up
Orchards with Specific pollutants	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	SP	-	-	-	-	-	-	-
Orchards with priority Substances	**No**	0	0	0	0	0	0	0
	PPP	-	-	-	-	-	-	-
	PS	-	-	-	-	-	-	-
Irrigated orchards		0	0	0	0	1	0	1

The 2 orchards that are found in moderate erosion potential areas are located in the western part of Agri9 and in the north-western part of Agri8 sub-basins. While from these two orchards only the one in Agri9 is fertilized and irrigated, in both of them PPPs are used (Fig. 89). From the PPPs that are used in these two orchards only 3 (Cupravit, Pyrethron Nature and Trebon Up) are classified as H410 and none of them as H400 (Fig. 90). More specific, Cupravit and Pyrethron Nature are used in the orchard in Agri8 sub-basin, while Cupravit and Trebon Up are used in the orchard in Agri9 sub-basin.
As it is shown in Fig. 91 where the spatial distribution of parcels where PPPs with priority substances and/or specific pollutants are used, none of the PPPs which are used in this class of orchards contain neither priority substances nor specific pollutants.

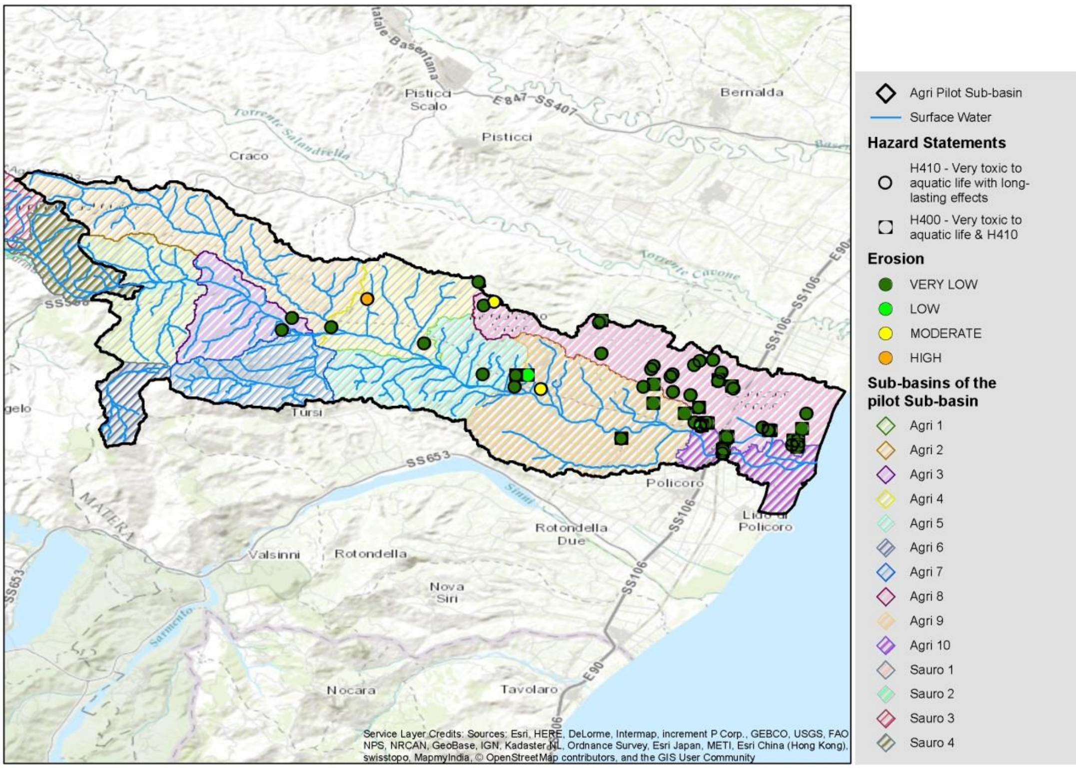

Fig. 90: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their erosion potential in Agri pilot sub-basin

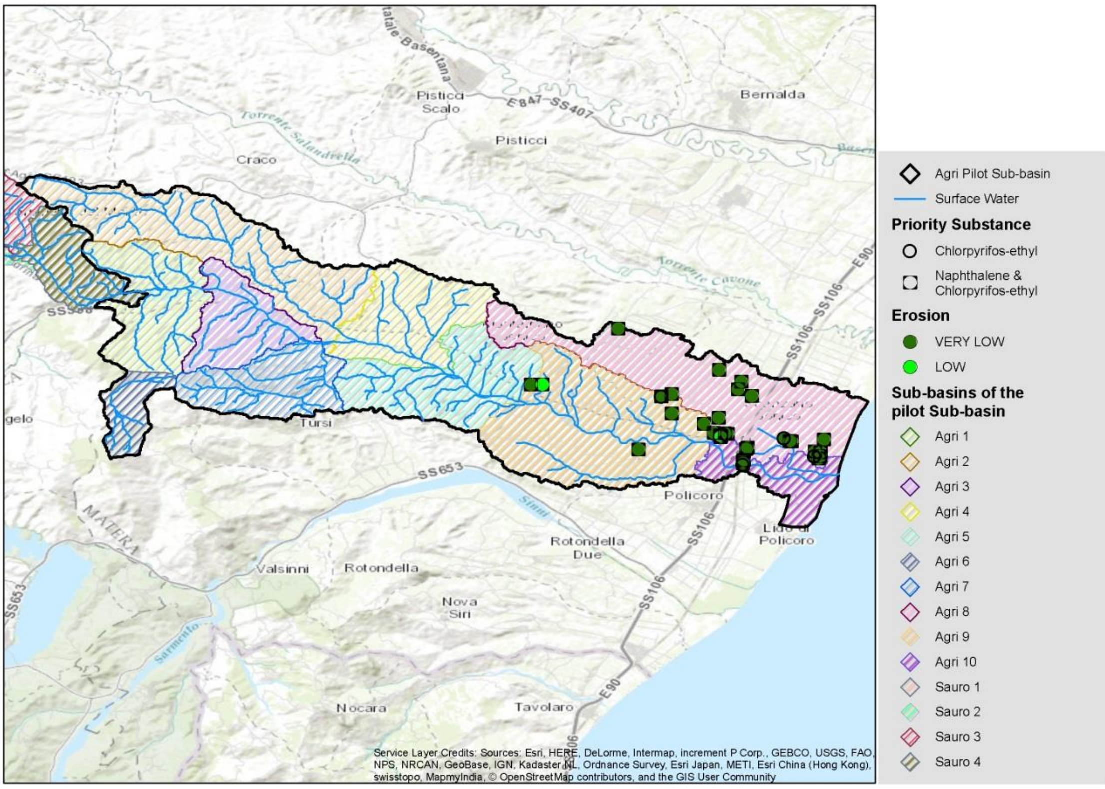

Fig. 91: Spatial distribution of parcels where PPPs with priority substances are used and classification according to their erosion potential in Agri pilot sub-basin

4 AGROCHEMICALS AND LEACHING RISK POTENTIAL

4.1 VOUKOLIES AND MALEME SUB-BASINS

As the leaching of substances from fertilizers and PPPs will impact only the groundwater and not the surface water bodies, assuming that the substances will be moved vertically to the lower ground layers, the following description takes into account that orchards that are located above each of the groundwater bodies of the pilot areas and not the sub-basins of the surface water bodies as was the case of runoff and erosion description.

From the registered orchards in Platanias 62 farms are found in moderate leaching potential class (or 62%), 30 farms (or 30%) are found in low leaching potential class and 8 farms indicated high leaching potential, while none of the 100 registered farms was found to be classified as of either very high or very low leaching potential.

While in Voukolies and Maleme sub-basins there are 2 groundwater bodies, GR1300022 (Porous of campos Chanion) and GR1300330 (Gypsum karst of Crete), all the registered orchards (100) are located only above GR1300330 and as a result the agriculture activity in these orchards will affect only GR1300022 groundwater body.

From the 8 orchards that are found in leaching potential areas almost all (7 out of 8) are fertilized. They are located only within Voukolies pilot sub-basin boundaries and especially in the central and northern part of this sub-basin (Table 43, Fig. 92).

Table 43: Agrochemicals in orchards with high leaching potential Voukolies and Maleme sub-basins

Water body		GR1300022	GR1300330	Total
Fertilized Orchards		7	0	7
Orchards with PPP		8	0	8
Orchards with H400	**No**	1	0	1
	PPP	Dursban	-	Dursban
Orchards with H410	**No**	4	0	4
	PPP	Copper, Decis, Pyrethron	-	Copper, Decis, Pyrethron
Orchards with Specific pollutants	**No**	3	0	3
	PPP	Copper, Rogor	-	Copper, Rogor
	SP	Copper, Dimethoate	-	Copper, Dimethoate
Orchards with priority Substances	**No**	1	0	1
	PPP	Dursban	-	Dursban
	PS	Chlorpyrifos-ethyl	-	Chlorpyrifos-ethyl
Irrigated orchards		6	0	6

As far as PPPs are concerned they are applied in all orchards of this group. According to their spatial distribution (Fig. 92) the pattern is the same with the one described above for the fertilized orchards. From the PPPs applied in these orchards only 1 is classified as H400, Dursban, which is used in 1 orchard in the south-eastern part of Voukolies pilot sub-basin. In 4 out of 8 orchards which are located in the eastern part of Voukolies pilot sub-basin 3 PPPs classified as H410 (Copper, Decis, Pyrethron) are also applied (Fig. 93, Table 57 in Appendix II).

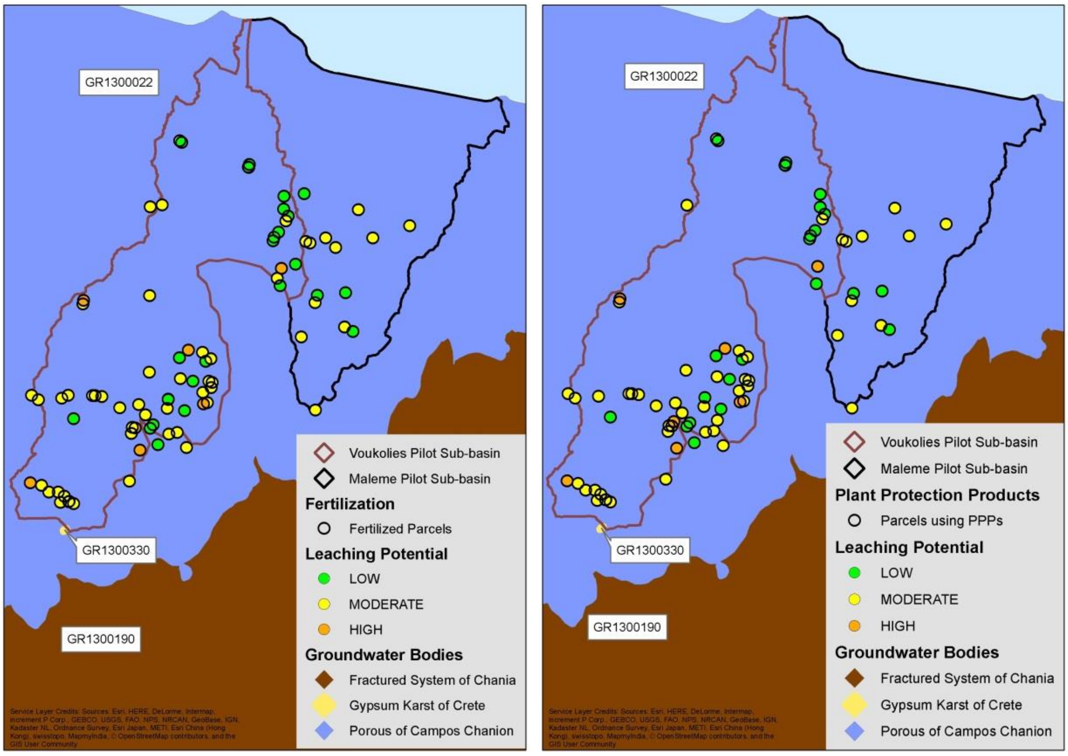

Fig. 92: Spatial distribution of orchards where fertilizers (left) and PPPs (right) are used and classification according to their leaching potential in Voukolies and Maleme sub-basins

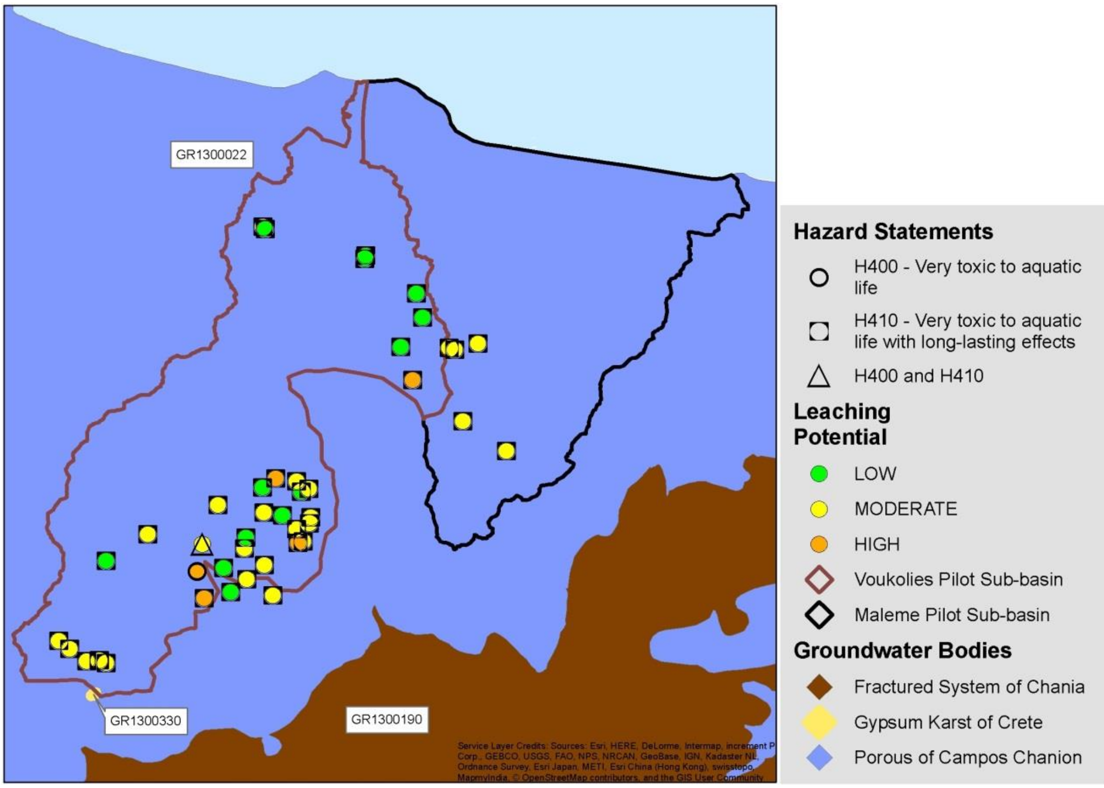

Fig. 93: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their leaching potential in Voukolies and Maleme sub-basins

In 3 out of 8 orchards (37.5%) of this group 2 PPPs, Copper and Rogor which contain the specific pollutants of copper and dimethoate, respectively, are applied. Rogor is applied in 2 orchards in the southern and eastern part of Voukolies pilot sub-basin. However, there is 1 orchard in the south-eastern part of Voukolies pilot sub-basin where both Copper and Rogor are used (Fig. 94, Table 57 in Appendix II). As far as PPPs with priority substances are concerned in this group of orchards there is only 1 orchard where such PPP is applied. The orchard is located in the south-eastern part of Voukolies pilot sub-basin and the priority substance which is applied is Chlorpyrifos-ethyl due to the use of Dursban (Fig. 94, Table 57 in Appendix II).

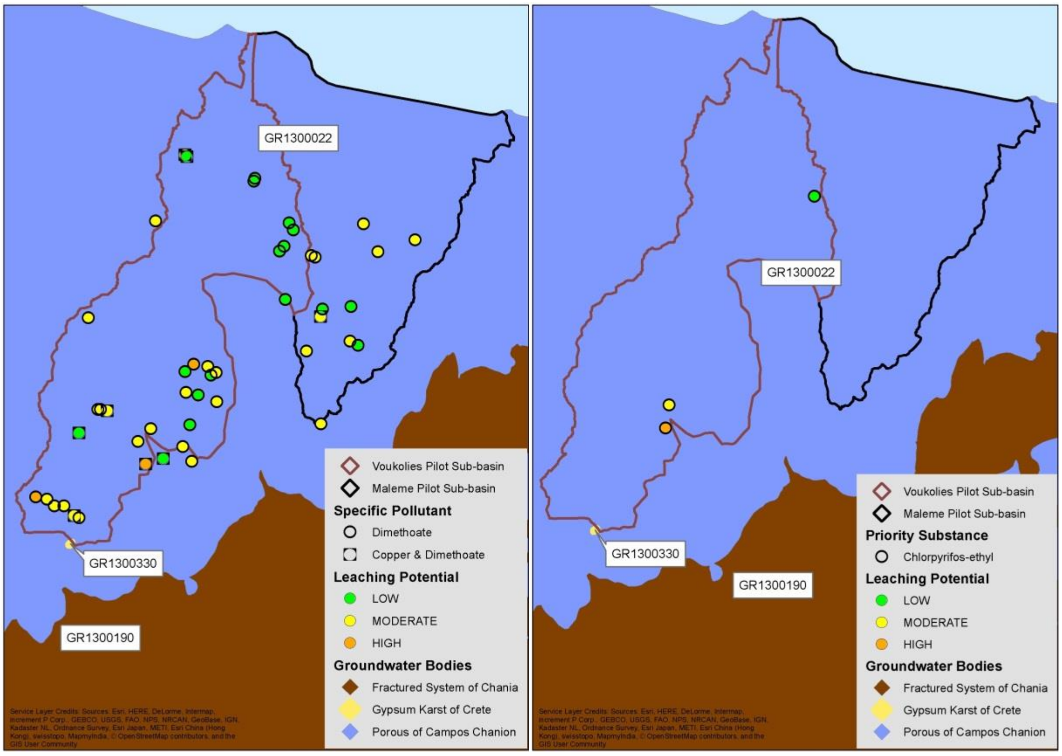

Fig. 94: Spatial distribution of parcels where PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their leaching potential in Voukolies and Maleme sub-basins

52 out of 62 (or 83.8%) orchards which are included in the group of orchards with moderate leaching potential in Platanias are fertilized. From these, 12 orchards are located in the western and southern part of Maleme pilot sub-basin and the rest of them (40 orchards) are scattered in the north-eastern and north-western part of Voukolies pilot sub-basin (Fig. 92).

Table 44: Agrochemicals in orchards with moderate leaching potential Voukolies and Maleme sub-basins

Water body		GR1300022	GR1300330	Total
Fertilized Orchards		54	0	54
Orchards with PPP		51	0	51
Orchards with H400	**No**	1	0	1
	PPP	Dursban	-	Dursban
Orchards with H410	**No**	28	0	28
	PPP	Copper, Decis,	-	Copper

		Pyrethron, Proteus		Decis Proteus Pyrethron
Orchards with Specific pollutants	**No**	30	0	30
	PPP	Copper, Rogor	-	Copper Rogor
	SP	Copper, Dimethoate	-	Copper Dimethoate
Orchards with priority Substances	**No**	1	0	1
	PPP	Dursban	-	Dursban
	PS	Chlorpyrifos-ethyl	-	Chlorpyrifos-ethyl
Irrigated orchards		29	0	29

Similar is the situation in reference to the orchards where PPPs are applied. More specific in 51 out of 62 orchards (or 82.3%) PPPs are applied and their spatial distribution within Voukolies and Maleme pilot sub-basins is similar to the one described above. From the PPPs applied in these orchards only 1 is classified as H400, Dursban, which is used in 1 orchard (or 1.6%) in the south-eastern part of Voukolies pilot sub-basin. In 28 out of 62 orchards (45.25) of this group 4 PPPs classified as H410 (Copper, Decis, Proteus, Pyrethron) are also applied (Fig. 93, Table 57 in Appendix II). Copper is applied in 5 out of 62 (or 8.1%) orchards, Decis in 13 out of 62 (or 21%), Proteus in 6 out of 62 (or 9.7%) and Pyrethron in 4 out of 62 (or 6.5%) orchards. Their spatial distribution is presented in Fig. 93.

In this group of orchards, there is only one orchard in the south-eastern part of Voukolies pilot sub-basin (Fig. 94), where Dursban, the priority substance of chlorpyrifos-ethyl is used. Also, there are other 30 orchards (or 48.8%) where PPPs such as Copper and/ or Rogor which contain the specific pollutants of copper and dimethoate are used. Rogor is applied in 25 out of 62 orchards (40.3%) of this group (Table 58 in Appendix II) which are located in the eastern and southern part of Voukolies pilot sub-basin and in the central and southern part of Maleme pilot sub-basin (Fig. 94). However, there are 5 out of 62 (or 8.1%) orchards in the southern and north-western part of Voukolies pilot sub-basin and in the southern part of Maleme pilot sub-basin where both Rogor and Copper are applied (Fig. 94).

4.2 HAVGAS-MILATOS SUB-BASIN

In reference to the leaching potential, the majority of the registered orchards in Mirabello are found in low leaching potential class (80 farms or 79.2%), 17 farms (or 16.8%) are found in moderate leaching potential class, 2 farms (1.98%) indicated high leaching potential and also 2 farms (1.98%) are found in very low leaching potential.

Within the boundaries of Voukolies and Maleme sub-basins there are 5 groundwater bodies, GR1300166 (Karst of Sisio-Milatos-Elounda), GR1300115 (Karst of Fournai-Elounda), GR1300112 (Karst of Malia-Selena), GR1300240 (Fractured System of Dikti) and GR1300113 (Karst of NE Diktis). From the 101 registered orchards that participate in this project 4 (or 3.9%) are above GR1300112, 25 out of 101 (or 24.8%) above GR1300115, 30 out of 101 (or 29.7%) above GR1300116 and 42 out of 101 (or 41.6%) above GR1300240. None of the registered orchards is located above GR1300113.

From the 2 registered orchards that are included in the group of high leaching potential one is located in the southern part of Havgas - Milatos pilot sub-basin and more specific above GR1300240 groundwater body while the second one is located in the western part of the pilot sub-basin above GR1300113 groundwater body. From these 2 orchards only the first orchard is fertilized (Table 45, Fig. 95). However, in none of the 2 orchards of this group PPPs classified as H400 or H410 or with specific pollutants or priority substance are used. As a result, even if the impact of leaching is high for these 2 orchards the fact that no pollutants (PPPs, priority substances etc.) are used leads to the conclusion that they will not cause any impact neither in the groundwater bodies which are located below them.

Table 45: Agrochemicals in orchards with high leaching potential in Havgas - Milatos sub-basin

Sub-basin		GR1300112	GR1300115	GR1300116	GR1300240	GR1300113	Total
Fertilized Orchards		1	0	0	0	0	1
Orchards with PPP		0	0	0	0	0	0
Orchards with H400	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
Orchards with H410	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
Orchards with Specific pollutants	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
	SP	-	-	-	-	-	-
Orchards with priority Substances	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
	PS	-	-	-	-	-	-
Irrigated orchards		0	0	0	0	0	0

From the 17 orchards that are found in areas with moderate runoff potential 6 are located above GR1300115, 5 above GR1300116 and 6 above GR1300240 groundwater body. Fertilization is applied in 35.3% (6 out of 17) (Table 46) of the orchards that are found in moderate leaching potential and according to Fig. 95 they are scattered in the northern part of Havgas - Milatos pilot sub-basin (above GR1300116 groundwater body), in the central part above GR1300115 groundwater body and in the south-eastern part of Havgas - Milatos pilot sub-basin above GR1300240 groundwater body.

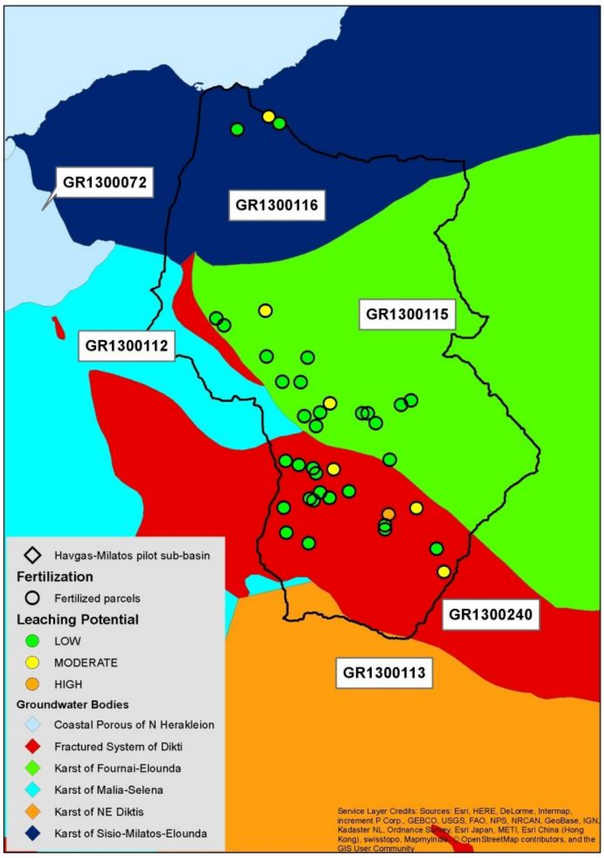

Fig. 95: Spatial distribution of fertilized orchards and classification according to their leaching potential in Havgas - Milatos sub-basin

Table 46: Agrochemicals in orchards with moderate leaching potential in Havgas - Milatos sub-basin

Sub-basin		GR1300112	GR1300115	GR1300116	GR1300240	GR1300113	Total
Fertilized Orchards		0	2	1	3	0	6
Orchards with PPP		0	3	0	2	0	5
Orchards with H400	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
Orchards with H410	**No**	0	1	0	2	0	3
	PPP	-	-	-	-	-	-
Orchards with Specific pollutants	**No**	0	2	0	2	0	4
	PPP	-	Copper, Rogor	-	Copper	-	Copper, Rogor
	SP	-	Copper, Dimethoate	-	Copper	-	Copper, Dimethoate
Orchards with priority Substances	**No**	0	0	0	0	0	0
	PPP	-	-	-	-	-	-
	PS	-	-	-	-	-	-
Irrigated orchards		0	1	3	0	0	0

From the statistical analysis it is concluded that in 5 out 17 (29.4%) orchards of this group PPPs are used. These orchards are located in the central and south-eastern part of Havgas - Milatos pilot sub-basin and only above GR1300115 (3 orchards) and GR1300240 (2 orchards) groundwater bodies (Fig. 96). Moreover, none of the PPPs which are used in these orchards is classified as H400. However, there are two PPPs (Copper and Bulldock) which are classified as H410 and both of them are used in 3 out of 17 orchards of this group. 2 out of these orchards are located in the south-eastern part of the pilot sub-basin, above GR1300240 while the third one is found in the central part of the pilot sub-basin, above GR1300115 groundwater body (Fig. 96, Table 66 in Appendix II).

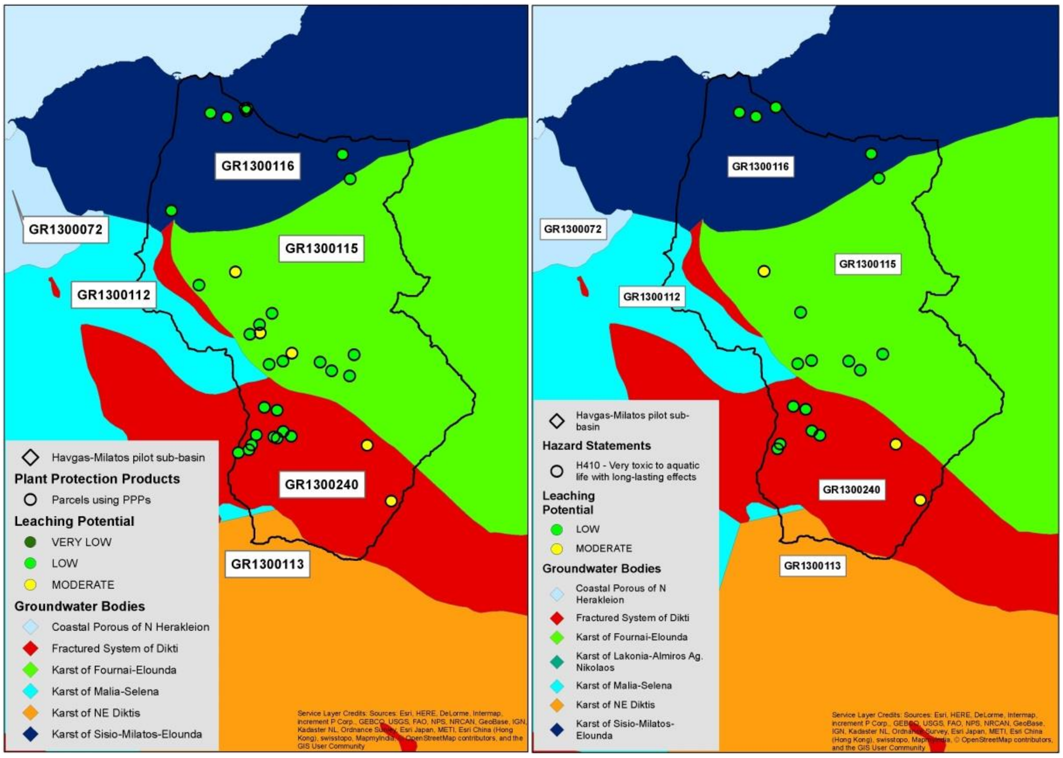

Fig. 96: Spatial distribution of parcels where PPPs (left) and H410 (right) are used and classification according to their leaching potential in Havgas - Milatos sub-basin

Only 4 out of 17 (23.5%) orchards that are found in moderate leaching potential areas contain substances that have been characterized as specific pollutants according to the Greek legislation and especially the specific pollutants of dimethoate and copper due to the use of Rogor and Copper, respectively (Table 66 in Appendix II). Rogor is used in 1 orchard which is located in the central part of Havgas - Milatos pilot sub-basin above GR1300115 and Copper is applied in 3 orchards in the central and south-eastern part of the pilot sub-basin, above GR1300115 (1 orchard) and GR1300240 (2 orchards) (Fig. 97) groundwater bodies. Also, it should be mentioned that in none of the orchards which are found in this category PPPs which contain priority substances are used.

While the majority of the registered orchards in Mirabello (80 out of 101) are located in low leaching potential areas, the analysis of the collected data will not be presented here, as the leaching potential is low and it is considered that the agricultural practices that are applied (fertilization, PPPs, etc.) will not cause any significant impact on the groundwater quality.

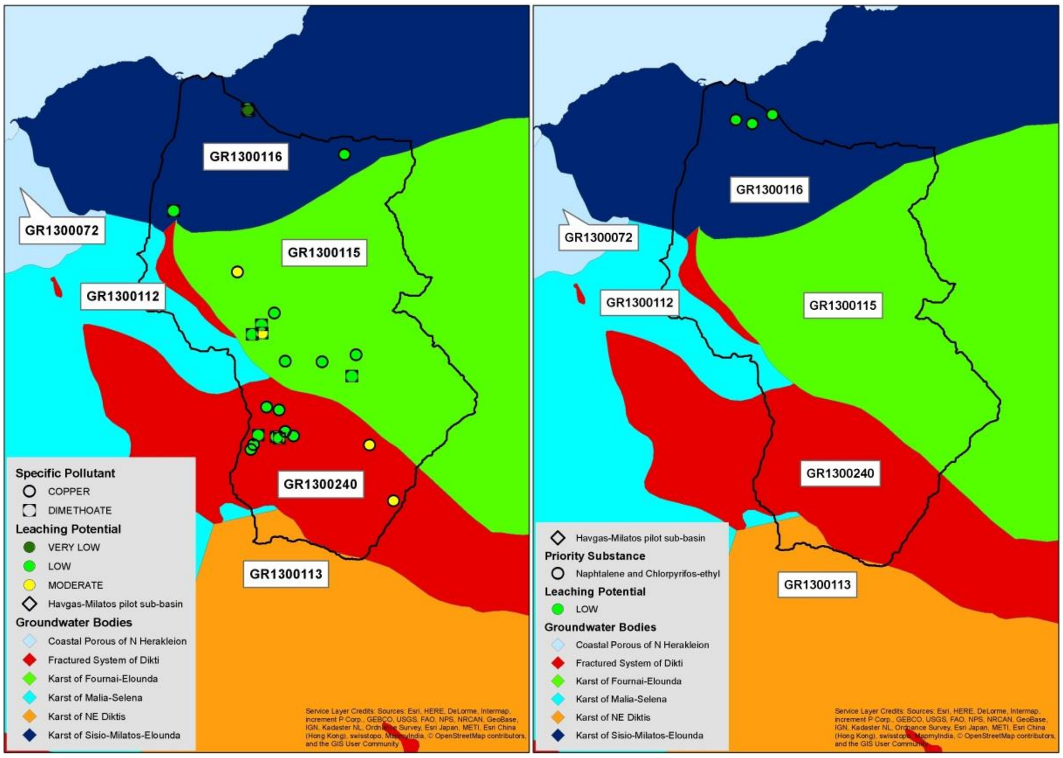

Fig. 97: Spatial distribution of parcels in which PPPs with specific pollutants (left) and priority substances (right) are used and classification according to their erosion potential in Havgas - Milatos sub-basin

4.3 AGRI SUB-BASIN

The majority of the registered orchards in Metapontino are found in moderate leaching potential class (57 farms or 57%), 42 farms (or 42%) are found in low leaching potential class and also 1 farm (1%) is found in very low leaching potential.
Within Agri pilot sub-basin boundaries there are 2 groundwater bodies, P-AGR (Acquifero alluvionale del fiume Agri) and P-MET (Piana del Metaponto). From the 57 registered orchards that are found in moderate leaching potential 11 orchards (or 19.3%) are above P-AGR and 24 registered orchards (or 42.6%) are above P-MET.

Table 47: Agrochemicals in orchards with moderate leaching potential in Agri pilot sub-basin

Sub-basin		P-AGR	P-MET	Total
Fertilized Orchards		10	24	34
Orchards with PPP		9	23	32
Orchards with H400	**No**	4	15	19
	PPP	Signum	Delan, Signum	Delan, Signum
Orchards with H410	**No**	9	23	32
	PPP	Calypso, Chorus, Confidor, Karate Zeon, Reldan, Signum, Cupravit, Laser, Pomarsol, Mezene WG, Poltiglia Dispress, Pyrethrum Nature, Trebon Up, Vertimec	Calypso, Confidor, Delan, Epik, Karate Zeon, Pomarsol, Reldan, Trebon Up, Vertimec, Zelig, Laser, Mezene WG, Signum, Cupravit, Chorus	Calypso, Chorus, Confidor, Cupravit, Karate Zeon, Laser, Mezene WG, Poltiglia Dispress, Pomarsol, Pyrethrum Nature, Reldan, Signum, Trebon Up, Vertimec, Delan,

				Epik, Zelig
Orchards with Specific pollutants	**No**	0	0	0
	PPP	-	-	-
	SP	-	-	-
Orchards with priority Substances	**No**	4	19	23
	PPP	Reldan	Reldan & Zelig	Reldan & Zelig
	PS	Naphthalene	Naphthalene & Chlorpyrifos-ethyl	Naphthalene & Chlorpyrifos-ethyl
Irrigated orchards		11	23	34

The majority of the 11 registered orchards that are included in the group of moderate leaching potential and are above P-AGR groundwater body are located in the central part of Agri pilot sub-basin. Almost all of them are both fertilized and use PPPs as 10 out of 11 (or 90.9%) registered orchards are fertilized and in 9 out of 11 (or 81.8%) registered orchards the farmers use PPPs (Table 42, Fig. 98 and Fig. 99).

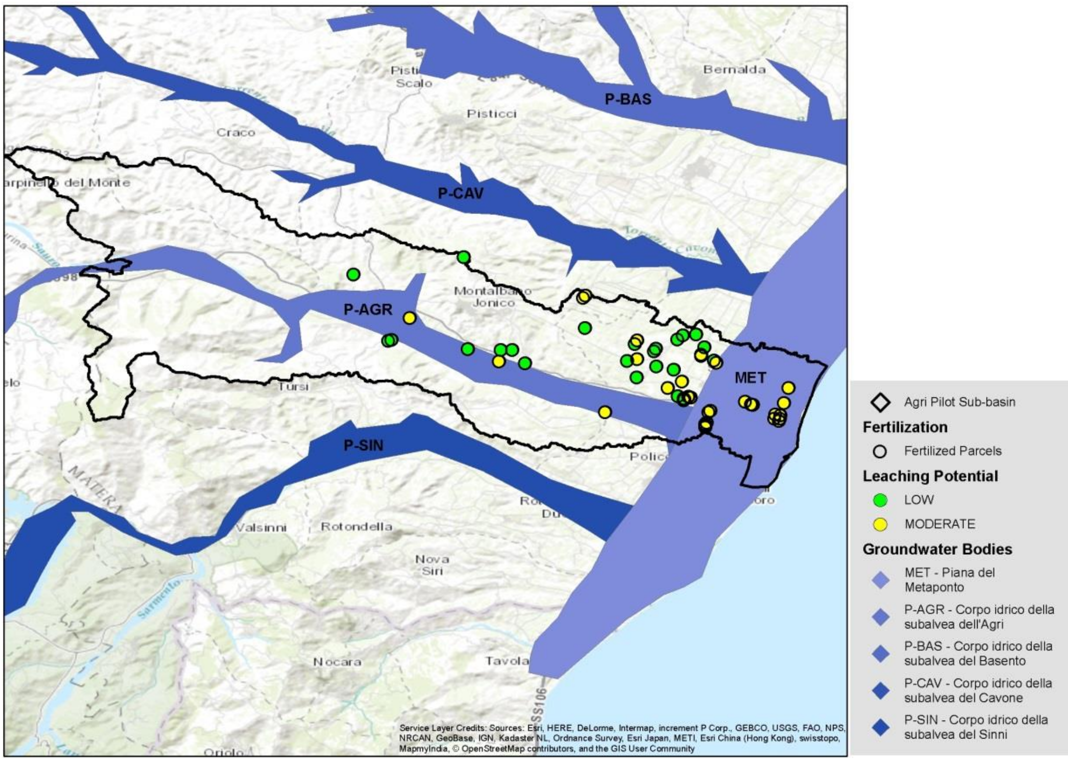

Fig. 98: Spatial distribution of fertilized orchards and classification according to their leaching potential in Agri pilot sub-basin

In 4 out of 11 orchards of this group which are located in the eastern part of P-AGRI the PPP of Signum which is classified as very toxic to aquatic life (H400) is used. Moreover, there other 14 PPPs classified as very toxic to aquatic life with long lasting effects (H410) are used in 9 out 11 (or 81.8%) registered orchards of this group which are located in the central part of Agri pilot sub-basin (Table 47, Fig. 100). From these 9 orchards there 4 orchards where 8 PPPs classified as H410 are used, in 2 orchards 6 and 5 PPPs classified as H410 are used, respectively, while there are other 2 orchards where 2 PPPs classified as H410 are used in each orchard (Table 71 in Appendix II).
As far as the specific pollutants and priority substances that are used per registered orchard are concerned it should be mentioned that in none of the registered orchards of this group any PPP which contains specific pollutant is applied. However, there are 4

registered orchards, which are located in the eastern part of P-AGRI groundwater body, where 1 PPP, Reldan, which contains the priority substance of naphthalene is applied (Table 47, Fig. 101).

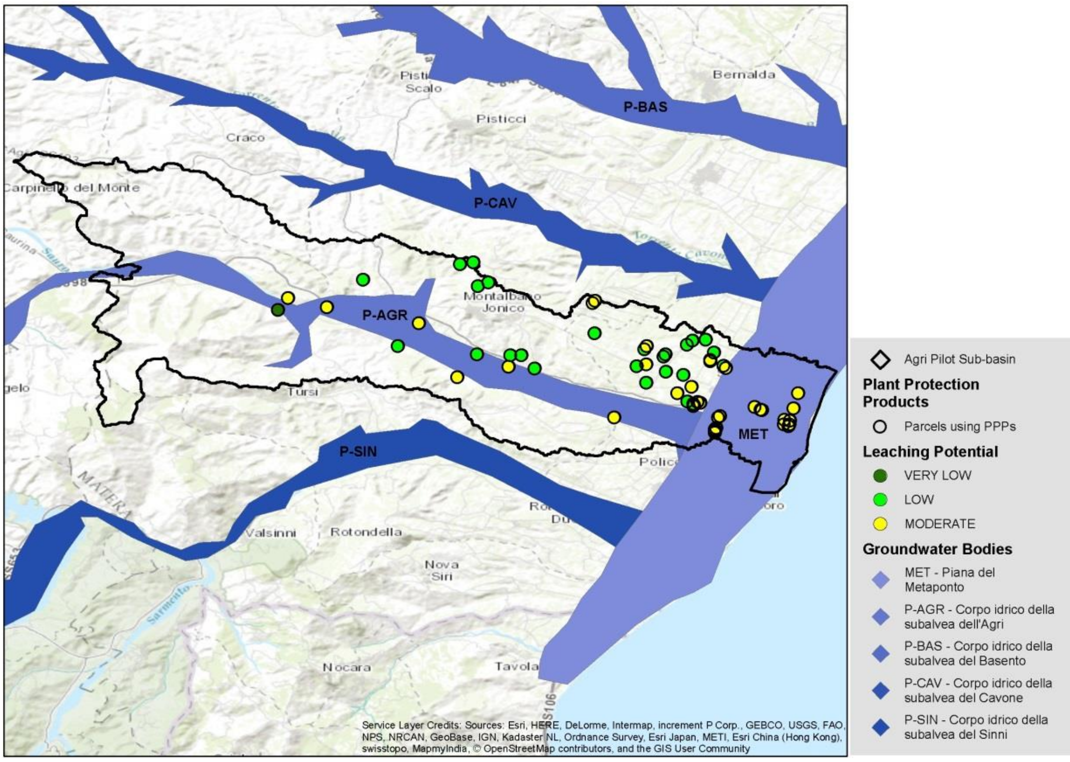

Fig. 99: Spatial distribution of orchards where PPPs are used and classification according to their leaching potential in Agri pilot sub-basin

The situation of the registered orchards that are found above P-MET groundwater body is quite similar with what has already been described above in reference to P-AGRI. More specific, from the 24 registered orchards that are found in moderate leaching potential group and they are located in the eastern part of Agri pilot sub-basin all orchards (100%) are fertilized and 23 orchards (or 95.8%) use PPPs (Table 47). The PPPs which are used in these orchards are rather toxic to the aquatic environment as in 15 out of 23 orchards (65.2%) 2 PPPs (Delan and Signum) classified as H400 are used and in all of them a total of 15 PPPs classified as H410 are applied (Table 71 in Appendix II).

From the PPPs which are used in the orchards of this group none of them contain specific pollutants. However, there are 2 PPPs (Reldan and Zelig) which contain 2 priority substances, naphthalene and chlorpyrifos-ethyl which are applied in 19 registered orchards that are located above P-MET (Table 47, Fig. 101). In 3 out of 19 orchards only Zelig is applied, in 15 out of 19 orchards only Reldan is applied, while there is only 1 orchard where both Reldan & Zelig are applied (Table 71 in Appendix II).

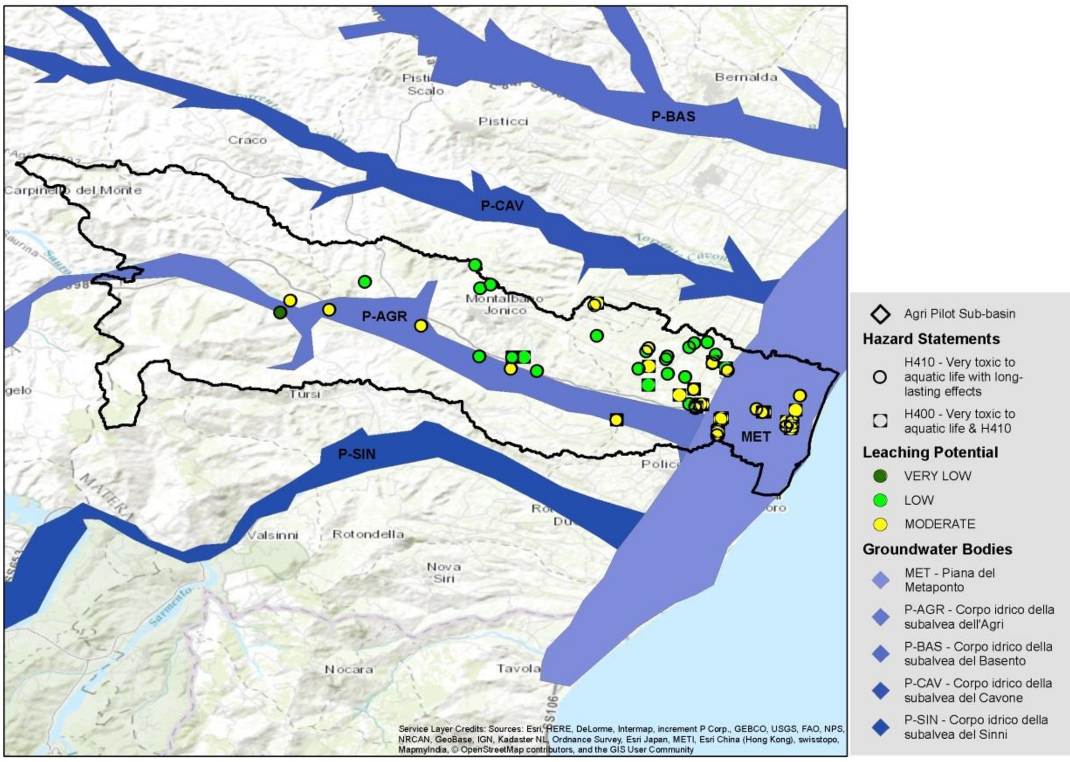

Fig. 100: Spatial distribution of parcels where PPPs classified as H400 and H410 are used and classification according to their leaching potential in Agri pilot sub-basin

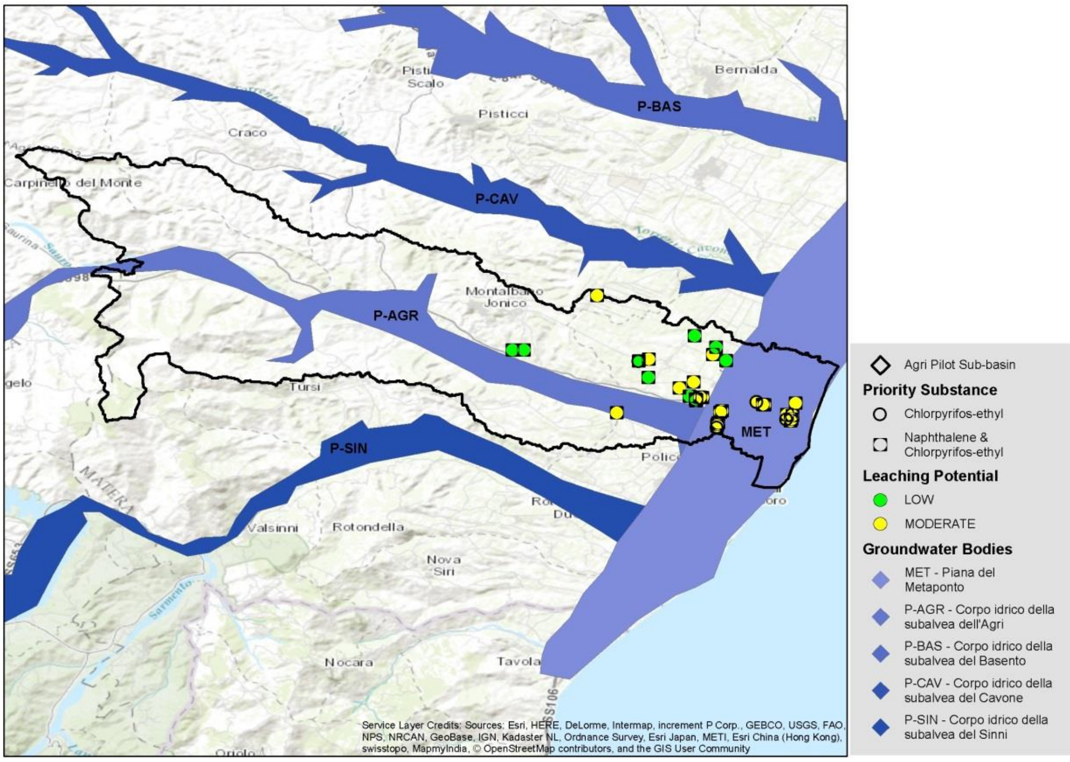

Fig. 101: Spatial distribution of parcels where PPPs with priority substances are used and classification according to their leaching potential in Agri pilot sub-basin

REFERENCES

– Ajmal, M., Waseem, M., Ahn, J. H., & Kim, T. W. (2015). Improved runoff estimation using event-based rainfall-runoff models. Water Resources Management, 29(6), 1995-2010.
– Arnoldus, H. M. J., Boodt, M. D., & Gabriels, D. (1980). An approximation of the rainfall factor in the Universal Soil Loss Equation. Assessment of Erosion., 127-132.
– Bakker, M. M., Govers, G., Jones, R. A., & Rounsevell, M. D. (2007). The effect of soil erosion on Europe's crop yields. Ecosystems, 10(7), 1209-1219.
– Diodato, N., Fagnano, M., & Alberico, I. (2011). Geospatial and visual modeling for exploring sediment source areas across the Sele river landscape, Italy. Italian Journal of Agronomy, 6(2), 14.
– Fang, H., Sun, L., & Tang, Z. (2015). Effects of rainfall and slope on runoff, soil erosion and rill development: an experimental study using two loess soils. Hydrological Processes, 29(11), 2649-2658.
– García-Ruiz, J. M., Nadal-Romero, E., Lana-Renault, N., & Beguería, S. (2013). Erosion in Mediterranean landscapes: changes and future challenges. Geomorphology, 198, 20-36.
– Hellenic Special Secretariat for Water (2015) Water Resources Management Plan of Crete Water District (GR13). Ministry of Environment & Energy.
– Lal, R. (1990). Soil erosion in the tropics: principles and management. McGraw Hill.
– Lehmann, J., & Schroth, G. (2003). Nutrient leaching. Trees, Crops and Soil Fertility, CABI Publishing, Wallingford, 151-166.
– Mohammad, F. S., & Adamowski, J. (2015). Interfacing the geographic information system, remote sensing, and the soil conservation service–curve number method to estimate curve number and runoff volume in the Asir region of Saudi Arabia. Arabian Journal of Geosciences, 8(12), 11093-11105.
– Moore, I. D., Turner, A. K., Wilson, J. P., Jenson, S. K., Band, L. E., Goodchild, M. F., & Steyaert, L. T. (1993). GIS and land-surface-subsurface modeling. Environmental modeling with GIS., 196-230.
– NRCS-USDA (1986) Urban hydrology for small watersheds (PDF). Technical Release 55 (TR-55) (Second ed.). Natural Resources Conservation Service, Conservation Engineering Division.
– NRCS-USDA (1996) National soil survey handbook, title 430-VI. Available at: www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242 accessed (27/06/2016).
– Panagos, P., Meusburger, K., Ballabio, C., Borrelli, P., & Alewell, C. (2014). Soil erodibility in Europe: A high-resolution dataset based on LUCAS. Science of the total environment, 479, 189-200.
– Teh S.H. (2011). Soil erosion modeling using RUSLE and GIS on Cameron Highlands, Malaysia for hydropower development. Master thesis, the School for Renewable Energy Science, University of Iceland & University of Akureyri.
– Van der Knijff, J., Jones, R. J. A., & Montanarella, L. (1999). Soil erosion risk assessment in Italy. JRC, European Commission.
– Wischmeier, W. H., & Smith, D. D. (1978). Predicting rainfall erosion losses-A guide to conservation planning. U.S. Department of Agriculture, Handbook 537.

Internet Links

– ASTER Global Digital Elevation Map - https://asterweb.jpl.nasa.gov/gdem.asp
– CORINE land cover - www.eea.europa.eu/publications/COR0-landcover
– LIFE09 ENV/GR/000302 - SAGE 10. Establishment of an impact assessment procedure as a toll for sustainability of agro-ecosystem: The case of Mediterranean olives - www.sage10.gr/index.php/en/
– Shuttle Radar Topography Mission - www2.jpl.nasa.gov/srtm/
– The European Soil Database, distribution version V2.0 - http://esdac.jrc.ec.europa.eu/ESDB_Archive/ESDBv2/index.htm
– USGS, Runoff (surface water runoff) - http://water.usgs.gov/edu/runoff.html
– USGS, Water Science Glossary of Terms - http://water.usgs.gov/edu/dictionary.html

APPENDIX I: CURVE NUMBER TABLES

Table 48. Runoff curve numbers for cultivated agricultural lands (from NRCS 1986)

COVER			HYDROLOGIC GROUP			
Land Use	**Treatment or Practice**	**Hydrologic Condition**	**A**	**B**	**C**	**D**
Fallow	Bare soil	-	77	86	91	94
	Crop residue (CR)	poor	76	85	90	93
	Crop residue (CR)	good	74	83	88	90
Row Crops	Straight row (SR)	poor	72	81	88	91
	Straight row (SR)	good	67	78	85	89
	SR + Crop residue	poor	71	80	87	90
	SR + Crop residue	good	64	75	82	85
	Contoured (C)	poor	70	79	84	88
	Contoured (C)	good	65	75	82	86
	C + Crop residue	poor	69	78	83	87
	C + Crop residue	good	64	74	81	85
	Cont & terraced(C&T)	poor	66	74	80	82
	Cont & terraced(C&T)	good	62	71	78	81
	C&T + Crop residue	poor	65	73	79	81
	C&T + Crop residue	good	61	70	77	80
Small Grain	Straight row (SR)	poor	65	76	84	88
	Straight row (SR)	good	63	75	83	87
	SR + Crop residue	poor	64	75	83	86
	SR + Crop residue	good	60	72	80	84
	Contoured (C)	poor	63	74	82	85
	Contoured (C)	good	61	73	81	84
	C + Crop residue	poor	62	73	81	84
	C + Crop residue	good	60	72	80	83
	Cont & terraced(C&T)	poor	61	72	79	82
	Cont & terraces(C&T)	good	59	70	78	81
	C&T + Crop residue	poor	60	71	78	81
	C&T + Crop residue	good	58	69	77	80
Closeseeded or broadcast legumes or rotation meadow	Straight row	poor	66	77	85	89
	Straight row	good	58	72	81	85
	Contoured	poor	64	75	83	85
	Contoured	good	55	69	78	83
	Cont & terraced	poor	63	73	80	83

	Cont & terraced	good	51	67	76	80

Table 49. Runoff curve numbers for other agricultural lands (from NRCS 1986)

COVER		HYDROLOGIC GROUP			
Cover Type	**Hydrologic Condition**	**A**	**B**	**C**	**D**
Pasture, grassland or range	poor	68	79	86	89
	fair	49	69	79	84
	good	39	61	74	80
Meadow cont. grass (non grazing)	-	30	58	71	78
Brush - brush, weed, grass mix	poor	48	67	77	83
	fair	35	56	70	77
	good	30	48	65	73
Woods - grass combination (orchard or farm tree)	poor	57	73	82	86
	fair	43	65	76	82
	good	32	58	72	79
Woods	poor	45	66	77	83
	fair	36	60	73	79
	good	30	55	70	77
Farmsteads - buildings, lanes, driveways and surrounding lots.	-	59	74	82	86

Table 50. Runoff curve numbers for urban areas (from NRCS 1986)

COVER			HYDROLOGIC GROUP			
Land Use	**Hydrologic Condition**	**Avg % impervious area**	**A**	**B**	**C**	**D**
FULLY DEVELOPED URBAN AREAS						
Open space (Lawns,parks etc.)	poor	-	68	79	86	89
	fair	-	49	69	79	84
	good	-	39	61	74	80
Impervious Areas						
Paved parking lots, roofs, driveways	-	-	98	98	98	98
Streets and roads	-	-				
Paved; curbs and storm sewers	-	-	98	98	98	98
Paved; open ditches (w/rightofway)	-	-	83	89	92	93
Gravel (w/ rightofway)	-	-	76	85	89	91
Dirt (w/ rightofway)	-	-	72	82	87	89

Urban Districts						
Commercial & business	-	85	89	92	94	95
Industrial	-	72	81	88	91	93
Residential districts by average lot size						
1/8 acre (town houses)	-	65	77	85	90	92
1/4 acre	-	38	61	75	83	87
1/3 acre	-	30	57	72	81	86
1/2 acre	-	25	54	70	80	85
1 acre	-	20	51	68	79	84
2 acre	-	12	46	65	77	82
DEVELOPING URBAN AREA (No Vegetation)						
Newly graded area (pervious or	-		77	86	91	94

Table 51. Runoff curve numbers for several crop and land cover types as retrieved from SWAT model database (ArcSWAT Version 2012.10_2.16)

Crop or Land Cover	Soil Hydrologic Group			
	A	B	C	D
Agricultural Land-Close-grown	62	73	81	84
Agricultural Land-Generic	67	77	83	87
Agricultural Land-Row Crops	67	78	85	89
Alamo Switchgrass	31	59	72	79
Alfalfa	31	59	72	79
Almonds	45	66	77	83
Alsike Clover	31	59	72	79
Altai Wildrye	31	59	72	79
Apple	45	66	77	83
Asparagus	63	74	82	85
Bananas	45	66	77	83
Barren	77	86	91	94
Bell Pepper	67	77	83	87
Bermudagrass	31	59	72	79
Big Bluestem	31	59	72	79
Broccoli	67	77	83	87
Cabbage	67	77	83	87
Cantaloupe	67	77	83	87
Carrot	67	77	83	87
Cashews	45	66	77	83
Cassava	67	77	83	87
Cauliflower	67	77	83	87
Celery	67	77	83	87

Crop or Land Cover	Soil Hydrologic Group			
	A	B	C	D
Coconut	45	66	77	83
Coffee	45	66	77	83
Corn	67	77	83	87
Corn Silage	67	77	83	87
Cowpeas	67	78	85	89
Crested Wheatgrass	31	59	72	79
Cucumber	67	77	83	87
Durum Wheat	62	73	81	84
Eastern Gamagrass	31	59	72	79
Eggplant	67	77	83	87
Eragrostis Teff	62	73	81	84
Eucalyptus	45	66	77	83
Field Peas	67	77	83	87
Flax	62	73	81	84
Forest-Deciduous	45	66	77	83
Forest-Evergreen	25	55	70	77
Forest-Mixed	36	60	73	79
Garden or Canning Peas	67	77	83	87
Grain Sorghum	67	77	83	87
Grarigue	39	61	74	80
Green Beans	67	77	83	87
Hay	31	59	72	79
Head Lettuce	67	77	83	87
Honey Mesquite	45	66	77	83
Honeydew Melon	67	77	83	87
Indiangrass	31	59	72	79
Italian (Annual) Ryegrass	31	59	72	79
Johnsongrass	31	59	72	79
Kentucky Bluegrass	31	59	72	79
Lentils	67	77	83	87
Lima Beans	67	77	83	87
Little Bluestem	31	59	72	79
Meadow Bromegrass	31	59	72	79
Mung Beans	67	78	85	89
Oak	45	66	77	83
Oats	62	73	81	84
Oil Palm	45	66	77	83
Olives	45	66	77	83
Onion	67	77	83	87
Orange	45	66	77	83
Orchard	45	66	77	83

Crop or Land Cover	Soil Hydrologic Group			
	A	B	C	D
Papayas	45	66	77	83
Pasture	49	69	79	84
Peanut	67	77	83	87
Pearl Millet	62	73	81	84
Peppers	67	77	83	87
Pine	25	55	70	77
Pineapple	45	66	77	83
Pinto Beans	67	78	85	89
Plaintains	67	77	83	87
Poplar	45	66	77	83
Potato	67	77	83	87
Radish	67	77	83	87
Range-Brush	39	61	74	80
Range-Grasses	49	69	79	84
Red Clover	31	59	72	79
Rice	62	73	81	84
Rubber Trees	45	66	77	83
Russian Wildrye	31	59	72	79
Rye	62	73	81	84
Septic Area	31	59	72	79
Sesbania	67	77	83	87
Sideoats Grama	31	59	72	79
Slender Wheatgrass	31	59	72	79
Smooth Bromegrass	31	59	72	79
Sorghum Hay	67	77	83	87
Southwestern US (Arid) Range	39	61	74	80
Soybean	67	78	85	89
Spinach	67	77	83	87
Spring Barley	62	73	81	84
Spring Canola-Argentine	67	77	83	87
Spring Canola-Polish	67	77	83	87
Spring Wheat	62	73	81	84
Strawberry	67	77	83	87
Sugarbeet	67	77	83	87
Sugarcane	67	77	83	87
Summer Pasture	49	69	79	84
Sunflower	67	77	83	87
Sweet Corn	67	77	83	87
Sweetclover	31	59	72	79
Sweetpotato	67	77	83	87

Crop or Land Cover	**Soil Hydrologic Group**			
	A	**B**	**C**	**D**
Tall Fescue	31	59	72	79
Timothy	31	59	72	79
Tobacco	67	77	83	87
Tomato	67	77	83	87
Upland Cotton	67	77	83	87
Vineyard	45	66	77	83
Water	92	92	92	92
Watermelon	67	77	83	87
Western Wheatgrass	31	59	72	79
Wetlands-Forested	45	66	77	83
Wetlands-Mixed	49	69	79	84
Wetlands-Non-Forested	49	69	79	84
Willow	45	66	77	83
Winter Barley	62	73	81	84
Winter Pasture	49	69	79	84
Winter Wheat	62	73	81	84

APPENDIX II: AGROCHEMICALS AND RISK POTENTIAL ANALYSIS

II.1 Platanias

Table 52: Agrochemicals in orchards with high runoff potential Voukolies and Maleme sub-basins

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR3901R000301006N	07.P.OL.04 08.P.OL.03 17.P.OL.01 17.P.OL.02 23.P.C.01 23.P.OL.02 23.P.OL.03 23.P.OL.04 24.P.OL.03 25.P.C.01 25.P.OL.02 27.P.OL.01 28.P.OL.01 28.P.OL.02	07.P.OL.04 17.P.OL.01 17.P.OL.02 23.P.C.01 23.P.OL.02 23.P.OL.03 23.P.OL.04 24.P.OL.03 25.P.C.01 25.P.OL.02 27.P.OL.01 28.P.OL.01 28.P.OL.02			07.P.OL.04	Copper	17.P.OL.01 17.P.OL.02 23.P.OL.02 23.P.OL.03 23.P.OL.04 24.P.OL.03 25.P.C.01 28.P.OL.01 28.P.OL.02	Rogor	Dimethoate	23.P.C.01	Pyrinex	Chlorpyrifos-ethyl	07.P.OL.04 12.P.OL.02 17.P.OL.01 17.P.OL.02 23.P.C.01 23.P.OL.02 23.P.OL.03 23.P.OL.04 24.P.OL.03 25.P.C.01 25.P.OL.02 28.P.OL.02
					17.P.OL.01	Proteus							
					23.P.C.01	Pyrinex							
					17.P.OL.02 24.P.OL.03 25.P.OL.02	Decis	07.P.OL.04	Cooper & Rogor	Copper & Dimethoate				
GR3901R000301007N	01.P.OL.01 01.P.OL.02 02.P.OL.01 02.P.OL.02 03.P.OL.02 04.C.01 11.P.OL.02 11.P.OL.03 13.P.OL.02 14.P.OL.01 14.P.OL.02 16.P.OL.01	01.P.OL.01 01.P.OL.02 02.P.OL.01 03.P.OL.01 03.P.OL.02 04.C.01 11.P.OL.01 11.P.OL.02 11.P.OL.03 11.P.OL.04 13.P.OL.02 14.P.OL.01			03.P.OL.01 03.P.OL.02	Decis & Cooper	03.P.OL.01 03.P.OL.02	Cooper & Rogor	Copper & Dimethoate				03.P.OL.01 03.P.OL.02 04.C.01 11.P.OL.01 11.P.OL.02 11.P.OL.03 11.P.OL.04 14.P.OL.01 14.P.OL.02 16.P.OL.01 16.P.OL.02 16.P.OL.03
					11.P.OL.01 11.P.OL.02 11.P.OL.03 11.P.OL.04 20.P.OL.01 20.P.OL.02 20.P.OL.03	Decis							

	16.P.OL.02 16.P.OL.03 18.P.C.04 18.P.OL.01 18.P.OL.02 18.P.OL.03 20.P.OL.01 20.P.OL.02 20.P.OL.03 21.P.OL.02 21.P.OL.04 22.P.OL.01 22.P.OL.02 27.P.OL.02	14.P.OL.02 16.P.OL.01 16.P.OL.02 16.P.OL.03 18.P.C.04 18.P.OL.01 18.P.OL.02 18.P.OL.03 20.P.OL.01 20.P.OL.02 20.P.OL.03 21.P.OL.02 21.P.OL.04 22.P.OL.01 22.P.OL.02 27.P.OL.02			14.P.OL.01 14.P.OL.02 16.P.OL.01 16.P.OL.02 16.P.OL.03 21.P.OL.02 21.P.OL.04	Proteus							18.P.C.04 18.P.OL.01 18.P.OL.02 18.P.OL.03 21.P.OL.02 28.P.OL.02
					18.P.OL.01 18.P.OL.02 18.P.OL.03 22.P.OL.01 22.P.OL.02	Pyrethron	04.C.01 13.P.OL.02 14.P.OL.01 14.P.OL.02 16.P.OL.01 16.P.OL.02 16.P.OL.03 20.P.OL.01 20.P.OL.02 20.P.OL.03	Rogor	Dimethoate				
GR3901R000301057N	04.OL.02 05.P.OL.03 06.P.OL.04 19..OL.04 19.P.OL.03 27.P.OL.03	04.OL.02 05.P.OL.03 06.P.OL.04 19..OL.04 19.P.OL.03 27.P.OL.03			05.P.OL.03	Copper	05.P.OL.03	Cooper & Rogor	Copper & Dimethoate				05.P.OL.03 06.P.OL.04
					19..OL.04 19.P.OL.03	Decis	06.P.OL.04 19..OL.04 19.P.OL.03	Rogor	Dimethoate				
Maleme	09.P.OL.01 24.P.OL.04 26.P.OL.04 29.P.OL.01 29.P.OL.02 29.P.OL.03 29.P.OL.04	09.P.OL.01 24.P.OL.04 29.P.OL.01 29.P.OL.02 29.P.OL.03 29.P.OL.04			24.P.OL.04	Decis	09.P.OL.01 24.P.OL.04 29.P.OL.01 29.P.OL.02 29.P.OL.03 29.P.OL.04	Rogor	Dimethoate				09.P.OL.01 24.P.OL.04

Table 53: Agrochemicals in orchards with moderate runoff potential Voukolies and Maleme sub-basins

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR3901R000301006	07.P.OL.03 08.P.OL.02	07.P.OL.01 07.P.OL.03			07.P.OL.01 07.P.OL.03	Copper	07.P.OL.01 07.P.OL.03	Cooper & Rogor	Copper &				07.P.OL.01 12.P.OL.01

N	25.P.OL.03 26.P.C.01 26.P.OL.0	25.P.OL.03 26.P.C.01			25.P.OL.03	Decis			Dimethoate				25.P.OL.03 26.P.C.01
GR3901R000301007N	01.P.OL.03 04.P.OL.03 04.P.OL.04 05.P.OL.02 06.P.OL.01 06.P.OL.02 13.P.OL.03 20.P.OL.04 21.P.C.01 21.P.OL.03 26.P.OL.03	01.P.OL.03 04.P.OL.03 04.P.OL.04 05.P.OL.02 06.P.OL.01 06.P.OL.02 13.P.OL.03 20.P.OL.04 21.P.C.01 21.P.OL.03	21.P.C.01	Dursban	05.P.OL.02	Copper	05.P.OL.02	Cooper & Rogor	Copper & Dimethoate	21.P.C.01	Durban	Chlorpyrifos-ethyl	06.P.OL.02 21.P.C.01 21.P.OL.03 28.P.OL.03
					20.P.OL.04 21.P.C.01	Decis	06.P.OL.01 06.P.OL.02 13.P.OL.03 20.P.OL.04	Rogor	Dimethoate				
					21.P.OL.03	Proteus							
GR3901R000301057N	05.P.OL.01 06.P.OL.03 19.P.C.01 19.P.OL.02 22.P.OL.03 22.P.OL.04	05.P.OL.01 06.P.OL.03 19.P.C.01 19.P.OL.02 22.P.OL.03 22.P.OL.04			05.P.OL.01 19.P.C.01	Copper	05.P.OL.01 19.P.C.01	Cooper & Rogor	Copper & Dimethoate				05.P.OL.01 06.P.OL.03 19.P.C.01
					19.P.OL.02	Decis	06.P.OL.03 19.P.OL.02	Rogor	Dimethoate				
					22.P.OL.03 22.P.OL.04	Pyrethron							
Maleme	07.P.OL.02 08.P.OL.01 09.P.OL.02 09.P.OL.03 09.P.OL.04 24.P.OL.01 24.P.OL.02 25.P.OL.04 28.P.OL.03	07.P.OL.02 09.P.OL.02 09.P.OL.03 09.P.OL.04 24.P.OL.01 24.P.OL.02 25.P.OL.04 28.P.OL.03			07.P.OL.02	Copper	07.P.OL.02	Cooper & Rogor	Copper & Dimethoate				07.P.OL.02 09.P.OL.02 09.P.OL.03 09.P.OL.04 24.P.OL.01 24.P.OL.02 25.P.OL.04 28.P.OL.03
					24.P.OL.01 24.P.OL.02 25.P.OL.04	Decis	09.P.OL.02 09.P.OL.03 09.P.OL.04 24.P.OL.01 24.P.OL.02 28.P.OL.03	Rogor	Dimethoate				

Table 54: Agrochemicals in orchards with very high erosion potential Voukolies and Maleme sub-basins

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR3901R000301006N	25.P.C.01 27.P.OL.01	25.P.C.01 27.P.OL.01					25.P.C.01	Rogor	Dimethoate				25.P.C.01

GR3901R0 00301007 N	01.P.OL.01 01.P.OL.02 02.P.OL.01 13.P.OL.02 14.P.OL.01 18.P.C.04 20.P.OL.01 20.P.OL.02 21.P.OL.02 21.P.OL.04 22.P.OL.01 22.P.OL.02	01.P.OL.01 01.P.OL.02 02.P.OL.01 13.P.OL.02 14.P.OL.01 18.P.C.04 20.P.OL.01 20.P.OL.02 21.P.OL.02 21.P.OL.04 22.P.OL.01 22.P.OL.02			20.P.OL.01 20.P.OL.02	Decis	13.P.OL.02 14.P.OL.01 20.P.OL.01 20.P.OL.02	Rogor	Dimethoate				14.P.OL.01 18.P.C.04 21.P.OL.02
					14.P.OL.01 21.P.OL.02 21.P.OL.04	Proteus							
					22.P.OL.01 22.P.OL.02	Pyrethron							
GR3901R0 00301057 N													
Maleme	29.P.OL.02	29.P.OL.02					29.P.OL.02	Rogor	Dimethoate				

Table 55: Agrochemicals in orchards with high erosion potential Voukolies and Maleme sub-basins

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR3901R0 00301006 N	17.P.OL.01 23.P.OL.04	17.P.OL.01 23.P.OL.04			17.P.OL.01	Proteus	17.P.OL.01 23.P.OL.04	Rogor	Dimethoate				17.P.OL.01 23.P.OL.04
GR3901R0 00301007 N	14.P.OL.02 27.P.OL.02	11.P.OL.01 11.P.OL.04 14.P.OL.02 27.P.OL.02			11.P.OL.01 11.P.OL.04	Decis	14.P.OL.02	Rogor	Dimethoate				11.P.OL.01 11.P.OL.04 14.P.OL.02
					14.P.OL.02	Proteus							
GR3901R0 00301057 N	19..OL.04 19.P.C.01 19.P.OL.03 22.P.OL.03 22.P.OL.04	19..OL.04 19.P.C.01 19.P.OL.03 22.P.OL.03 22.P.OL.04			19..OL.04 19.P.OL.03	Decis	19.P.C.01	Copper & Rogor	Copper & Dimethoate				19.P.C.01
					19.P.C.01	Copper	19..OL.04 19.P.OL.03	Rogor	Dimethoate				
					22.P.OL.03 22.P.OL.04	Pyrethron							
Maleme	25.P.OL.04	25.P.OL.04			25.P.OL.04	Decis	29.P.OL.01	Rogor	Dimetho				25.P.OL.04

	29.P.OL.01	29.P.OL.01							ate				

Table 56: Agrochemicals in orchards with moderate erosion potential Voukolies and Maleme sub-basins

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR3901R000301006N	08.P.OL.02 08.P.OL.03 23.P.OL.02 23.P.OL.03 24.P.OL.03 25.P.OL.02 28.P.OL.01 28.P.OL.02	23.P.OL.02 23.P.OL.03 24.P.OL.03 25.P.OL.02 28.P.OL.01 28.P.OL.02			24.P.OL.03 25.P.OL.02	Decis	23.P.OL.02 23.P.OL.03 24.P.OL.03 28.P.OL.01 28.P.OL.02	Rogor	Dimethoate				23.P.OL.02 23.P.OL.03 24.P.OL.03 25.P.OL.02 28.P.OL.02
GR3901R000301007N	01.P.OL.03 11.P.OL.02 11.P.OL.03 16.P.OL.01 16.P.OL.03 18.P.OL.03 20.P.OL.03	01.P.OL.03 11.P.OL.02 11.P.OL.03 16.P.OL.01 16.P.OL.03 18.P.OL.03 20.P.OL.03			16.P.OL.01 16.P.OL.03	Proteus	16.P.OL.01 16.P.OL.03 20.P.OL.03	Rogor	Dimethoate				11.P.OL.02 11.P.OL.03 16.P.OL.01 16.P.OL.03 18.P.OL.03 28.P.OL.02
					18.P.OL.03	Pyrethron							
					11.P.OL.02 11.P.OL.03 20.P.OL.03	Decis							
GR3901R000301057N	04.OL.02	04.OL.02											
Maleme	09.P.OL.03 09.P.OL.04 26.P.OL.04 29.P.OL.04	09.P.OL.03 09.P.OL.04 29.P.OL.04					09.P.OL.03 09.P.OL.04 29.P.OL.04	Rogor	Dimethoate				09.P.OL.03 09.P.OL.04

Table 57: Agrochemicals in orchards with high leaching potential Voukolies and Maleme sub-basins

Water body	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR1300022	04.P.OL.03 05.P.OL.01	04.P.OL.03 05.P.OL.01	28.P.C.01	Dursban	05.P.OL.01	Copper	05.P.OL.01	Copper & Rogor	Copper &	28.P.C.01	Dursban	Chlorpyrifos-	05.P.OL.01 06.P.OL.03

	06.P.OL.03 18.P.OL.02 20.P.OL.04 25.P.OL.03 28.P.C.01	06.P.OL.03 18.P.OL.02 20.P.OL.04 25.P.OL.03 28.P.C.01 28.P.OL.04							Dimethoate			ethyl	18.P.OL.02 25.P.OL.03 28.P.C.01 28.P.OL.04
					18.P.OL.02	Pyrethron	06.P.OL.03 20.P.OL.04	Rogor	Dimethoate				
					20.P.OL.04 25.P.OL.03	Decis							
GR1300330													

Table 58: Agrochemicals in orchards with moderate leaching potential Voukolies and Maleme sub-basins

Water body	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR1300022	01.P.OL.01 01.P.OL.02 01.P.OL.03 02.P.OL.01 02.P.OL.02 04.C.01 04.OL.02 04.P.OL.04 05.P.OL.02 06.P.OL.01 06.P.OL.02 06.P.OL.04 07.P.OL.02 07.P.OL.03 08.P.OL.01 08.P.OL.02 09.P.OL.02 09.P.OL.03 09.P.OL.04 11.P.OL.02 11.P.OL.03 13.P.OL.02 13.P.OL.03 14.P.OL.02 16.P.OL.01 16.P.OL.03	01.P.OL.01 01.P.OL.02 01.P.OL.03 02.P.OL.01 04.C.01 04.OL.02 04.P.OL.04 05.P.OL.02 06.P.OL.01 06.P.OL.02 06.P.OL.04 07.P.OL.01 07.P.OL.02 07.P.OL.03 09.P.OL.02 09.P.OL.03 09.P.OL.04 11.P.OL.02 11.P.OL.03 11.P.OL.04 13.P.OL.02 13.P.OL.03 14.P.OL.02 16.P.OL.01 16.P.OL.03 18.P.C.04	21.P.C.01	Dursban	11.P.OL.02 11.P.OL.03 11.P.OL.04 19..OL.04 19.P.OL.02 19.P.OL.03 20.P.OL.01 20.P.OL.03 21.P.C.01 24.P.OL.01 24.P.OL.02 24.P.OL.04 25.P.OL.04	Decis	05.P.OL.02 07.P.OL.01 07.P.OL.02 07.P.OL.03 19.P.C.01	Copper & Rogor	Copper & Dimethoate	21.P.C.01	Dursban	Chlorpyrifos-ethyl	04.C.01 06.P.OL.02 06.P.OL.04 07.P.OL.01 07.P.OL.02 09.P.OL.02 09.P.OL.03 09.P.OL.04 11.P.OL.02 11.P.OL.03 11.P.OL.04 14.P.OL.02 16.P.OL.01 16.P.OL.03 18.P.C.04 18.P.OL.01 18.P.OL.03 19.P.C.01 21.P.C.01 21.P.OL.02 21.P.OL.03 24.P.OL.01 24.P.OL.02 24.P.OL.04 25.P.OL.04 26.P.C.01
					05.P.OL.02 07.P.OL.01 07.P.OL.02 07.P.OL.03 19.P.C.01	Copper	04.C.01 06.P.OL.01 06.P.OL.02 06.P.OL.04 09.P.OL.02 09.P.OL.03 09.P.OL.04 13.P.OL.02 13.P.OL.03 14.P.OL.02 16.P.OL.01 16.P.OL.03 19..OL.04	Rogor	Dimethoate				

	18.P.C.04 18.P.OL.01 18.P.OL.03 19..OL.04 19.P.C.01 19.P.OL.02 19.P.OL.03 20.P.OL.01 20.P.OL.03 21.P.C.01 21.P.OL.02 21.P.OL.03 21.P.OL.04 22.P.OL.03 22.P.OL.04 24.P.OL.01 24.P.OL.02 24.P.OL.04 25.P.OL.04 26.P.C.01 26.P.OL.02 26.P.OL.03 27.P.OL.03 28.P.OL.01 28.P.OL.02 28.P.OL.03 29.P.OL.03 29.P.OL.04	18.P.OL.01 18.P.OL.03 19..OL.04 19.P.C.01 19.P.OL.02 19.P.OL.03 20.P.OL.01 20.P.OL.03 21.P.C.01 21.P.OL.02 21.P.OL.03 21.P.OL.04 22.P.OL.03 22.P.OL.04 24.P.OL.01 24.P.OL.02 24.P.OL.04 25.P.OL.04 26.P.C.01 27.P.OL.03 28.P.OL.01 28.P.OL.02 28.P.OL.03 29.P.OL.03 29.P.OL.04			14.P.OL.02 16.P.OL.01 16.P.OL.03 21.P.OL.02 21.P.OL.03 21.P.OL.04	Proteus	19.P.OL.02 19.P.OL.03 20.P.OL.01 20.P.OL.03 24.P.OL.01 24.P.OL.02 24.P.OL.04 28.P.OL.01 28.P.OL.02 28.P.OL.03 29.P.OL.03 29.P.OL.04						28.P.OL.02 28.P.OL.03 28.P.OL.03
					18.P.OL.01 18.P.OL.03 22.P.OL.03 22.P.OL.04	Pyrethro n							
GR130033 0													

II.2 Mirabello

Table 59: Agrochemicals in orchards with very high runoff potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1													
HM-2													

HM-3							
HM-4							
HM-5							
HM-6	4.01 35.02						

Table 60: Agrochemicals in orchards with high runoff potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1	11.03	16.04					16.04	Rogor	Dimethoate				16.04
HM-2		3.01 3.02			3.01	Copper	3.01	Copper	Copper				
					3.02	Bulldock							
HM-3													
HM-4													12.03
HM-5	23.02 40.01 40.02	16.02 40.01					16.02	Rogor	Dimethoate				
HM-6	1.01 5.02 5.03 5.04 6.02 7.01 7.02 7.03 7.04 7.05 7.06 17.01 17.02 18.02 27.01 27.02 28.02 30.01	1.01 4.04 5.01 5.02 5.03 7.01 7.02 7.03 7.04 7.05 7.06 8.01 30.01 30.02 30.04 30.05 31.02 34.01			1.01 7.01 7.02 7.03 7.04 7.05 7.06 30.01 30.02 30.04 30.05	Bulldock & Copper	1.01 7.01 7.02 7.03 7.04 7.05 7.06 30.01 30.02 30.04 30.05	Copper	Copper				7.01 7.06 8.01 34.01
					38.01 38.02	Bulldock	5.01 5.02 5.03 8.01 31.02 34.01	Rogor	Dimethoate				

	30.04 30.05 31.02 35.01 35.03 35.04 38.01 38.02	38.01 38.02											

Table 61: Agrochemicals in orchards with moderate runoff potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1	33.02 33.03	16.03 33.02 33.03 33.06			33.02 33.03 33.06	Reldan	16.03	Rogor	Dimethoate	33.02 33.03 33.06	Reldan	Naphthalene & Chlorpyrifos-ethyl	16.03 22.01 33.03 43.03
HM-2													
HM-3													
HM-4	30.03	30.03			30.03	Bulldock & Copper	30.03	Copper	Copper				30.03
HM-5													
HM-6	1.02 13.03 31.01	1.02 9.01 31.01			1.02	Copper & Bulldock	1.02 9.01	Copper Rogor	Copper Dimethoate				

Table 62: Agrochemicals in orchards with very high erosion potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1		16.04					16.04	Rogor	Dimethoate				16.04

HM-2													
HM-3													
HM-4													
HM-5	40.01	40.01											
HM-6	5.02 7.01 7.02 7.03 7.04 27.02 30.04 30.05 31.02 35.02 35.04 38.01	5.02 7.01 7.02 7.03 7.04 9.01 30.02 30.04 30.05 31.02 38.01			7.01 7.02 7.03 7.04 30.02 30.04 30.05	Copper & Bulldock	7.01 7.02 7.03 7.04 30.02 30.04 30.05	Copper	Copper				7.01
					38.01	Bulldock	5.02 9.01 31.02	Rogor	Dimethoate				

Table 63: Agrochemicals in orchards with high erosion potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1													
HM-2		3.01			3.01	Copper	3.01	Copper	Copper				
HM-3													
HM-4													
HM-5	23.02 40.02	16.02					16.02	Rogor	Dimethoate				
HM-6	5.03 5.04 7.05 30.01 38.02	4.04 5.03 7.05 8.01 30.01 34.01 38.02			7.05 30.01	Copper & Bulldock	7.05 30.01	Copper	Copper				8.01 34.01
					38.02	Bulldock	5.03 8.01 34.01	Rogor	Dimethoate				

Table 64: Agrochemicals in orchards with moderate erosion potential in Havgas - Milatos sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
HM-1	11.03												
HM-2		3.02			3.02	Bulldock							
HM-3													
HM-4													
HM-5													
HM-6	1.01 6.02 17.01 17.02 27.01 28.02	1.01			1.01	Copper & Bulldock	1.01	Copper	Copper				

Table 65: Agrochemicals in orchards with high leaching potential in Havgas - Milatos sub-basin

Water body	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
GR1300112	6.01												
GR1300115													
GR1300116													
GR1300240													
GR1300113													

Table 66: Agrochemicals in orchards with moderate leaching potential in Havgas - Milatos sub-basin

Water body	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code

Sub-basin	Fertilized Orchards Code	Orchards with PPP Code	PPPs with H400 Code	PPPs with H400 PPP	PPPs with H410 Code	PPPs with H410 PPP	PPPs with Specific pollutants Code	PPPs with Specific pollutants PPP	PPPs with Specific pollutants SP	PPPs with priority substances Code	PPPs with priority substances PPP	PPPs with priority substances PS	Irrigated orchards Code
GR1300112													
GR1300115	30.03 31.01	9.01 30.03 31.01			30.03	Bulldock & Copper	9.01 30.03	Rogor Copper	Dimethoate Copper				30.03
GR1300116	43.01												22.01 43.01 43.04
GR1300240	1.01 1.02 13.03	1.01 1.02			1.01 1.02	Bulldock & Copper	1.01 1.02	Copper	Copper				
GR1300113													

II.3 Metapontino

Table 67: Agrochemicals in orchards with high runoff potential in Agri pilot sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
Agri3		21.1			21.1	Pyrethrum Nature, Cupravit							21.1
Agri4	26.1	26.1			26.1	Trebon Up, Cupravit							26.1
Agri5													
Agri8													
Agri9													
Agri10													

Table 68: Agrochemicals in orchards with moderate runoff potential Agri pilot sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code

Agri3		21.2			21.2	Pyrethrum Nature, Cupravit					
Agri4	24.2 30.1	24.2 27.1 30.1			24.2	Trebon Up					24.2 27.1 30.1
					24.2 27.1 30.1	Cupravit					
					30.1	Pyrethrum Nature					
Agri5	29.1 31.1	24.1 28.1 31.1			24.1, 28.1 31.1	Cupravit					24.1 28.1 31.1
					31.1	Pyrethrum Nature					
Agri8	2.8 5.1 5.2 6.1 7.1 7.2 7.3 9.1 9.2 9.3 9.4 14.2 14.7 15.1 15.2 16.1 16.2 16.3 18.1 18.3 18.4 18.5 18.7 20.1 21.2 20.3 20.4	2.8 5.1 5.2 6.1 7.1 7.2 7.3 9.1 9.2 9.3 9.4 14.2 14.7 15.1 15.2 16.1 16.2 16.3 18.1 18.3 18.4 18.5 18.7 20.1 21.2 20.3 20.4	9.1 9.2 14.2 16.1	Signum	2.8, 5.1, 5.2, 6.1, 7.2, 7.3, 15.2, 16.1, 16.2, 16.3, 18.1, 18.3, 18.4, 18.5, 18.7	Vertimec	-	2.8	Zelig	Chlorpyrifos-ethyl	2.8 5.1 5.2 6.1 7.1 7.2 7.3 9.1 9.2 9.3 9.4 14.2 14.7 15.1 15.2 16.1 16.2 16.3 18.1 18.3 18.4 18.5 18.7 20.1 21.2 20.3 20.4
					7.1, 7.2, 7.3, 9.1, 9.2, 9.3, 9.4, 14.2, 15.1, 15.2 16.1, 16.2 16.3, 18.1 14.7, 18.3 20.1, 18.4 18.5, 21.2 20.3, 20.4 18.7, 20.5 20.6, 20.7	Laser		9.1 9.2 14.2 16.1	Reldan	Napthalene	
					9.1, 2.8 9.2, 14.2 16.1, 16.2 16.3	Confidor		15.2 18.7	Reldan & Zelig	Napthalene & Chlorpyrifos-ethyl	
					20.1, 21.2 20.3, 20.4	Cobre Nordox					

	20.5 20.6 20.7 20.8 20.9	20.5 20.6 20.7 20.8 20.9 23.1 23.2			20.5, 20.6 20.7, 20.8 20.9						20.5 20.6 20.7 20.8 20.9 23.2
					2.8, 15.1 15.2, 16.2 16.3	Epik					
					7.1, 9.1, 9.2, 9.3, 9.4, 14.2, 16.1	Pomarso l					
					20.1, 21.2 20.3, 20.4 23.2, 20.5 20.6, 20.7 20.8, 20.9 23.1	Pyrethru m Nature					
					5.1, 5.2, 6.1, 7.2, 7.3, 15.2, 18.1, 14.7, 18.3, 18.4, 18.5, 18.7	Trebon Up					
					9.3, 9.4, 14.7, 18.3, 5.1, 5.2, 6.1, 7.1, 7.2, 7.3, 18.1, 18.4, 18.5	Calypso					
					5.1, 5.2, 6.1, 7.1, 7.2, 7.3, 9.1, 9.2, 14.2, 16.1 18.1, 18.4, 18.5, 23.1	Cupravit					
					9.1, 9.2, 14.2, 15.2, 16.1, 18.7	Reldan					
					5.1, 5.2, 6.1, 7.2, 7.3, 9.3, 9.4, 18.1, 14.7, 18.4,	Chorus					

					18.5						
					18.7, 15.2	Zelig					
					9.1, 9.2 14.2, 16.1	Signum					
					5.1, 5.2 6.1, 7.2 7.3, 18.1 18.4, 18.5	Poltiglia Dispress					
					9.1, 9.2 14.2, 16.1	Karate Zeon					
					18.4, 18.5	Protil EC					
					9.1, 9.2 14.2, 16.1	Mezene WG					
Agri9	2.9 8.2 10.1 10.2 14.1 14.3 14.4 14.5 25.1	2.9 8.2 10.1 10.2 14.1 14.3 14.4 14.5 25.1	8.2 14.3 14.4 14.5	Signum	14.1	Calypso		2.9	Zelig	Chlorpyrifos-ethyl	2.9 8.2 10.1 10.2 14.1 14.3 14.4 14.5 25.1
					14.1	Chorus		8.2 14.3 14.4 14.5	Reldan	Napthalene	
					8.2 14.3 14.4 14.5 2.9	Confidor		10.1 10.2	Reldan & Zelig	Napthalene & Chlorpyrifos-ethyl	
					25.1 8.2 14.3 14.4 14.5	Cupravit					
					2.9	Epik					
					8.2 14.3 14.4 14.5	Karate Zeon					
					8.2 14.3 14.4 14.5	Laser					
					8.2 14.3 14.4	Mezene WG					

					14.5						
					8.2 14.3 14.4 14.5	Pomarsol					
					10.2 10.1 8.2 14.3 14.4 14.5	Reldan					
					8.2 14.3 14.4 14.5	Signum					
					14.1 25.1 10.2 10.1	Trebon Up					
					2.9 10.1	Vertimec					
					10.2 10.1 2.9	Zelig					
Agri10	14.6 14.8 15.3 15.4 15.5	14.6 15.3 15.4 15.5	15.5	Signum	14.6 15.5	Confidor	-	14.6 15.5	Reldan	Napthalene	14.6 14.8 15.3 15.4 15.5
					14.6 15.5	Cupravit					
					15.3 15.4	Epik					
					15.5	Karate Zeon					
					14.6 15.5	Laser					
					14.6 15.5	Mezene WG					
					14.6 15.5	Pomarsol		15.3 15.4	Zelig & Reldan	Napthalene & Chlorpyrifos-ethyl	
					14.6 15.3 15.4 15.5	Reldan					
					15.5	Signum					

					15.3 15.4	Trebon Up							
					15.3 15.4	Vertimec							
					15.3 15.4	Zelig							

Table 69: Agrochemicals in orchards with high erosion potential in Agri pilot sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
Agri3													
Agri4	26.1	26.1			26.1	Trebon Up, Cupravit							26.1
Agri5													
Agri8													
Agri9													
Agri10													

Table 70: Agrochemicals in orchards with moderate erosion potential in Agri pilot sub-basin

Sub-basin	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
Agri3													
Agri4													
Agri5													
Agri8		23.1			23.1	Cupravit Pyrethron Nature							
Agri9	25.1	25.1			25.1	Trebon Up, Cupravit							25.1
Agri10													

Table 71: Agrochemicals in orchards with moderate leaching potential in Agri pilot sub-basin

Water body	Fertilized Orchards	Orchards with PPP	PPPs with H400		PPPs with H410		PPPs with Specific pollutants			PPPs with priority substances			Irrigated orchards
	Code	Code	Code	PPP	Code	PPP	Code	PPP	SP	Code	PPP	PS	Code
P-AGR	17.1 17.2 17.3 17.4 17.5 17.6 17.7 17.8 24.2 32.1	17.1 17.2 17.3 17.6 17.7 17.8 22.1 24.2 32.1	17.1 17.3 17.6 17.7	Signum	17.1 17.3 17.6 17.7	Confidor Laser Reldan Signum, Cupravit Pomarsol, Karate Zeon Mezene WG				17.1 17.3 17.6 17.7	Reldan	Naphthalene	17.1 17.2 17.3 17.4 17.5 17.6 17.7 17.8 22.1 24.2 32.1
					17.2	Laser Cupravit Pomarsol Mezene WG Calypso							
					17.8	Vertimec Cupravit Trebon Up Calypso Chorus Poltiglia Dispress							
					22.1	Pyrethrum nature Cupravit							
					24.2 32.1	Trebon Up Cupravit							
P-MET	1.1 1.2 1.3	1.1 1.2 1.3	1.3 1.4 1.5	Signum	6.3 9.3 9.4	Calypso Chorus				1.1 2.1 3.1	Zelig	Chlorpyrifos-ethyl	1.1 1.2 1.3

	1.4 1.5 1.6 1.7 1.8 1.9 2.1 2.2 2.3 2.4 2.5 2.6 3.1 3.2 6.3 9.3 9.4 12.1 12.2 13.1 13.2	1.4 1.5 1.6 1.7 1.8 2.1 2.2 2.3 2.4 2.5 2.6 3.1 3.2 6.3 9.3 9.4 12.1 12.2 13.1 13.2	1.7 1.8 2.2 2.3 2.6 3.2 12.1 12.2 13.1		1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 2.1 2.2 2.3 2.4 2.5 2.6 3.1 3.2 12.1 12.2 13.1	Confidor					1.4 1.5 1.6 1.7 1.8 2.1 2.2 2.3 2.4 2.5 2.6 3.1 3.2 6.3 9.3 9.4 12.1 12.2 13.1 13.2
					1.6 2.4 2.5	Delan					
					1.1 1.2 2.1 3.1 13.2	Epik		1.3 1.4 1.5 1.6 1.7 1.8 2.2 2.3 2.4 2.5 2.6 3.2 12.1 12.2 13.1	Reldan	Naphthal ene	
					1.3 1.4 1.5 1.6 1.7 1.8 2.2 2.3 2.4 2.5 2.6 3.2 12.1 12.2 13.1	Karate Zeon, Laser, Mezene WG, Signum, Cupravit					
			1.6 2.4	Delan & Signum	1.3 1.4	Pomarso l					

			2.5		1.5 1.6 1.7 1.8 2.2 2.3 2.4 2.5 2.6 3.2 9.3 9.4 12.1 12.2 13.1						
					1.3 1.4 1.5 1.6 1.7 1.8 2.2 2.3 2.4 2.5 2.6 3.2 12.1 12.2 13.1 13.2	Reldan		13.2	Reldan & Zelig	Naphthalene & Chlorpyrifos-ethyl	
					6.3 3.1 13.2	Trebon Up					
					1.1 1.2 2.1 3.1 13.2	Vertimec					
					1.1 2.1 3.1 13.2	Zelig					