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

Deliverable A1.2: Report on project's targeted areas and pilot sub-basins characteristics

Action A1: Identification of targeted project's areas and selection of pilot sub-basins – Gaining local support in the targeted project's areas

Sub Action A1.1: Identification of targeted project's areas and selection of pilot sub-basins – Collection of generic data

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Terminology / Abbreviations

Term	Description
2D	Two-dimensional
AATO	Authority of Optimum Territorial Ambit
AFI	Assofruit Italia Società Cooperativa Agricola
AWMS	Agricultural Water Management Strategy
AWU	Annual work unit
BC	Before christ
C	Celsius
CBBM	Consorzio di Bonifica di Bradano e Metaponto
CCDA	Common Database on Designated Areas
d	Day
DEYA	Municipal Water & Sewage Company
DEYAAN	Municipal Enterprise of Agios Nikolaos
DEYABA	Inter municipal Water & Sewage Company of the Northern Coast of the Prefecture of Chania (Diamimotiki Epihirisi Ydrefsis Apohetefsis Voriou Axona)
E	East
Elev	Elevation
ELSTAT	Hellenic Statistical Authority
EU	European Union
Fig.	Figure
GDP	Gross Domestic Product
GPV	Gross Production Value
GR	Greece
GVA	Gross Value Added
ha	Hectare
HCV areas	High Conservation Value areas
hr	Hour
i.e.	id est
IBA	Important Bird Areas
IRBA	Interregional River Basin Authority of Basilicata
IT	Italy
KEDHP	Platanias Municipality Development Enterprise
Km	Kilometer
L.D.	Legislative Decree
Lat	Latitude
Long	Lognitude
m	Meter
M	Mirabello
m^3	Cubic meters
MA	Metapontino
Max	Maximum
Min	Minimum
mm	Millimeter
Mm^3	Million qubic meters
N	North
No / N.	Number
NW	Northwest
O.A.K.	Organization for the Development of Crete
OJ	Official Journal
P	Platanias
RH	Rain Humidity

S.A.	Société anonyme
S.p.A.	Società per azioni
SCI	Sites of Community Importance
SE	Southeast
SPA	Special Protection Areas
sq.km	Square Kilometer
T	Temperature
UAA	Utilized Agricultural Area
y/ yr	Year

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PART A – DESCRIPTION OF THE TARGETED AREAS AND THE PILOT RIVER SUB-BASINS IN CRETE REGION, GREECE

1. DESCRIPTION OF THE TARGETED AREAS IN CRETE REGION, GREECE

1.1 GENERAL DESCRIPTION

1.1.1 Crete Region, Greece

Crete is the southernmost region of Greece and Europe. It is the largest Greek island and the 5th largest in the Mediterranean basin. Crete's location is between the Aegean Sea and the Libyan Sea, and consequently is considered to be a physical boundary between Europe and Africa. Furthermore, it is located at the southern edge of the Aegean Sea, about 100 km south of Peloponnese (mainland Greece) and is surrounded by a number of small islands (Gavdos, Gavdopoula, Chrysi, Koufonisi, Dia, Dyonisases, etc.), all uninhabited with the exception of Gavdos island (River Basin Management Plan of GR13, 2015).

Crete's history is profound. The island's fertile soil and towering peaks witnessed the development of the Minoan civilization (2800-1150 BC), one of the most important in the history of mankind. Cretan History starts at 6000 BC, when the island was first inhabited. The best known period is the Bronze Age (2600-1100 BC), during which Cretans colonized Cyclades Islands and the famous palaces of Knossos, Festos and Zakros were built in Crete. When Egyptians had not yet attempted travel by sea, Minoan ships used to sail and trade all around Mediterranean Sea. The cultural influence of the various nations Cretans came in contact with, gave birth to this civilization that it is still admired and considered to be the first high-level civilization in Europe, (Detorakis, 1994). www.ics.forth.gr/gd2008/about_crete.html

Administratively, the island of Crete and the surrounding smaller islands form one of the 13 administrative divisions of Greece, the Region of Crete. Region of Crete is further divided in four regional units (from west to east) Chania, Rethymno, Heraklion, and Lasithi, which are further subdivided into 24 municipalities (Table 1). Capital and seat of Crete region is Heraklion city.

Table 1: Administrative divisions of Crete

Regional Unit	Municipality	
Heraklion	Archanes-Asterousia	Malevizi
	Viannos	Minoas Pediados
	Gortyna	Phaistos
	Heraklion	Hersonissos
Chania	Apokoronas	Platanias
	Gavdos	Sfakia
	Kardanos-Selino	Chania
	Kissamos	
Rethymno	Agios Vassilios	Mylopotamos
	Amari	Rethymno
	Anogeia	
Lasithi	Agios Nikolaos	Lasithi Plateau
	Ierapetra	Siteia

The total area of Crete is 8.336 sq.km, (6,3% of the total area of the Greek territory). It has a remarkable coastline of more than 1000 km. The length of the island from one edge (west) to the other (east) is 256 km. Its largest width of 57 km is located in the Regional Unit of Heraklion, while its smallest width of 12 km is in the Regional Unit of Lasithi. Morphologically, Crete is characterized by three elevation zones, the

mountainous zone, with an altitude of 400 m and above, the semi mountainous zone with an altitude of 200-400 m and the plain zone area with altitudes of up to 200 m above the sea level. The first two elevation zones cover about 3/5 of the island. The percentage of mountainous area is 49%. The important mountain ranges of Crete are the Lefka Ori (2.452 m), Psiloritis (2.456 m) and Dikti (2.148 m), (Region of Crete, 2011- 2013 http://www.crete.gov.gr).

The period between 1981 and 2011, Crete's population has demonstrated significant growth compared to the country's population change (Table 2). The population of Crete has increased by 24,08% during the period 1981-2011, a fact that underlines its ability to maintain and renew its inhabitants. According to data published by the Region of Crete, the area has 623.065 inhabitants today (308.665 men and 314.400 women), with the population density equal to 74,74 per sq.km. Crete represents 5,69% of the total population of Greece and is ranked fifth among the Greek Regions (Region of Crete, 2011-2013).

Table 2**: Crete's Population change during the past 30 years** (Source: ELSTAT)

Administrative Division	Population				% Population Change			
	1981	1991	2001	2011	1981-1991	1991-2001	2001-2011	1981-2011
Reg. Unit Heraklion	243.622	264.906	292.489	305.490	8,74	9,94	4,44	25,40
Reg. Unit Lasithi	70.053	71.279	76.319	75.381	1,75	6,25	-1,23	7,61
Reg. Unit Rethymno	62.634	70.095	81.936	85.609	11,91	12,64	4,48	36,68
Reg. Unit Chania	125.856	133.774	150.387	156.585	6,29	10,97	4,12	24,42
Region of Crete	502.165	540.054	601.131	623.065	7,55	11,31	3,65	24,08
Greece total	9.740.417	10.259.900	10.964.020	10.940.777	5,33	6,86	-0,21	12,32

Fig. 1: Geografical framework (Crete is highlighted)

According to data included in the Regional Accounts published by Hellenic Statistical Authority (ELSTAT), the GDP of Crete is maintained over time at about 5% of the country's GDP and in 2013 reached 8.831 million euros. The Regional Unit of Heraklion contributes vigorously (48-50%) to the regional GDP, followed by the Regional Unit of Chania (25-26%), while the Regional Units of Lasithi (12,89%) and Rethymnon (11,99%) have lower contribution (ELSTAT, 2013).

In 2012, the per capita GDP of Crete, was about 14.398 €, significantly lower than the country's average per capita GDP, 17.311 € (ELSTAT, 2012). The evolution of the per capita GDP in Crete, as well as in the respective Regional Units is presented in Fig. 2.

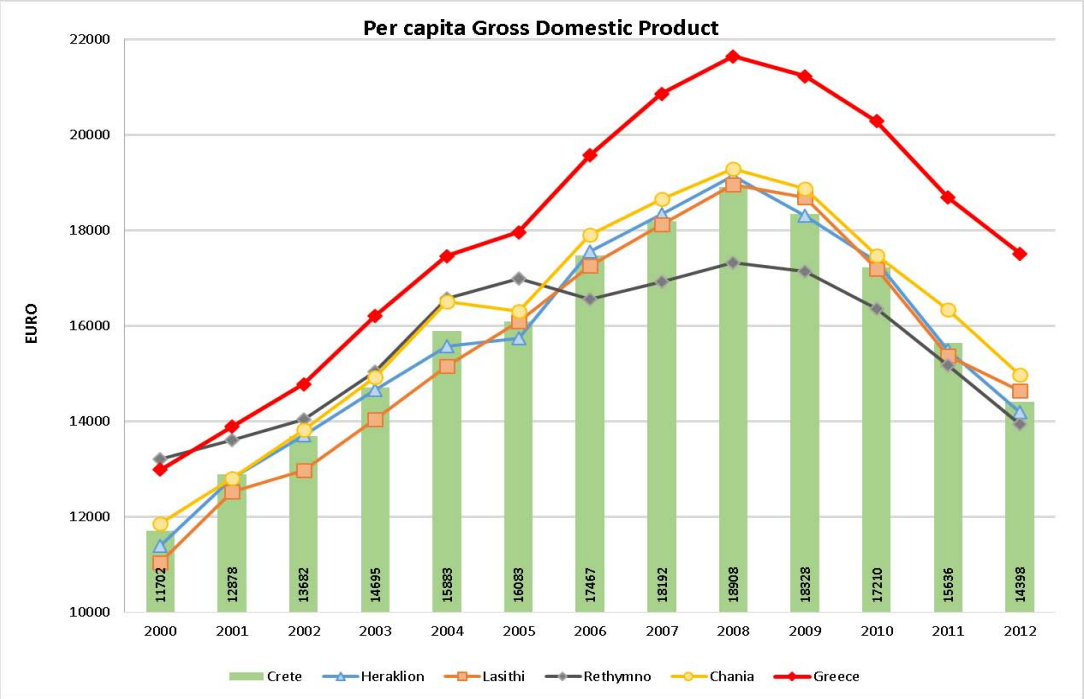


Fig. 2: Per capita Gross Domestic Product of Crete (Source: ELSTAT, 2012)

1.1.2 Platanias Municipality

Platanias is located at the northern part of the Regional Unit of Chania, between Kissamos Bay on the east and Chania Bay on the west. Platanias falls within the administrative boundaries of Regional Unit of Chania. The Municipality of Platanias (Fig. 3) was formed during the 2011 local government reform by the merger of four former municipalities (Kolymvari, Mousoures, Platanias, Voukolies), now known as municipal units (Law no 3852/2011). The seat of the Municipality is the village Gerani. Municipality of Platanias has administrative borders with the following municipalities:

- Kissamos (west)
- Kantanos − Selino (south) on the south
- Chania (east), and
- Sfakia (southeast)

On its northeast edge Rodopos Penninsula is found.

Municipality of Platanias covers an area of 491,78 sq.km, rendering it as one of the largest municipalities of Greece, with 51 local communities and 125 active settlements (Table 3).

Fig. 3: Geographic framework (Municipality of Platanias is highlighted)

Table 3: Administrative divisions of Platanias Municipality

Municipality	Municipal Unit	Local Communities	
Platanias	Voukolies	Anoskeli	Palaia Roumata Chania
		Voukolies Chania	Polemarchi
		Kakopetrou Chania	Tavronitis Chania
		Neo Chorio Kidonias Chania	Chrysavgi Chania
		Neriana	
	Kolymvari	Afrata	Kamisiana
		Vasilopoulo Chania	Karres Kissamos Chania
		Vouves Chania	Kolymvari Chania
		Glossa Chania	Nochia Chania
		Deliana Chania	Panethimos Chania
		Drakonas Kolymvari Chania	Ravdoucha Chania
		Episkopi Chania	Rodopos Chania
		Zimpragos Chania	Spilia Chania
		Kalidonia Chania	
	Mousoures	Alikianos	Orthouni Chania
		Vatolakkos Chania	Prases Chania
		Karanos Chania	Sempronas
		Koufos Chania	Skines Chania
		Lakkoi Chania	Fournes
		Meskla Chania	Psathogiannos Chania
	Platanias	Vlacheronitissa	Manoliopoulo Chania
		Vrisses Kydonias Chania	Modi Chania
		Gerani Chania	Deres Chania
		Zounaki Chania	Ksamoudochori
		Kontomari Chania	Platanias
		Kyparissi Chania	Sirili Chania
		Maleme	

According to the last population census conducted by ELSTAT in 2011, the population of Platanias is 16.874 inhabitants, 8.548 of which are male and 8.326 female. Out of the 16.874 inhabitants only 6.504 people are considered to be economically active (4.121 male and 2.383 female). The unemployed population of Platanias Municipality in 2011, as compared to the regional unit, the region and the country levels is shown on Table 4.

Table 4: Unemployment in Platanias Municipality (ELSTAT, 2011)

Place	Unemployed	**"Newly"** Unemployed	Total
Municipality of Platanias	564	408	972
Regional Unit of Chania	7.272	3.290	10.562
Region of Crete	30.521	13.634	44.155
Greece	593.235	265.768	859.003

Regarding the history of the area, Platanias has its roots in the Late Minoan period according to the findings of archaeological excavations. In particular, archaeological

findings in Modi and Vryssai have revealed life and development in the region from the 13th to the 4th century BC.

1.1.3 Agios Nikolaos Municipality (Mirabello area)

The area in Crete known as Mirabello, covers the administrative area of Agios Nikolaos Municipality, as reformed with the Law no 3852/2011. Nowadays, Agios Nikolaos Municipality (Fig. 4) is the merger of the former municipalities of Neapoli, Agios Nikolaos and the local community of Vrachassi. Its capital is the city of Agios Nikolaos, however its historic seat is Neapoli. Geographically, the Municipality is located in the northwestern part of the regional unit of Lasithi. Its borders are as follows:

- Gulf of Mirabello to the east
- Municipality of Ierapetra to the south
- Lasithi Plateau, Minoa Pediados and Hersonisos to the west
- Gulf of Malia to the north

The Municipality of Agios Nikolaos covers an area of 511,99 sq.km and it consists of three Municipal Units, four Municipal Communities, twenty one Local Communities, one hundred and seventeen settlements and five islets (Table 5).

Fig. 4: Geographical framework (Municipality of Agios Nikolaos is highlighted)

Table 5: Administrative Division of Agios Nikolaos

Municipality	Municipal Unit	Municipal Communities	
Agios Nikolaos	Agios Nikolaos	Agios Nikolaos Lasithi	Kritsa Lasithi
		Elounda Lasithi	
		Local Communities	
		Vroucha Lasithi	Limnes Lasithi
		Ekso Lakkonia Lasithi	Loumas Lasithi
		Ekso Potamoi Lasithi	Mesa Lakkonia Lasithi
		Zenia Lasithi	Prina
		Kalo Chorio Lasithi	Skinias Lasithi
		Kroustas	
	Vrachasi	Vrachasi Lasithi	
	Neapoli Lasithi	Municipal Communities	
		Neapoli Lasithi	
		Local Communities	
		Kastelli Fournis	Latsida Lasithi

		Agios Antonios Lasithi	Nikithianos Lasithi
		Voulismeni Lasithi	Fourni Lasithi
		Vrises Lasithi	Choumeriakos Lasithi
		Karidi Mirabello Lasithi	

The total population of Agios Nikolaos is 27.074 inhabitants, 13.372 of which are male and 13.702 female (ELSTAT, 2011). In addition, this census provided information about the unemployment of the Municipality of Agios Nikolaos (Table 6). It is worth mentioning that only 12.074 inhabitants are considered to be economically active out of the total of the Municipality's population.

Table 6: Unemployment in Agios Nikolaos Municipality (ELSTAT, 2011)

Place	Unemployed	**"Newly"** Unemployed	Total
Municipality of Agios Nikolaos	1.146	515	1.661
Regional Unit of Lasithi	2.950	1.462	5.412
Region of Crete	30.521	13.634	44.155
Greece	593.235	265.768	859.003

As far as the history of the area is concerned, Agios Nikolaos was settled in the Late Bronze Age by Dorian occupants, who wanted to gain access to the harbor of Agios Nikolaos, which was very important at the time. Archaeological findings, however, near the city of Agios Nikolaos have shown that the first settlement there was built in the Final Neolithic Period 3.000 BC.

1.2 METEREOLOGICAL DATA

1.2.1 Weather Stations in Platanias Municipality

Within the administrative boundaries of Platanias Municipality, there are three meteorological stations, namely Platanias, Alikianos and Sebronas (Fig. 5). Four more meterological stations are located in the greater area, i.e. Elos Chanion, Samaria Drimos, Chania Kentro and Politechneio Chanion.

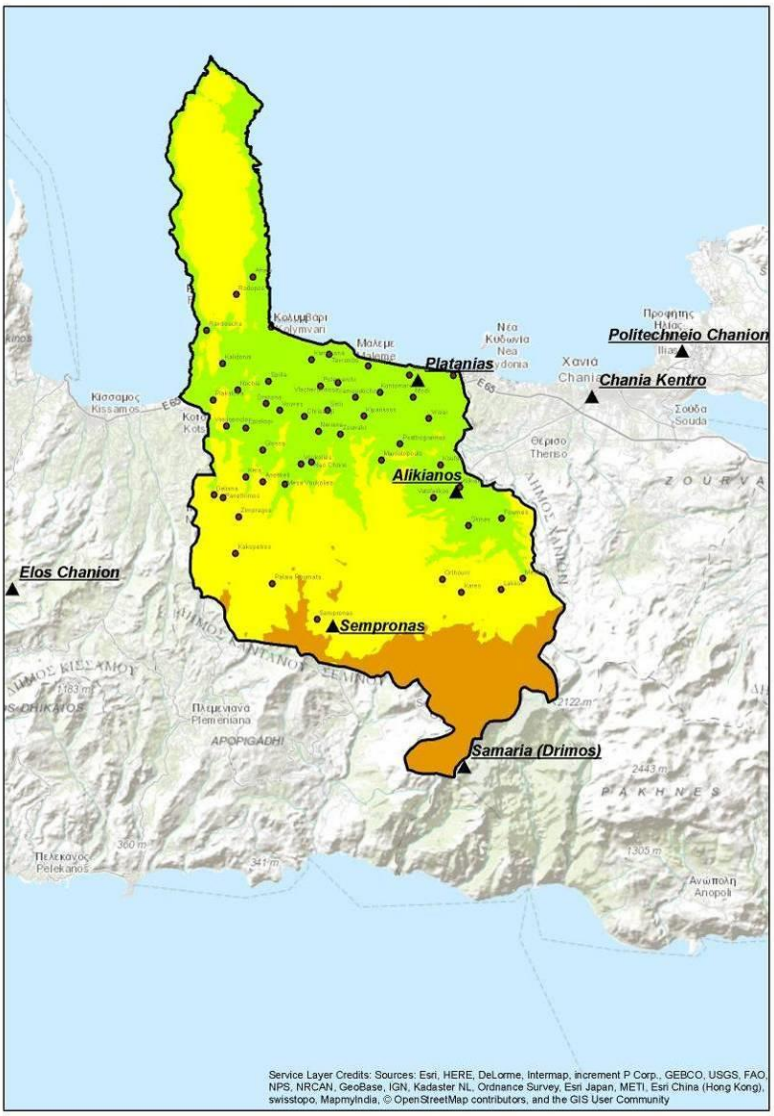


Fig. 5: Geodatabase Map Extract of the area of interest, depicting the boundaries of Platanias Municipality and the meteorological stations located in its greater area

The exact locations, the starting dates and the parameters monitored are presented on Table 7.

Table 7: Municipality of Platanias weather stations

Station Name	Location			Parameters Monitored	Data from
	Lat	Logn	Elev		
Alikianos	35°27'10"N	23°54'59"E	70m	Mean Temperature, Rain, Wind	2012-08-07
Elos Chanion	5°24'00"N	23°36'00"E	535m	Mean Temperature, Rain, Wind	2014-12-01
Platanias	35°31'01"N	23°53'03"E	12m	Mean Temperature, Rain, Wind	2015-06-25
Leandros Symeonidis (Politechneio)	35°32'00"N	24°04'09"E	137m	Mean Temperature, Rain, Wind	2006-01-07
Samaria	35°18'00"N	23°55'00"E	1250m	Mean Temperature, Rain, Wind	2008-07-04
Sebronas	35º22'45''N	23º49'28''E	640m	Mean Temperature, Rain, Wind	2015-05-30

Chania Kentro	35º30'28''N	24º00'22''E	7m	Mean Temperature, Rain, Wind	2010-09-13

As shown on Table 8, two of the meteorological stations of the area, Platanias and Sebronas, have only recently started monitoring data. Thus, historic data from these stations are not available. Available historic data for temperature from the weather stations in Platanias Municipality are summarized on Table 9.

Table 8: Municipality of Platanias weather stations data

Station Name	T_{mean}	T_{min}	T_{max}	Average Wind speed (km/hr)
Alikianos	18,2	10,7	26,1	7,11
Elos Chanion	16,4	8,1	23,7	3,03
Platanias	-	-	-	-
Leandros Symeonidis (Politechneio)	18,9	9,3	28,0	7,79
Samaria	11,6	0,6	21,8	8,38
Sebronas	-	-	-	-
Chania Kentro	18,6	10,2	26,7	5,69

Table 9: Municipality of Platanias – available historic data for temperature

Station Name	Mean		Max		Min	
	Annual	Month	Annual	Month	Annual	Month
Alikianos	566,3	47,2	859,4	187	406,4	0,0
Elos Chanion	-	101,9	-	377,2	-	0,0
Platanias	-	-	-	-	-	-
Leandros Symeonidis (Politechneio)	626,7	52,2	924,8	216,6	455,9	0,0
Samaria	1631,4	135,9	2450,4	728,2	1096,2	0,0
Sebronas	-	-	-	-	-	-
Chania Kentro	605,3	50,4	730,0	208,0	483,2	0,0

Based on the data available, the Blanney – Criddle method has been utilized for the estimation of Evapotranspiration. Monthly evapotranspiration coefficients are summarized on Table 10.

Table 10: Municipality of Platanias - Monthly Evapotranspiration

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alikianos Chanion	94,96	94,35	120,55	138,37	171,23	183,41	196,28	186,02	158,24	134,11	108,25	92,83
Leandros Symeonidis (Politechneio)	94,15	93,64	119,45	138,33	171,07	188,39	204,00	193,19	162,31	138,83	111,17	94,28
Samaria	68,30	68,73	91,93	110,81	143,00	157,79	172,92	163,70	135,33	108,90	85,76	71,06
Chania Kentro	95,72	94,41	120,56	138,78	169,54	185,17	198,86	188,07	160,20	136,40	109,17	96,33

For the purposes of Agroclimawater project historic data from Alikianos Chanion and Chania Kentro will be utilized, owed to the proximity to the project's areas. Meteorological data from Platanias station can also be utilized during the project, though historic data from this station are not available, since it has only started functioning recently.

1.2.2 Weather Stations in Ag.Nikolaos Municipality

There are three weather stations within the administrative boundaries of Agios Nikolaos Municipality, namely Agios Nikolaos, Tzermiadon and Finokalia (Fig. 6).

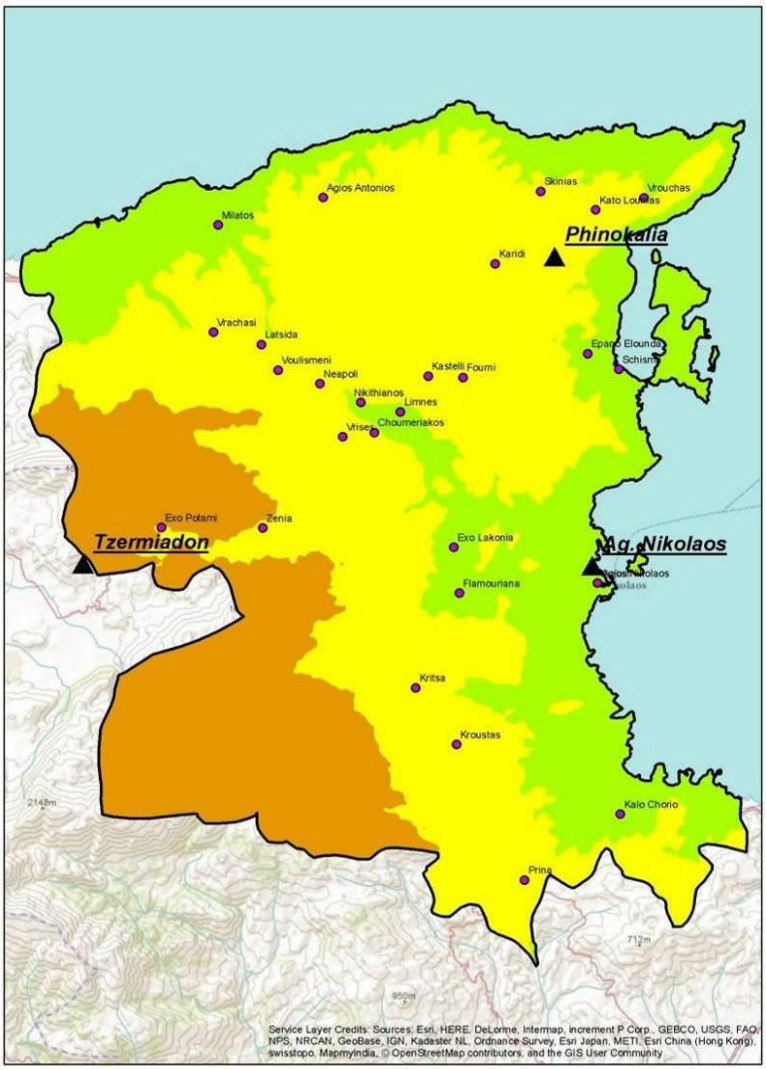


Fig. 6: Geodatabase Map Extract of the area of interest, depicting the boundaries of Agios Nikolaos Municipality and the meteorological stations located in its greater area

The exact locations, the starting dates and the parameters monitored per weather station are presented on Table 11.

Table 11: Municipality of Agios Nikolaos weather stations

Station Name	Location			Parameters Monitored	Data from
	Lat	Long	Elev		
Agios Nikolaos	35°11'58"N	25°42'53"E	30 m	Mean Temperature, Rain, Wind, RH	2009-10-21
Tzermiadon	35°12'00"N	35°30'00"E	820 m	Mean Temperature, Rain, Wind, RH	2006-11-30
Finokalia	35°18'00"N	25°42'00"E	250 m	Mean Temperature, Rain, Wind, RH	2014-09-12

Finokalia weather station has only recently started monitoring data. Thus, historic data from this station are not available. Available historic data for temperature from the weather stations in Agios Nikolaos Municipality are summarized on Table 13.

Table 12: Municipality of Agios Nikolaos weather stations data

Station Name	T_{mean}	T_{min}	T_{max}	Average wind speed (km/hr)
Agios Nikolaos	20,0	11,1	28,9	12,43
Tzermiadon	13,2	4,2	21,0	2,75
Finokalia	18,0	11,0	25,3	25,6

Table 13: Municipality of Agios Nikolaos – available historic data for temperature

Station Name	Mean		Max		Min	
	Annual	Month	Annual	Month	Annual	Month
Agios Nikolaos	454,2	37,8	635,0	280,2	358,0	0,0
Tzermiadon	1039,4	86,6	1.448,2	505,1	612,9	0,0
Finokalia	-	30,4	-	112,8	-	0,2

Based on the data available, the Blanney − Criddle method has been utilized for the estimation of Evapotranspiration. Monthly evapotranspiration coefficients are summarized on Table 14.

Table 14: Municipality of Agios Nikolaos - Monthly Evapotranspiration

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agios Nikolaos	101,30	99,03	124,47	141,72	173,73	190,74	206,91	197,05	164,04	140,67	114,21	101,26
Tzermiadon	77,68	78,67	100,39	118,02	148,10	160,83	171,60	161,77	136,35	116,78	93,46	78,65
Finokalia	94,00	90,71	116,72	133,57	168,56	177,22	193,52	185,33	161,03	135,26	109,65	99,28

For the purposes of Agroclimawater project historic data from Agios Nikolaos and Tzermiadon Meteo Stations will be utilized, owed to the proximity to the project's areas. Meteorological data from Finokalia weather station can also be utilized during the project, though historic data from this station are not available, since it has only started functioning recently.

1.3 GEOLOGICAL – HYDROLOGICAL CHARACTERISTICS

1.3.1 Platanias Municipality

The Platanias Municipality is located in West Crete and administratively is a part of the Regional Unit of Chania. Platanias covers an area of 495 sq.km extending from the northern coastal zone to the plateau of Omalos and its distance from Chania center is about 11km.

Its topography varies and its highest altitude is 1400m, while its minimum is 0m, which is the marine coastline. In the northern part of Platanias, the land is mainly lowland and its topography is mild and hilly, with the exception of cape Spatha. The latter is characterized by steep slopes due to the soil's composition of calcareous rocks. Platanias' central part is semi-mountainous (200 − 800m), whereas its southern part is mountainous, as it includes part of Lefka Ori.

Within the boundaries of Platanias Municipality five river sub-basins have been identified. In the northern and western part there is the complex torrent of Kissamos Gulf, while in the central part, from west to east, the following catchment areas are found:

- Skoutelonas Torrent,
- Tavronitis Torrent and
- Keritis (Platania) Torrent

Finally, in the south of Platanias the catchment area of Sougias Torrent is situated.

The hydrographic network of the area starts from Lefka Ori and flows into the Cretan sea. In the region, there are normal faults with NW-SE and W-E direction, which clearly define the boundaries between the geological formations. The most significant, in terms of size and hydrogeological importance, geological formations that are found in the area of Platanias are as follows.

In the northern part of Platanias, Cape Spatha is located, which is also the northern edge of Crete (Fig. 7). On this peninsula, the Karstic aquifer system of Spatha Chania Cape (GR1300322) is developed and its carbonate formations (ks) have moderate to high permeability (K1). This carbonate aquifer faces sea water intrusion at its northern part and shows salinization, while its southern part, which extends in the mainland, is considered to have good water quality due to the underlying phyllites unit that occurs in altitudes above sea level and forms the watertight background of limestones.

The central part of Platanias is covered by phyllitic quartzites (Ts.ph). These formations, which cover an area of about 93 (GR1300190), are practically impermeable or of selective circulation of water with very low to low permeability (A2), (Fig. 7). The carbonate formations (Tk-d) that occur in the northern parts of the basin cover approximately 14 sq.km (GR1300031 & GR1300034). They are of moderate to high permeability (K1).

Part of western Platanias is covered by Neogene breccia − conglomerate (Mic) formations, with an area of 97 sq.km that form the karstic Topolia System (GR1300011). These formations have very low to low permeability (K3).

North of the Topolia Karst, Neogene deposits (Mi.mk) of low to moderate permeability (P2) are found and cover an area of 38 sq.km, known as Kissamos System Porous (GR1300021).

The limestones of Tripoli zone (Ks) cover the south-western part of the Municipality and form the Kantanos Karstic System (GR1300173). This system is not exploited for water abstraction because of its altitude (>500 m).

In the central part of Platanias, the Porous water System of Kampos Chania is developed in Neogene formations (pl) with an area of approximately 280 sq.km. This system is divided into two aquifers: the Neogene system in the west and the Quaternary system in the east. In particular, these formations are granulated non alluvial deposits of very low to low permeability (P3). Furthermore, an area of 21 sq.km is covered by deposits (dlc4) of low to moderate permeability (P2). In this category conglomerate and marly limestones of the Neogene formations are included. They host moderate to low water capacity aquifers. Moreover, a land area of 18 sq.km corresponds to sandstones, Quaternary terrace deposits and new alluvial formations (qf2), which occupy the boundaries of the wider riverbed of Tavronitis up to the settlement of Voukolies and the Nterianos tributary. These formations are characterized by fluctuating permeability (P1).

In the Neogene deposits, layers and interpolations of gypsum (Γ) with a considerable thickness are found. However, due to these intercalations, the aquifers formed inside of

these formations (GR1300330) are of low quality because of their high content of sulphites.

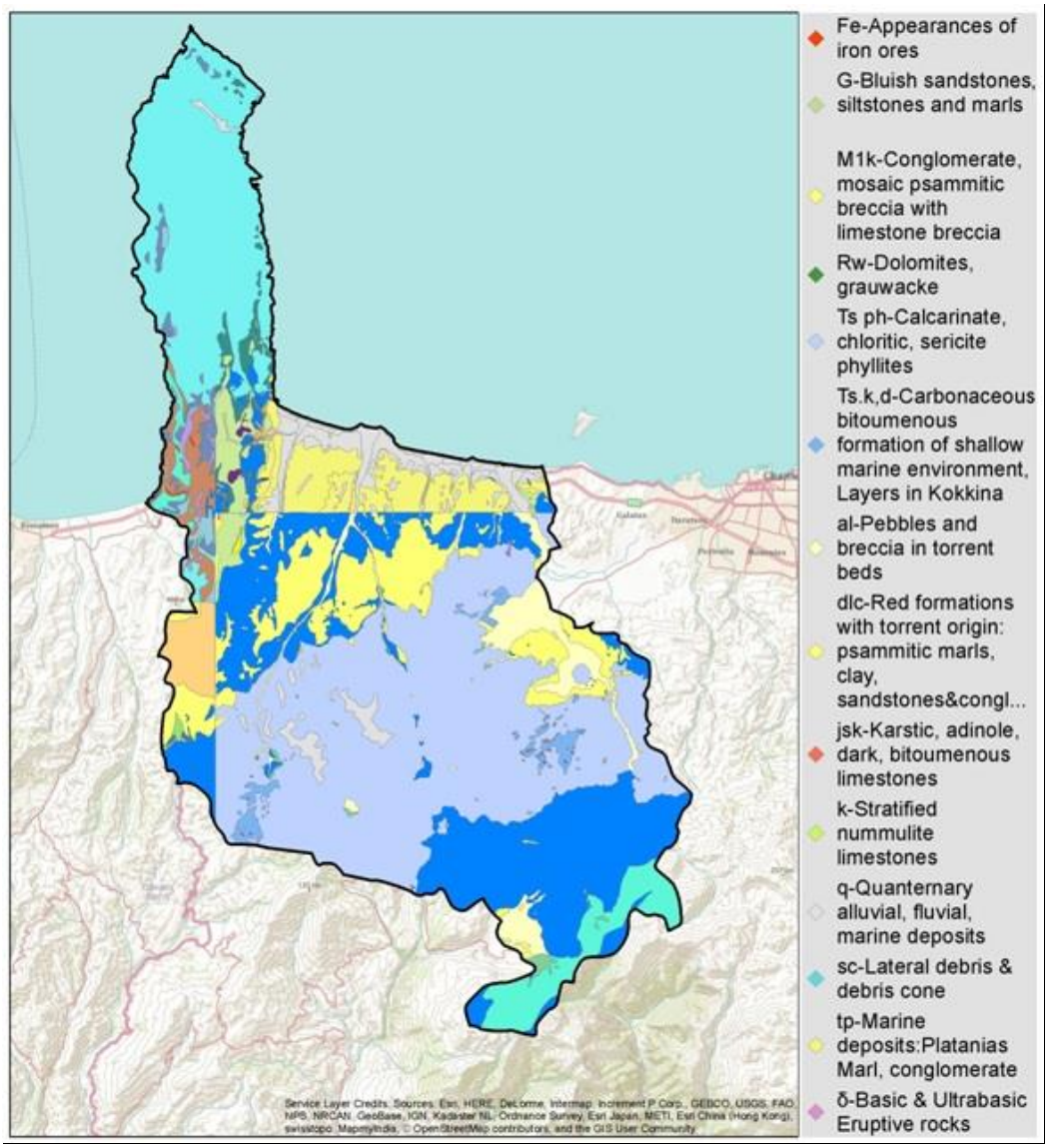


Fig. 7: Geodatabase Map Extract of the area of interest, depicting geology of Platanias

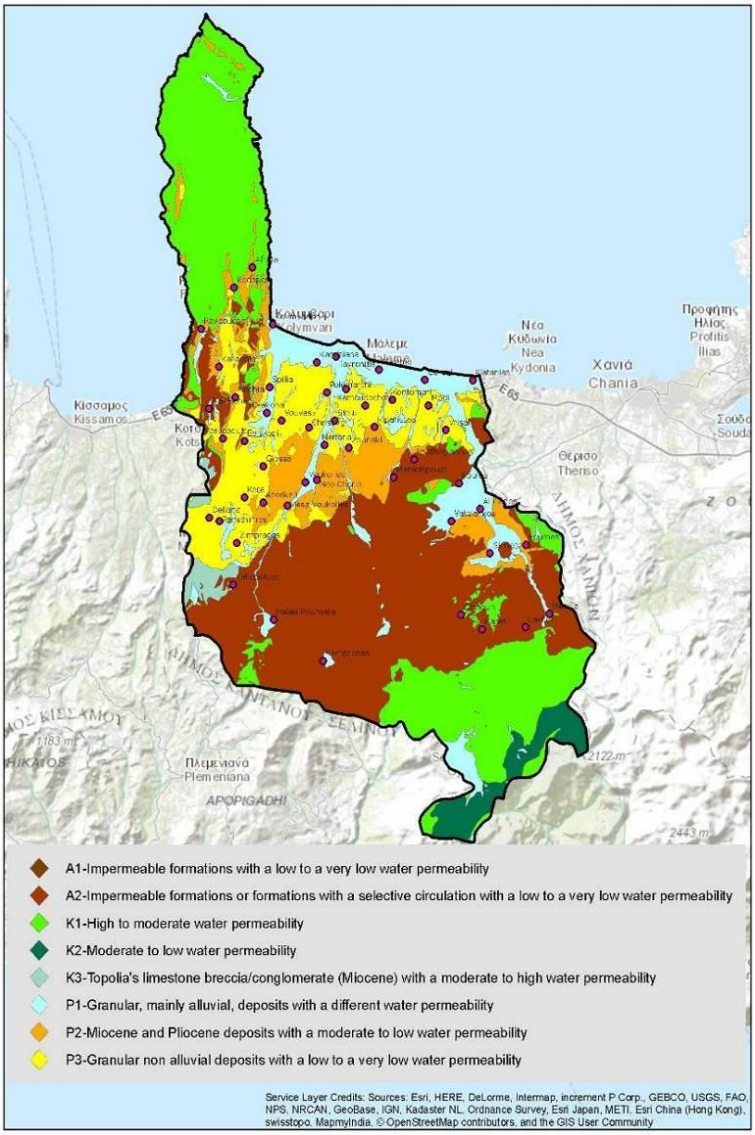


Fig. 8: Geodatabase Map Extract of the area of interest, depicting hydrogeology of Platanias

1.3.2 Agios Nikolaos Municipality

Agios Nikolaos covers the northwestern part of the regional unit of Lasithi and its largest area is considered to be mountainous. Dikti Massif (or Lassithiotika Mountains) is located in between the borders of the regional units of Lasithi and Heraklion and it covers part of Agios Nikolaos. The only flat areas are found in the areas of Neapoli-Limnes and Agios Nikolaos-Vathi. There are no noticeable rivers in Mirabello, but a few torrents, the most significant of which Almyros Lasithi.

The topography of Agios Nikolaos varies between the maximum altitude of 1.620m in its western part (Dikti Massif) and the minimum altitude of 0m (coastline) in its northern, northeastern and eastern part. In Fig. 9 the area of Agios Nikolaos is categorized by altitude into lowland (0−200m), semi-mountainous (201−800m) and mountainous (>801m). Its south-western part is part of Dikti Massif. In addition, in this region, the hydrographic network is less dense than the rest of the province and as a consequence it appears to have minimal vegetation. The intermediate area is semi-

mountainous and hilly with much denser hydrographic network and richer vegetation, while the south-eastern area is considered to be lowland with lush vegetation.

The geological conditions of the greater area of Mirabello are characterized by different age phases and formations, contributing to the configuration of its structure.

The north-northeastern part of Mirabello has an area of about 171 sq.km and consists of an autochthonous to parautochthonous rock system, which includes the semimetamorphic series (GR1300115 & GR1300116) and the underlying limestones, dolomites (Jm-Es.K1 & Jm-Es.K1) of the Ionian zone, with the interpolation of schists. These formations have moderate to low permeability (K2). Locally, during summer season, there are records of overexploitation of the underground water reserves and increased chloride values due to natural salinization in the coastal zone.

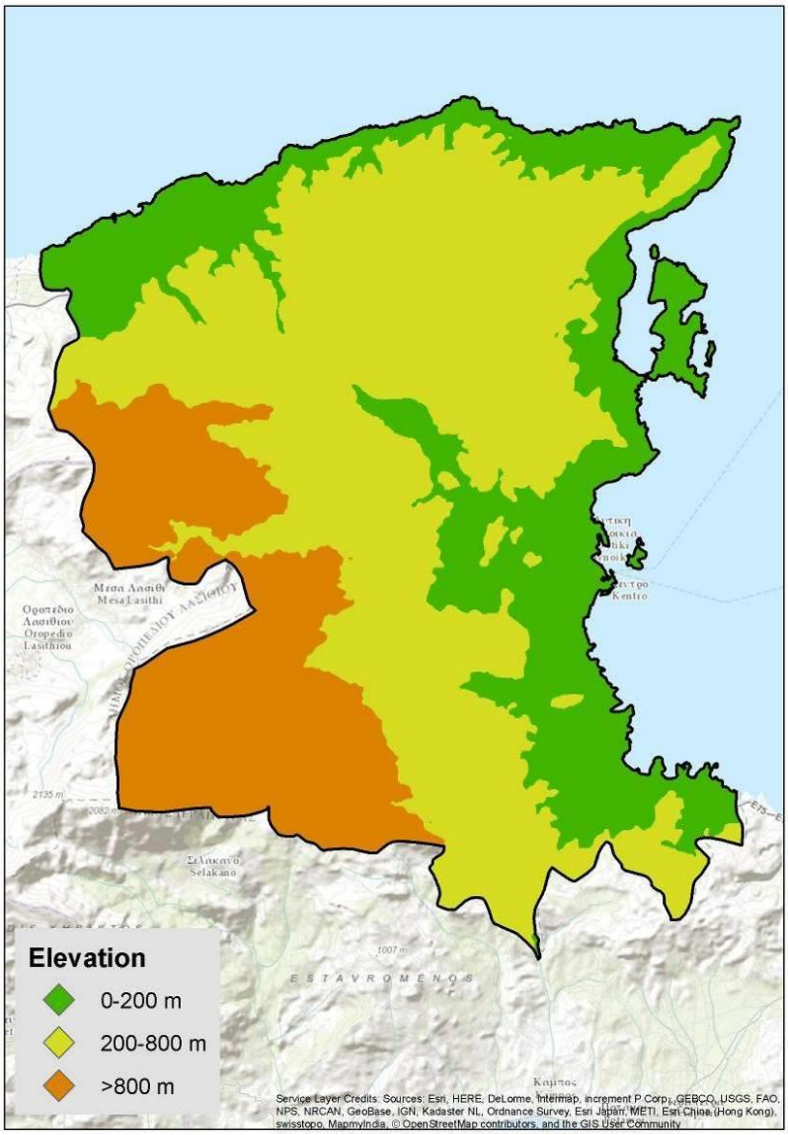


Fig. 9: Geodatabase Map Extract of the area of interest, depicting the boundaries of Agios Nikolaos Municipality and its elevation data (lowland – semi-mountainous – mountainous)

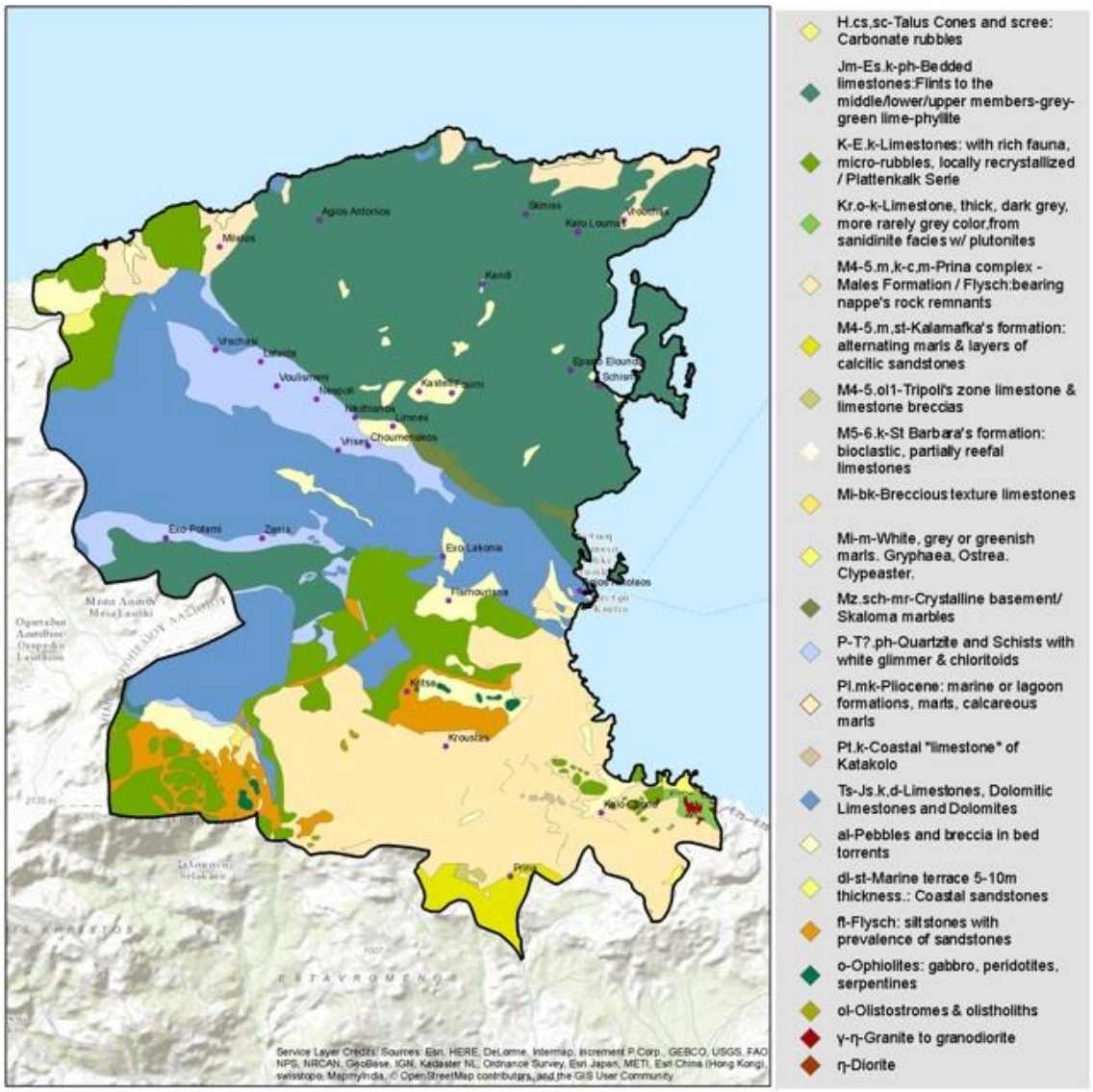
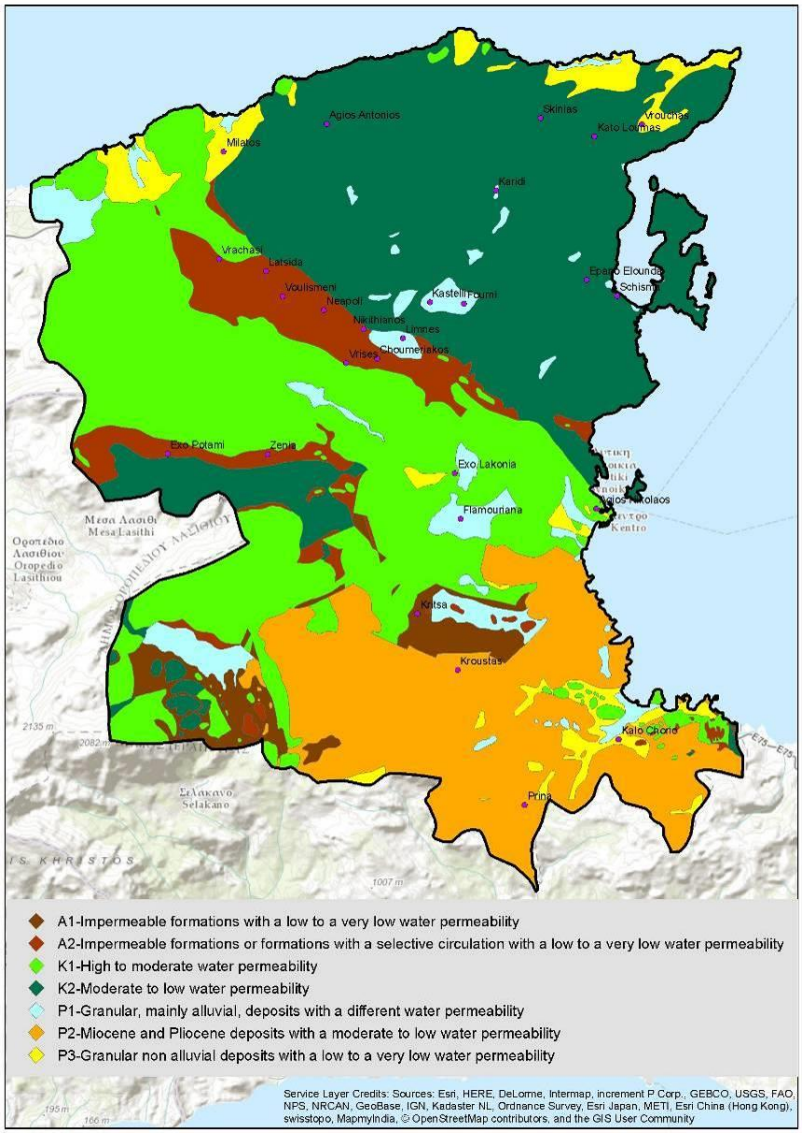


Fig. 10: Geodatabase Map Extract of the area of interest, depicting geology of Mirabello

Its western part consists of an allochthonous carbonate system (tectonic cover of Tripoli) with an area of approximately 223 sq.km, which is characterized by high to moderate permeability (K1). This carbonate system (GR1300112 & GR1300113 & GR1300114) is composed of limestones, dolomitic limestones and dolomites (Ts-Js.k,d & K-E.K). During summer season, there are some areas where underground water reserves are overexploited.

In the central part of Mirabello area the tectonic cover (GR1300240) of the phyllites-quartzites series (Permian − Upper Triassic) is developed in an elongated growth (southeast − northwest). In this section phyllites, quartzites and slates (P-T?.ph) are placed and interpolate between bedded limestones or metaplysch and carbonate rocks of Tripoli series (Jm-Es.k1 & Jm-Es.k1). These formations are practically impermeable or of selective water circulation and consequently have low to very low permeability (A2). In some areas, there are found low capacity aquifers, which are often under overexploitation.

A large area (261 sq.km) in the southern part of the province, is covered by Neogene deposits (conglomerate and marly limestones), (M4-5). These formations (GR1300123) host various underground aquifers (moderate to low aquatic potential) and are characterized by moderate to low permeability (P2).



A1-Impermeable formations with a low to a very low water permeability
A2-Impermeable formations or formations with a selective circulation with a low to a very low water permeability
K1-High to moderate water permeability
K2-Moderate to low water permeability
P1-Granular, mainly alluvial, deposits with a different water permeability
P2-Miocene and Pliocene deposits with a moderate to low water permeability
P3-Granular non alluvial deposits with a low to a very low water permeability

Fig. 11: Geodatabase Map Extract of the area of interest, depicting the hydrogeology of Mirabello

Smaller parts of Mirabello southern area are composed of Flysch (ft) formation. These deposits (GR1300240) are characterized by low to very low permeability (A1).

Small, though superficially spreading Pleocene deposits (Pl.mk) are located in the northern Mirabello provice. Basically, these deposits are marls and marly limestones of low thickness and low to very low permeability (P3).

Lastly, small scale alluvial deposits (al) occur in the lower parts of small basins of Mirabello and appear to have fluctuating permeability (P1). These deposits are comprised of loose aluminum-sandy materials, terra rossa with breccia conglomerate in smaller inner basins, unconnected materials of clay, sand and breccia conglomerate in the torrent beds and mouths and alluvial deposits.

Agios Nikolaos is described by intense tectonism in the presence of faults with a main direction of northeast-southwest. In most of the region small and large faults are visible while in the area of karst formations large fault zones are developed. Additionally, in the area a large number of water supply and irrigation drillings are registered and the particularly large karstic spring of Agios Nikolaos discharges.
The most important hydrogeological systems in terms of capacity and coverage of potential needs are karsts developed in carbonate rocks. Agios Nikolaos is rich in karstic aquifers deployed in calcareous rocks of the autocthonous system and nappes. Because of the existence of these aquifers, all the current water supply needs of Mirabello's settlements are covered almost entirely, while large amounts of water is available for irrigation, with a tendency of a continuous growth and expansion of irrigated lands.
In Agios Nikolaos, two large karstic aquifer systems are developed: a) The Karstic system of Almyrou Agios Nikolaos spring and b) The Karstic system of Elouda. These karstic systems, though, are further separated into smaller systems because of the complex tectonic structure and the intense tectonic activity that occurs in Crete. It is worth mentioning that Agios Nikolaos' spring wells up near the beach and the water is brackish by natural causes. This is the reason why that spring is named "Almyros", which means salty in Greek.

1.4 MORHOLOGY AND SLOPES

In the following paragraphs the morphology and slopes of the project's areas of interest are presented based on the respective digital terrain and slope models.
For the determination of the geomorphology of the project's areas the following geomorphologic units are utilized:

- flat areas (0-200 m),
- semi-mountainous areas (201-800 m), and
- mountainous areas (>800 m).

1.4.1 Platanias Municipality

Based on the geomorphologic units presented above, the semi-mountainous areas occupy the largest part of Platanias Municipality with an area of 245,37 sq.km (49,52%). Flat areas in Platanias cover 178,42 sq.km (36,01%), while the mountainous areas hold the smallest part and cover 71,72 sq.km (14,47%). The above are presented in Fig. 13. The Digital Terrain Model of Municipality of Platanias is shown in Fig. 14. Moreover, the Digital Slopes Model of Platanias Municipality is given in Fig. 15.
As shown in Fig. 15 the occurrence of the five classes of slopes presents a rather uniform view in Platanias area. However, as shown in the slope histogram of the area (Fig. 12) the classes of slopes 10-20% and >40%, exhibit higher frequencies.

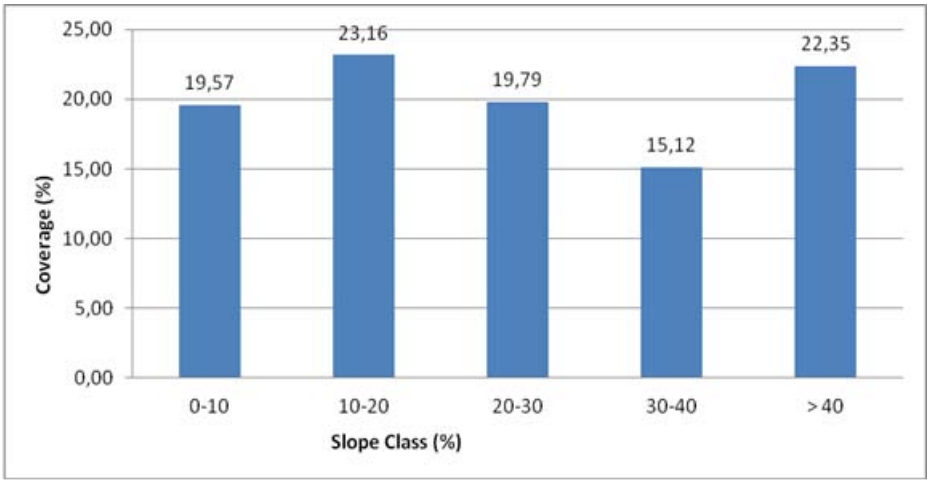


Fig. 12: Slope Histogram of Platanias Municipality

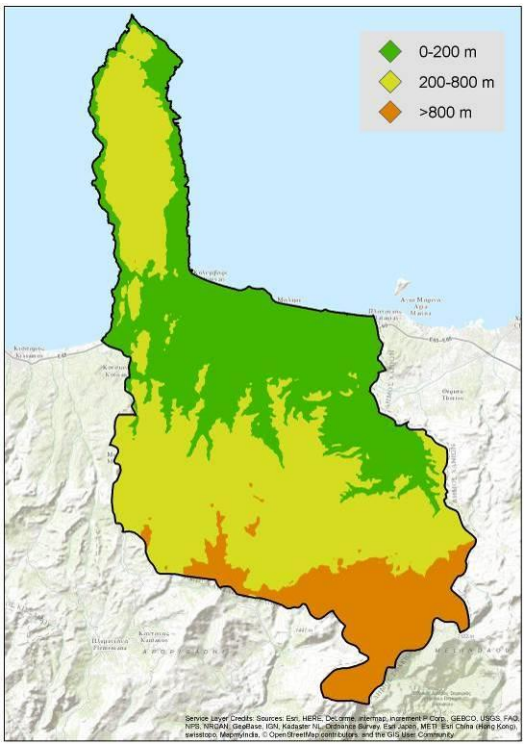


Fig. 13: Map Extract depicting the altitudes of Platanias Municipality

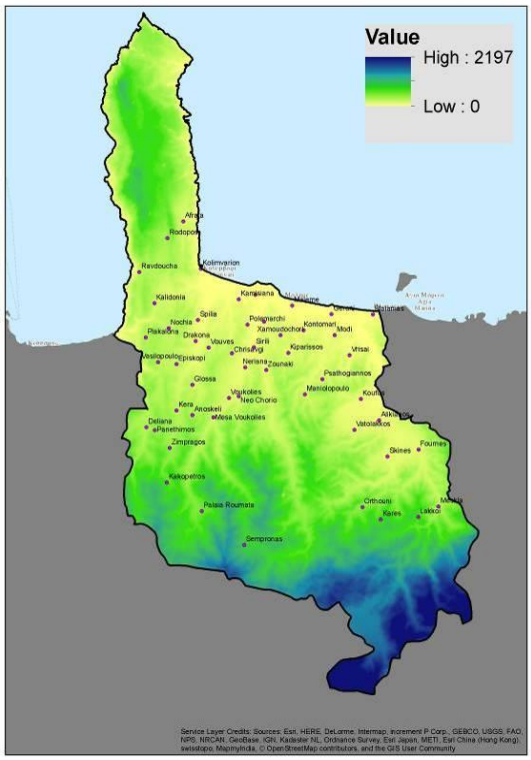


Fig. 14: Digital Terrain Model of Platanias Municipality

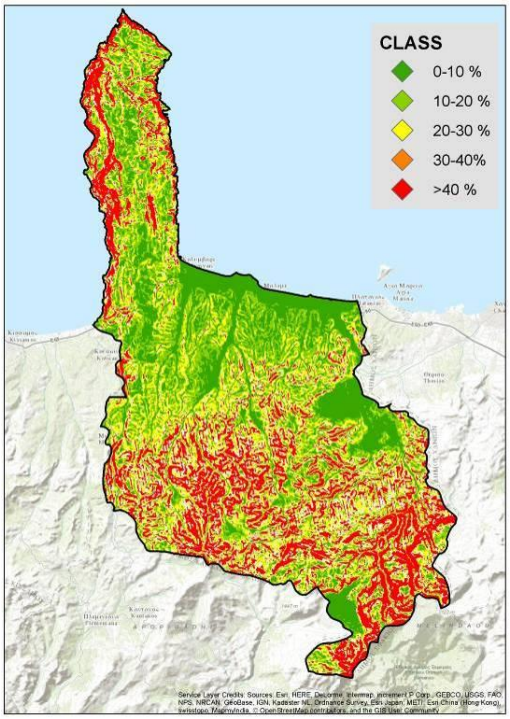


Fig. 15: Digital Slope Model of the Municipality of Platanias

1.4.2 Ag. Nikolaos Municipality (Mirabello area)

According to the geomorphologic units defined, the semi-mountainous areas in Agios Nikolaos Municipality cover 270,38 sq.km (52,01%). Flat areas cover 137,27 sq.km (26,40%), while mountainous areas cover 112,23 sq.km (21,59%). The above are shown in Fig. 16. The Digital Terrain Model of Municipality of Agios Nikolaos is shown in Fig. 17.

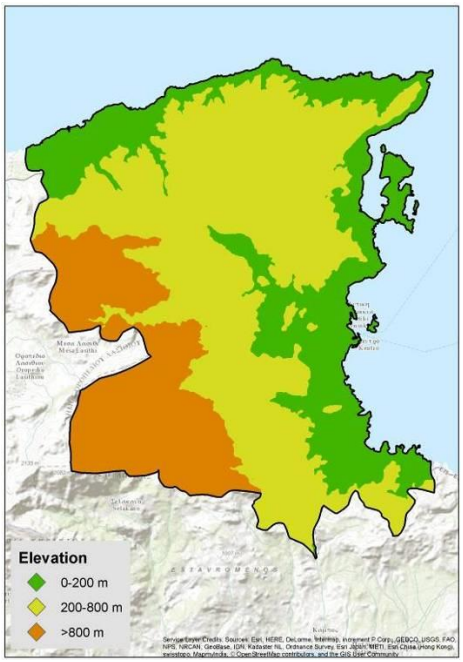


Fig. 16: Map Extract depicting the altitudes of Ag. Nikolaos Municipality

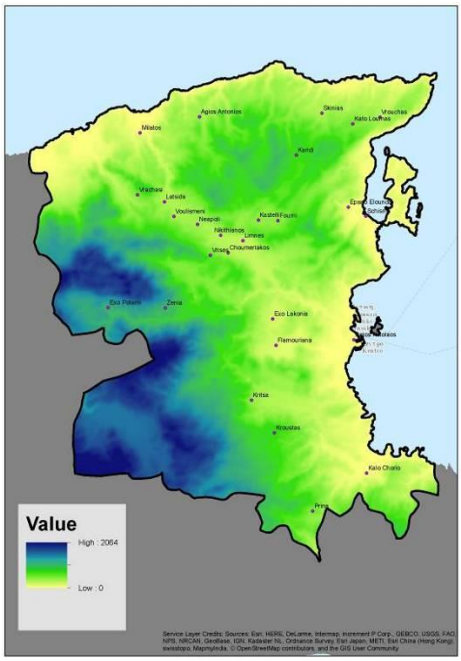


Fig. 17: Digital Terrain Model of Ag. Nikolaos Municipality

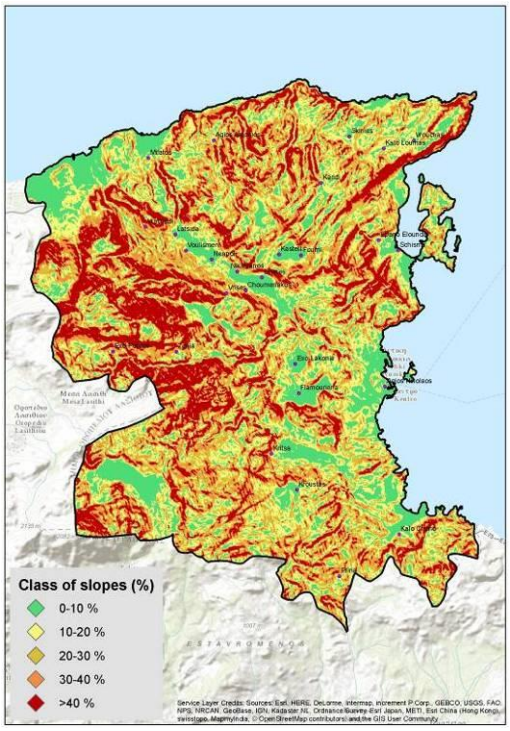


Fig. 18: Digital Slope Model of the Municipality of Ag. Nikolaos

Based on the analysis of the Digital Slopes Model presented in Fig. 18 similarly with Platanias Municipality, the occurrence of the five classes of slopes presents a uniform view in Agios Nikolaos Municipality.
However, in this case, the 10-20% and 20-30% slope classes present the highest frequencies, as shown in the following histogram of slopes (Fig. 19)

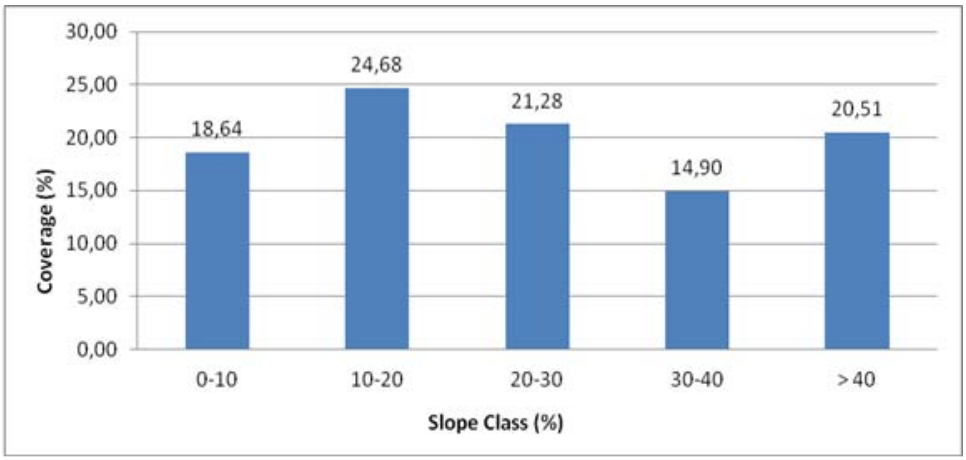


Fig. 19: Slopes Histogram of Agios Nikolaos Municipality

1.5 SOIL CHARACTERISTICS

The 1:1.000.000 scale soil map of Greece (Katakouzinos 1967) was used in order to identify the major soil units of the Mirabello and Platanias areas. Soil textural classification data was extracted from the European Soil Database (version 2.0) (Panagos et al. 2012). The textural composition of soils is one of the fundamental

properties for soil characterization, as it is directly connected to the hydraulic properties of the soils. As soil depth classes is regard the LEDDRA project was utilized (Fig. 20).

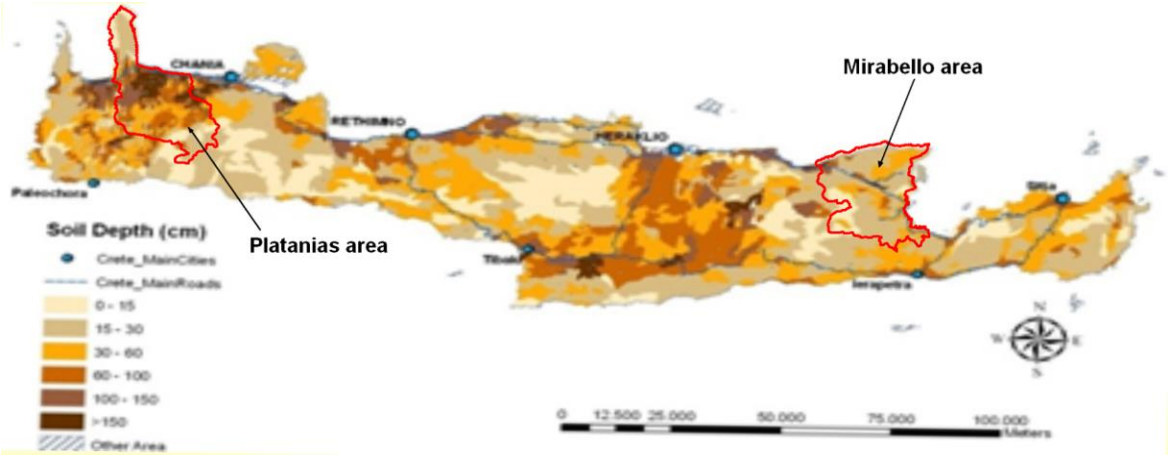


Fig. 20: Spatial distribution of soil depth classes in the island of Crete (source: LEDDRA project, http://leddra.aegean.gr/).

1.5.1 Platanias Municipality

The spatial distribution of soil mapping units identified in Platanias area illustrated in Fig. 21. The dominant unit is calcareous Rendzina & brown Mediterranean soils, most of them have been affected by erosion and cover the main portion of the northern part of the study area of Platanias. The southern part is dominated by brown and brown-red forest soils mixed with skeletal formations, while calcareous Rendzinas, podzolic mixed with acidic brown forest soils and allothigenic brown and brown-red Mediterranean soils are also observed. Alluvial deposits mixed with eroded soils (used to be identified as REGOSOLS) can be considered as a significant soil unit in this area and occupies mainly the central part.

The spatial distribution of the dominant soil textural classes at the surface of Platanias is presented in Fig. 22. Soils of medium textural class are found in the main part of Platanias area, while fine soils exist in the southern part. As presented in Fig. 23, the spatial distribution of dominant textural classes at the sub-surface demonstrates more complex variation pattern compared to the surface. More specifically, the central part of Platanias area is dominated by coarse and medium soils, while the northern and eastern part by fine soils.

When analyzing the secondary textural class distribution at the surface, as illustrated in Fig. 24, fine soils are found in the northern part of Platanias area, while coarse and medium soils are located in the southern part. At the sub-surface, the secondary textural class distribution as presented in Fig. 25 demonstrates that the major part of Platanias area is prevailing by medium soils, while fine soils are observed in the central part and coarse soils along the northwestern coastline. Considering all the above, medium to fine and coarse to medium soils are identified both for the surface and the sub-surface of Platanias.

According to soil depth classes spatial distribution presented in Fig. 20, in Platanias soil depths are found to be deeper than 60 cm in the major part of its area.

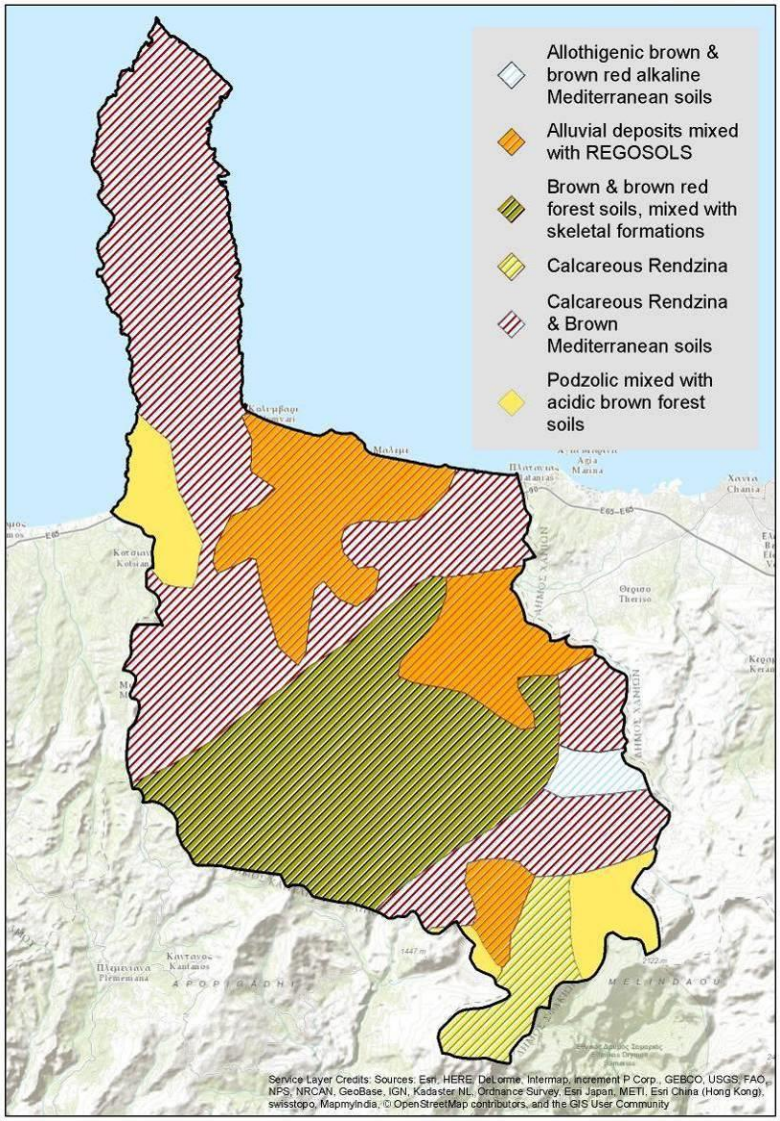


Fig. 21: Soil map of Platanias area

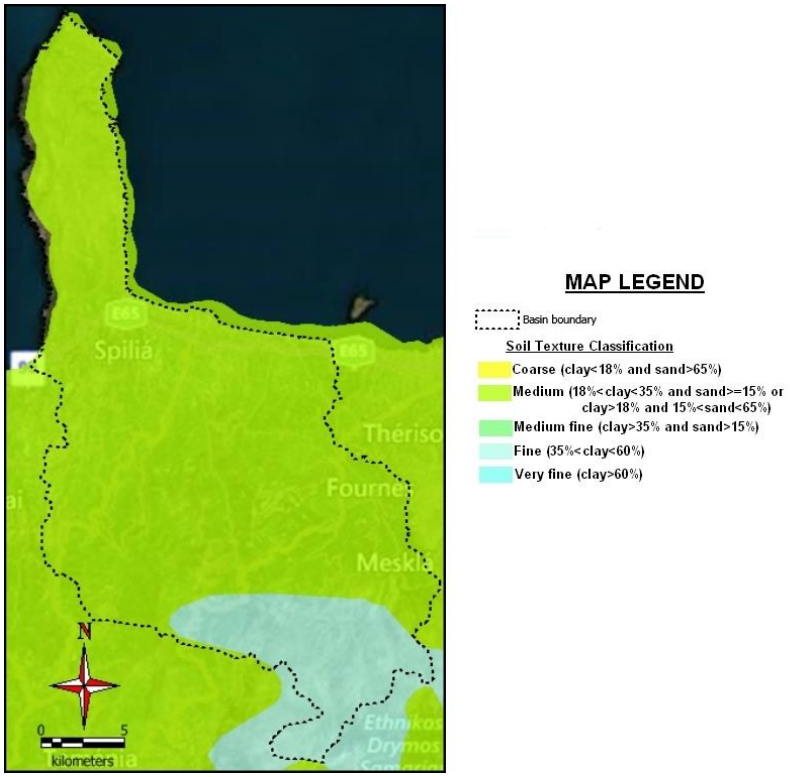


Fig. 22: Spatial distribution of the dominant textural class at the surface soil horizons for Platanias area. Bing imagery has been used as background map

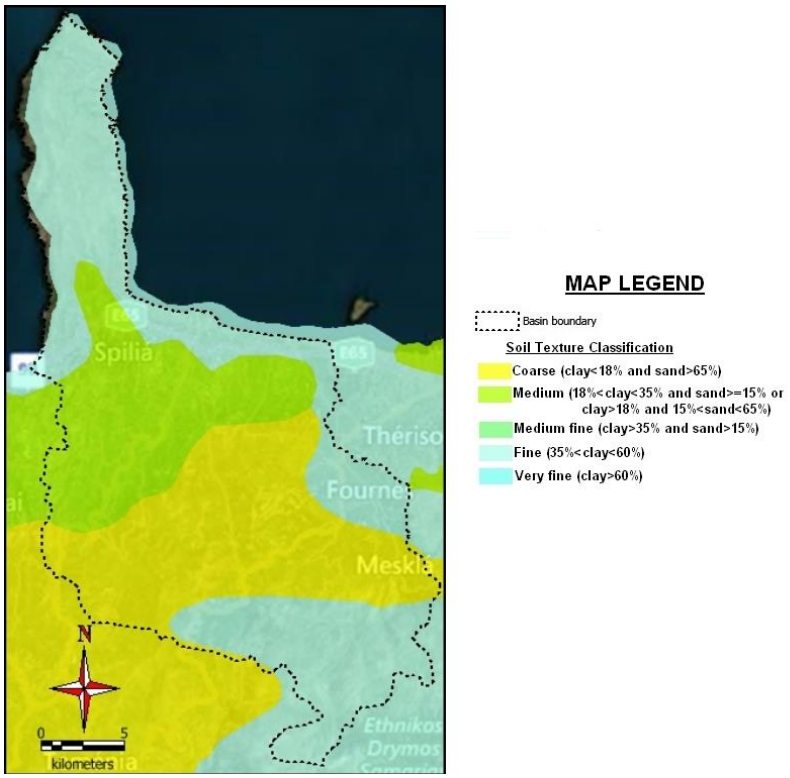


Fig. 23: Spatial distribution of dominant textural class at the sub-surface soil horizons for Platanias area. Bing imagery has been used as background map

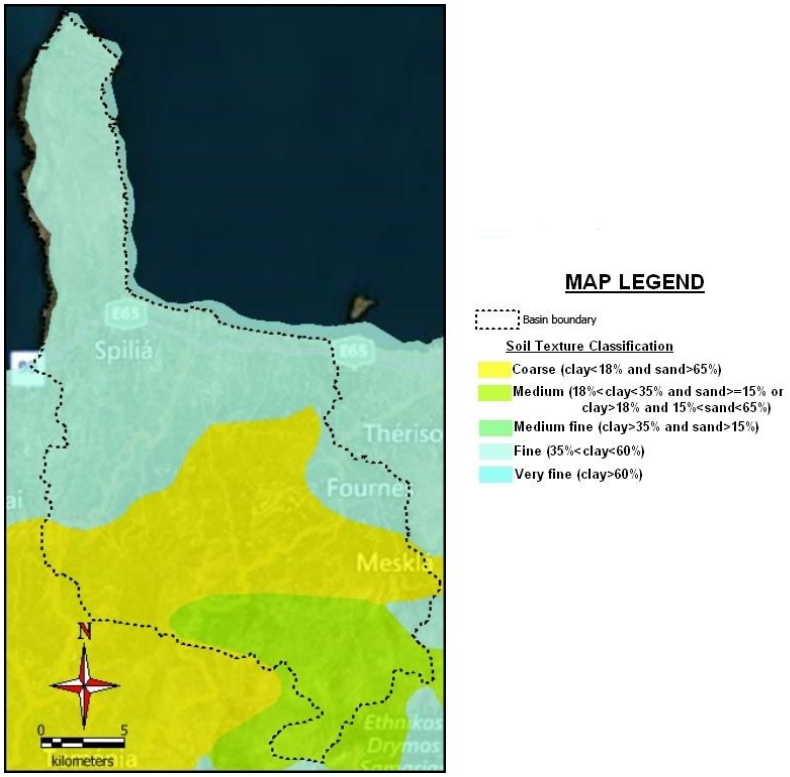


Fig. 24: Spatial distribution of secondary textural class at the surface soil horizons for Platanias area. Bing imagery has been used as background map

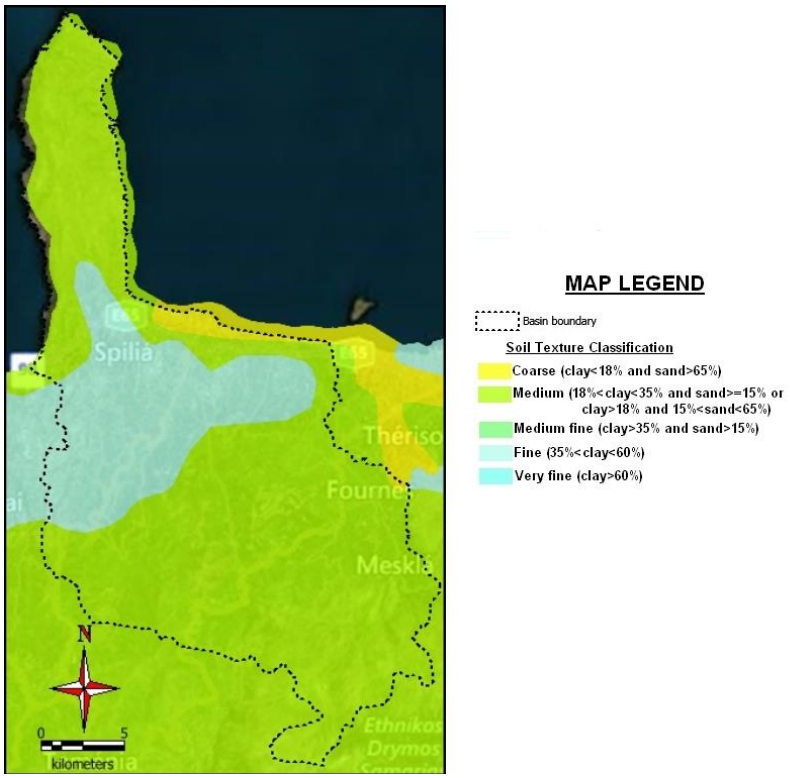


Fig. 25: Spatial distribution of secondary textural class at the sub-surface soil horizons for Platanias area. Bing imagery has been used as background map

1.5.2 Ag. Nikolaos Municipality (Mirabello)

Covering about 80% of Mirabello area, calcareous Rendzina & brown Mediterranean soils is the dominant soil unit, as indicated in the soil map of Fig. 26. These are shallow soils and according to Verheye & de la Rosa (2005), Mediterranean soils are intensively used for both rainfed and irrigated agriculture, while the brown phase is representative of a slightly advanced evolution stage of the weathering material. Rendzina soils (the term "Rendzina" is no longer used in soil taxonomy) correspond to shallow soils, usually formed by the weathering of carbonate rocks. Alluvial deposits mixed with material originated from the eroded soil surfaces (used to be classified as REGOSOLS) are found in the northwestern part of the wider study area. Two soil types are identified in the southwestern part including calcareous Rendzina and calcareous brown forest soils. Podzolic mixed with acidic brown forest soils are found in the western part of the study area, while allothigenic brown & brown red alkaline Mediterranean soils are met in a small part on the south. It has to be mentioned that calcareous soils are dominating in the study area.

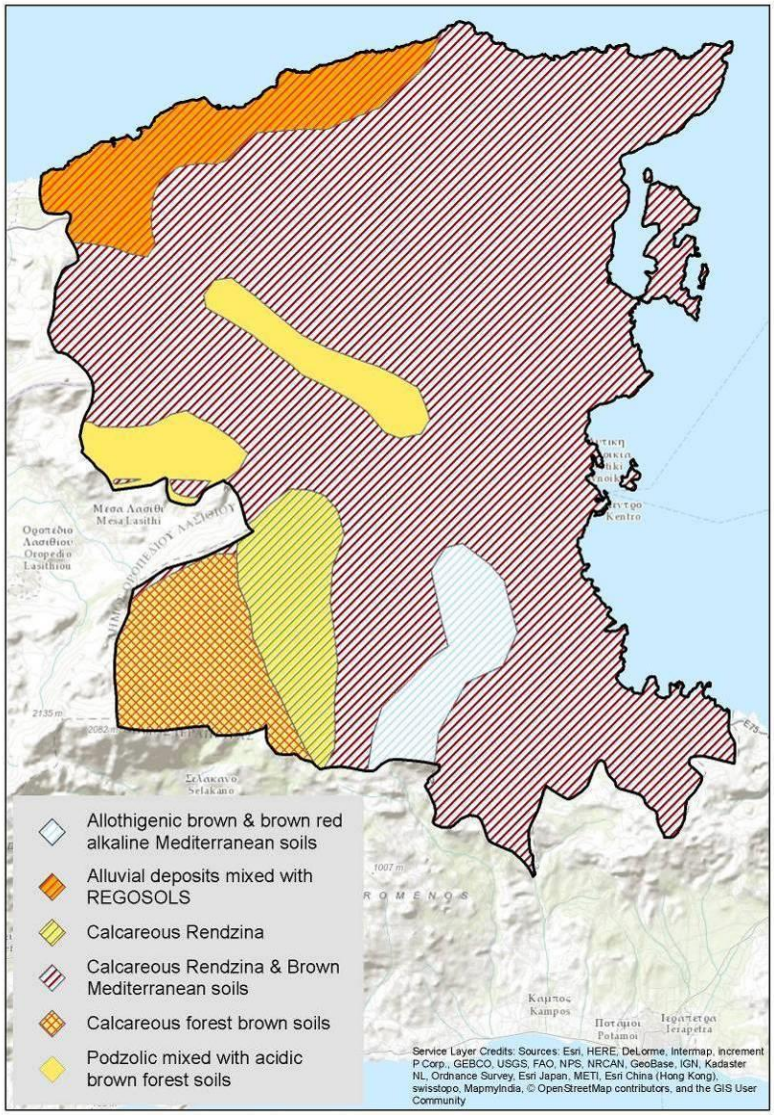


Fig. 26: Soil map of Mirabello area

The spatial distribution of the dominant soil surface textural classes is presented in Fig. 27. Soils of medium textural class are found in the major part of Mirabello area, while fine soils are located in the southeastern part. Soils, which are classified in their majority as fine, are observed in the sub-surface, as indicated by the spatial distribution of the main textural class at the sub-surface layers (Fig. 28). When analyzing the secondary textural distribution class at the surface, as illustrated in Fig. 29, the major textural is fine, while medium and coarse classes are observed in the southern part. At the sub-surface, the secondary textural class distribution, as presented in Fig. 30, indicates that apart from the southwestern part, medium soils are found in the major part of the study area. The combination of the dominant and the secondary textural classification indicate that both surface and sub-surface, medium to fine soils are dominating in the study area. It should be underlined that hydraulic soil properties depend on texture while soil depth and slope affect strongly infiltration and run off.

According to soil depth classes spatial distribution presented in Fig. 20, shallow soils of depth ranging between 15 and 30 cm are dominating in Mirabello area, while deeper soils (30-60 cm depth) are found in the western part.

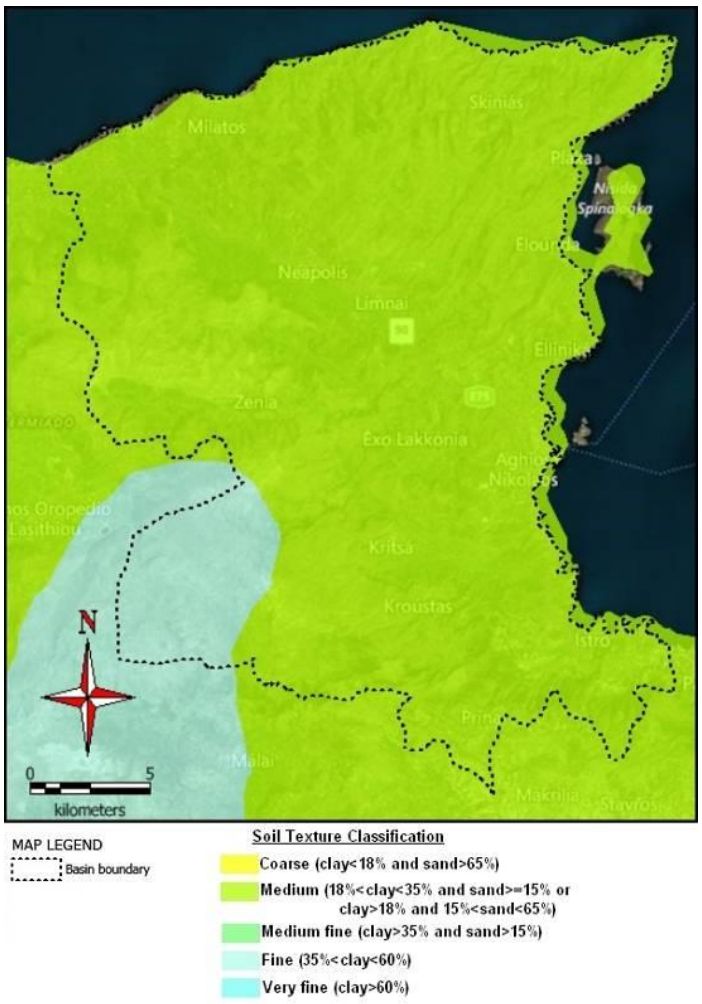


Fig. 27: Spatial distribution of dominant particle size distribution class at the surface for Mirabello area. Bing imagery has been used as background map

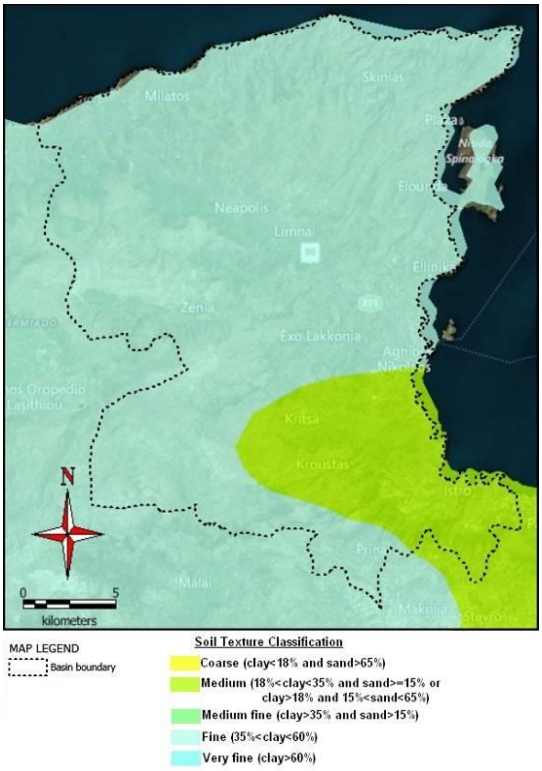


Fig. 28: Spatial distribution of the dominant textural classes of the sub-surface layers in Mirabello area. Bing imagery has been used as background map

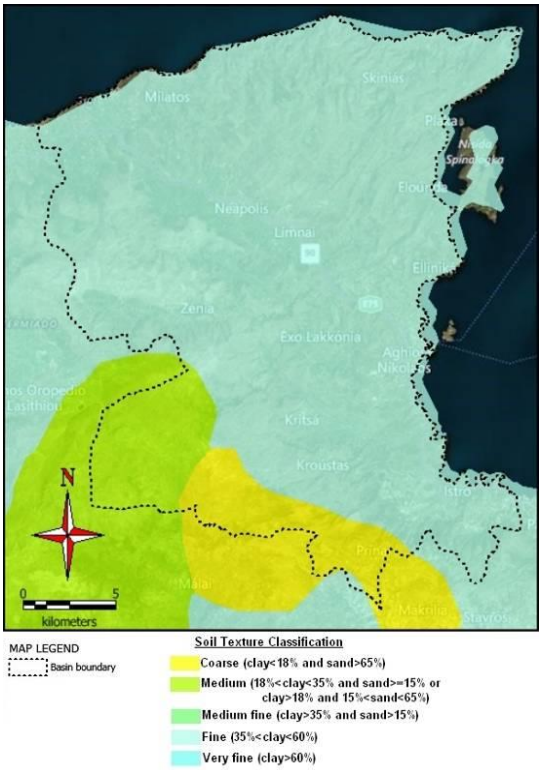


Fig. 29: Spatial distribution of secondary textural class at the surface soil horizons in Mirabello area. Bing imagery has been used as background map

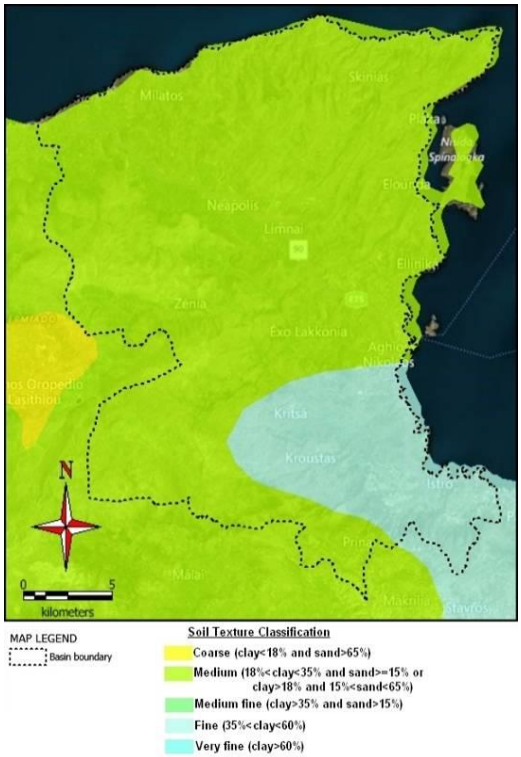


Fig. 30: Spatial distribution of secondary textural class at the sub-surface soil horizons in Mirabello area. Bing imagery has been used as background map.

1.6 LAND USES

1.6.1 Crete Water District (GR13)

Land Uses in GR13 Water District, involves a small percentage of forests (about 3% of total area), 27% of the total land is cultivated and 67% of land is covered by agricultural areas and pastures. Urban land use accounts for only 1% of the island's area. Fig. 31 shows the spatial distribution of land uses of four broad categories: agricultural areas, forests and semi-natural areas, artificial surfaces and areas under water in the three river basins, along with the administrative boundaries of the two areas of interest, Municipality of Ag. Nikolaos and Municipality of Platanias (Corine Land Cover, 2000).

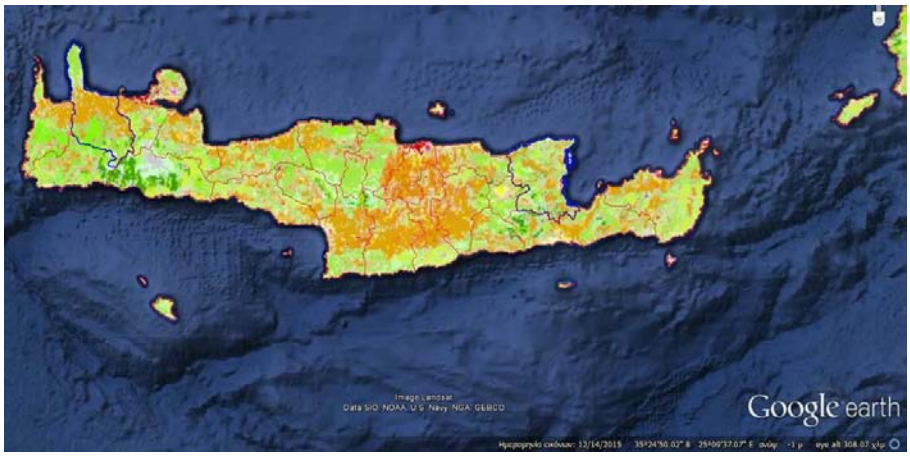


Fig. 31: Google Earth Map extract of Crete Island, depicting the spatial distribution of land uses

1.6.2 Platanias Municipality

The land uses in the area of Platanias Municipality are depicted in Fig. 32.

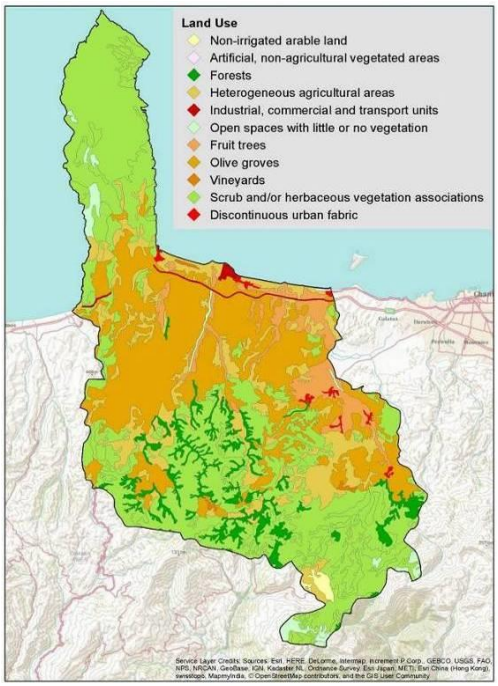


Fig. 32: Geodatabase Map extract of the area of interest, depicting the spatial distribution of land uses of Platanias

As shown in Fig. 33 land cover in Municipality of Platanias involves mostly agricultural areas and in particular permanent crops (olive groves and fruit trees) and to a lesser extent forests and semi-natural areas.

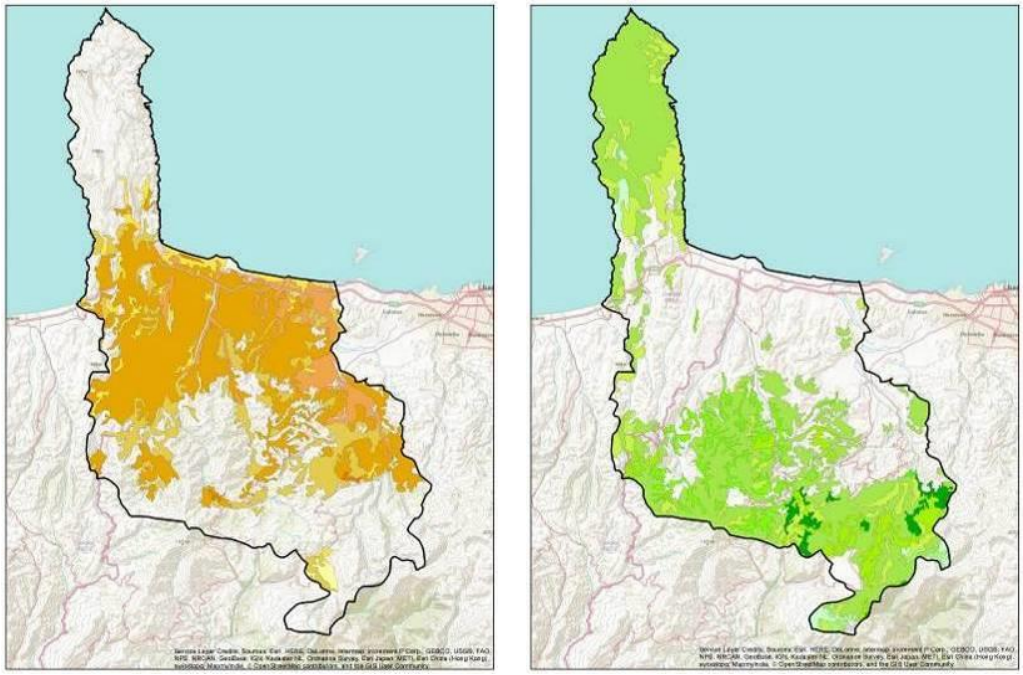


Fig. 33: Geodatabase Map extracts of Platanias, showing the agricultural areas – permanent crops (olive groves and fruit trees) (left) and the forests and semi-natural areas (right)

1.6.3 Ag. Nikolaos Municipality

The land uses in the area of Agios Nikolaos Municipality, on the other hand are depicted in Fig. 34.

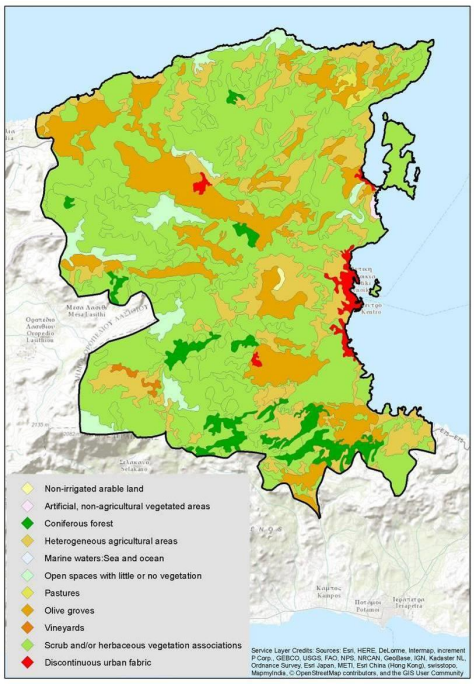


Fig. 34: Geodatabase Map extract of the area of interest, depicting the spatial distribution of land uses of Agios Nikolaos

Municipality of Ag. Nikolaos is covered by forests and semi-natural areas disturbed by (mainly) permanent crops (Fig. 35).

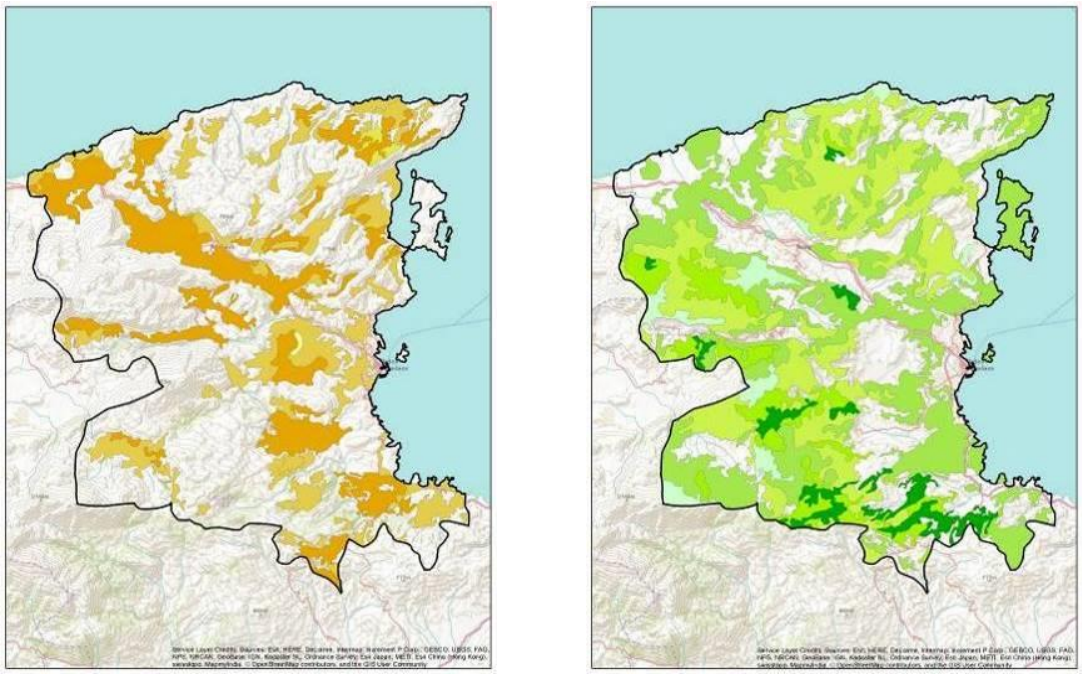


Fig. 35: Geodatabase Map extracts of Ag. Nikolaos, showing the agricultural areas – permanent crops (olive groves and fruit trees) (left) and the forests and semi-natural areas (right)

Land Cover data in broad and more detailed categories for both areas of interest in Crete are presented in Table 15 and Table 16.

Table 15: **Main land uses of Greece and Regional Units of Crete's Island**

Region	All areas (sq.km)	Cultivated areas & fallow land (sq.km)	Pastures (sq.km)	Forests (sq.km)	Area under water (sq.km)	Buildings, roads, etc. (sq.km)	Other areas (sq.km)
Greece	131.982,2	50.684,6	14.451,6	57.968,9	1.790,1	2.307,5	4.779,6
Region of Crete	8.312,9	3.586,9	2.360,5	1.852,8	2,9	106,3	403,6
Regional Unit of Lasithi	*1.827,2*	*661,1*	*624,1*	*412,3*	*1,3*	*11,1*	*117,4*
Municipality of Ag. Nikolaos	508,9	176,9	174,0	124,7	0,0	4,3	29,1
Municipal Unit of Ag. Nikolaos	*316,7*	*113,4*	*98,3*	*77,8*	*0,0*	*3,2*	*24,0*
Municipal Unit of Neapoli (including MU of Vrachasi)	*192,1*	*63,6*	*75,7*	*46,9*	*0,0*	*1,0*	*5,0*
Regional Unit of Chania	*2.349,5*	*765,6*	*498,9*	*882,3*	*0,7*	*34,1*	*167,9*
Municipality of Platanias	491,7	241,3	34,4	184,9	0,0	4,7	26,4
Municipal Unit of Voukolies	*75,5*	*43,4*	*6,6*	*24,5*	*0,0*	*0,3*	*0,7*
Municipal Unit of Mousoures	*190,3*	*76,9*	*7,9*	*101,0*	*0,0*	*0,8*	*3,7*
Municipal Unit of Platanias	*74,8*	*56,0*	*2,4*	*13,6*	*0,0*	*2,3*	*0,6*
Municipal Unit of Kolymvari	*151,1*	*65,0*	*17,5*	*45,8*	*0,0*	*1,3*	*21,5*
Regional Unit of Heraklion	*2.640,6*	*1.533,4*	*721,0*	*272,6*	*0,7*	*46,9*	*66,0*
Regional Unit of Rethymno	*1.495,6*	*626,8*	*516,6*	*285,6*	*0,1*	*14,1*	*52,4*

Table 16: **Detailed land use of Crete's island**

Region	All areas	AGRICULTURAL AREAS						FORESTS AND SEMI - NATURAL AREAS				SURFACES UNDER WATER			ARTIFICIAL SURFACES				
		Arable land	Permanent crops	Pastures - transitional wood land / shrumb	Pastures - shrumb and / or herbaceous vegetation associations	Pastures - Open spaces with little or no vegetation	Heterogenous agricultural areas	Forests	Transitional wood land / shrumb	Shrumb and / or herbaceous vegetation associations	Open spaces with little or no vegetation	Inland waters	Inland wetlands	Coastal wetlands	Urban fabric	Industrial and commercial units	Transport units	Mine , dump and construction sites	Artificial, non agricultural vegetated areas sport and cultural activity sites
Greece	131.982,2	21.181,5	7.491,6	879,9	9.151,5	4.420,2	22.011,5	22.411,6	11.606,6	23.950,6	4.509,3	1.197,3	108,3	484,5	1.913,1	212,7	156,4	270,3	25,4
Region of Crete	8.312,9	90,6	1.946,5	23,0	1.388,0	949,5	1.549,7	256,4	390,6	1.205,8	398,0	2,9	0,0	0,0	86,5	6,4	12,7	5,7	0,7
Regional Unit of Lasithi	*1.827,2*	*38,6*	*274,7*	*6,5*	*127,7*	*489,8*	*347,8*	*85,4*	*71,0*	*255,9*	*115,8*	*1,3*	*0,0*	*0,0*	*9,9*	*0,3*	*0,8*	*1,6*	*0,1*
Municipality of Ag. Nikolaos	508,9	2,2	80,5	3,0	38,7	132,2	94,3	34,6	34,7	55,3	28,6	0,0	0,0	0,0	4,2	0,0	0,0	0,5	0,0
Municipal Unit of Ag. Nikolaos	*316,7*	*1,8*	*45,2*	*0,0*	*20,9*	*77,4*	*66,3*	*30,7*	*16,3*	*30,8*	*23,8*	*0,0*	*0,0*	*0,0*	*3,2*	*0,0*	*0,0*	*0,3*	*0,0*
Municipal Unit of Neapoli (including MU of Vrachasi)	*192,1*	*0,4*	*35,3*	*3,0*	*17,9*	*54,8*	*27,9*	*3,9*	*18,4*	*24,5*	*4,8*	*0,0*	*0,0*	*0,0*	*1,0*	*0,0*	*0,0*	*0,2*	*0,0*
Regional Unit of Chania	*2.349,5*	*13,7*	*425,5*	*4,2*	*219,0*	*275,7*	*326,4*	*126,2*	*193,1*	*563,0*	*166,0*	*0,7*	*0,0*	*0,0*	*26,0*	*1,3*	*6,6*	*1,9*	*0,1*
Municipality of Platanias	491,7	3,0	170,3	0,0	17,6	16,8	68,0	7,0	60,0	117,9	26,4	0,0	0,0	0,0	3,9	0,0	0,8	0,0	0,0
Municipal Unit of Voukolies	*75,5*	*0,1*	*29,4*	*0,0*	*6,3*	*0,4*	*14,0*	*2,5*	*15,3*	*6,7*	*0,7*	*0,0*	*0,0*	*0,0*	*0,3*	*0,0*	*0,1*	*0,0*	*0,0*
Municipal Unit of Mousoures	*151,1*	*0,8*	*43,8*	*0,0*	*5,8*	*11,7*	*20,4*	*0,3*	*0,0*	*45,5*	*21,5*	*0,0*	*0,0*	*0,0*	*1,3*	*0,0*	*0,0*	*0,0*	*0,0*
Municipal Unit of Platanias	*190,3*	*1,3*	*52,9*	*0,0*	*3,2*	*4,8*	*22,7*	*3,5*	*36,2*	*61,3*	*3,7*	*0,0*	*0,0*	*0,0*	*0,8*	*0,0*	*0,0*	*0,0*	*0,0*
Municipal Unit of Kolymvari	*74,8*	*0,9*	*44,2*	*0,0*	*2,4*	*0,0*	*10,9*	*0,7*	*8,5*	*4,4*	*0,6*	*0,0*	*0,0*	*0,0*	*1,6*	*0,0*	*0,7*	*0,0*	*0,0*
Regional Unit of Heraklion	*2.640,6*	*31,6*	*960,8*	*8,6*	*574,3*	*138,1*	*541,0*	*30,2*	*92,9*	*149,5*	*64,4*	*0,7*	*0,0*	*0,0*	*38,4*	*3,0*	*5,2*	*1,6*	*0,4*
Regional Unit of Rethymno	*1.495,6*	*6,7*	*285,6*	*3,7*	*466,9*	*45,9*	*334,6*	*14,7*	*33,6*	*237,3*	*51,8*	*0,1*	*0,0*	*0,0*	*12,2*	*1,8*	*0,1*	*0,6*	*0,1*

1.7 HIGH CONSERVATION VALUE (HCV) AREAS

1.7.1 Nationally Designated Areas

Nationally designated areas are protected under national law and involve nature protection sites such as national parks, wildlife refuges and nature reserves. These areas are included in the Common Database on Designated Areas (CCDA), as well as the World Database of Protected Areas. Greek Nationally Designated Areas include:

- National Woodland Parks (Law No. 996/71)
- National Parks (Law No. 1650/86)
- Aesthetic Forests (Law No. 996/71)
- Natural Monuments and Landmarks (Law No. 996/71)
- Wildlife Refuges (Law No 177/75 as amended by Law No 2637/98)
- Controlled Hunting Areas (Law No. 177/75, as amended by Law No. 2637/98)
- Game Breeding Stations (Law No. 177/75, as amended by Law No. 2637/98)
- Nature Reserve Areas (Law No. 1650/86)
- Absolute Nature Reserve Areas (Law No. 1650/86)
- Protected Forests
- Protected significant natural formations and landscapes (Law No. 1650/86)
- Ecodevelopment Areas (Law No. 1650/86)

Nationally Designated Areas located within Municipality of Platanias include Wildlife Refuges and Protected Forests, while within the administrative boundaries of Ag. Nikolaos, only Wildlife Refuges are located (Fig. 36)

Fig. 36: Google Earth Map extract of Crete Island, depicting the municipal boundaries of Platanias and Agios Nikolaos and the Nationally Designated Areas

1.7.1.1 Wildlife refuges

The Wildlife Refuges located in Platanias are presented in Table 17. At the same table, the Official Government Gazette Issues in which the respective sites were designated are also included.

Table 17: The Wildlife Refuges of Platanias

Code	Name	Total Area (sq.km)[1]	Area (sq.km) within Platanias[2]	Government Gazette No
K899	Voreio Tmima Chersonisou Rodopou Dimou Kolymvariou	23,35	23,35	Designation: 53762/2963/01.07.76 Amendment: 813/B/27-06-01 Amendment: 1187/B/12-09-02
K734	Lefka Ori Anatolikou Selinou kai Sfakion	75,91	3,75	Designation: 803/B/26-06-01

[1]Source: http://cdr.eionet.europa.eu/gr/eea/cdda1/envviga8g

[2]Source: Own processing

Fig. 37 shows the location and areas covered by wildlife refuges in Municipality of Platanias.

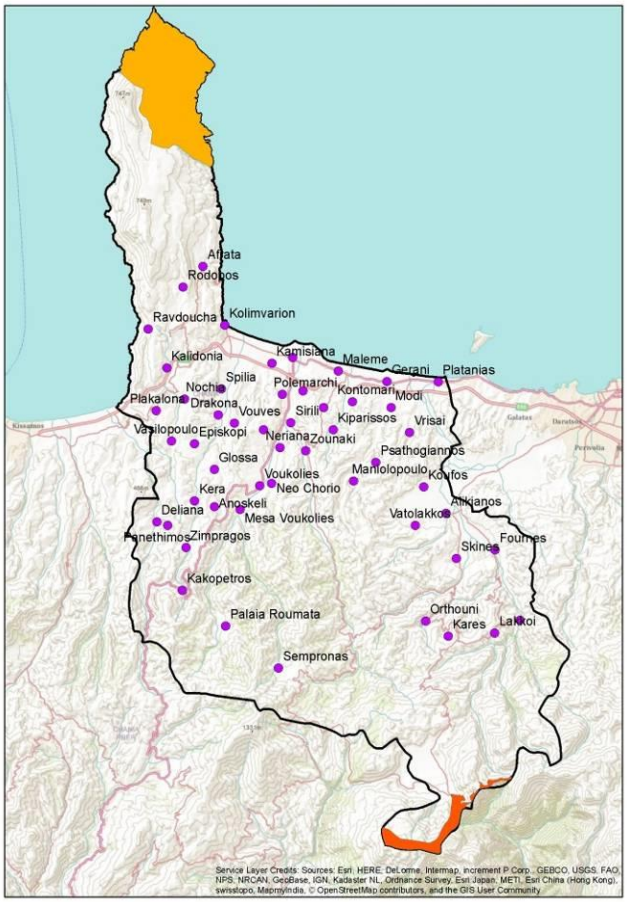


Fig. 37: Geodatabase Map Extract of the area of interest, depicting the boundaries of Platanias Municipality and the Wildlife refuges of the area

Wildlife Refuges within the Municipality of Ag. Nikolaos are presented in Table 18 and shown in Fig. 38.

Table 18: The Wildlife Refuges of Agios Nikolaos

Code	Name	Total Area (sq.km)[1]	Area (sq.km) within Ag.Nikolaos[2]	Government Gazette No
K876	Latsidiani Kefala Dimou Neapolis	4,90	4,90	Designation: 787/B/22-06-01
K557	Anavlocho (Vrachasiou)	4,74	4,74	Designation: 708/B/27-9-82
K862	Katselio Dimou Agiou Nikolaou	6,68	6,68	Designation: 176521/3128/10.07.80 Amendment: 809/B/27-06-01 Amendment: 459/B/15-04-02
K560	Oxya (Agiou Nikolaou Elountas)	5,16	5,16	Designation: 797/B/23-8-77
K565	Chalasia (Zenion-Exo Potamon-Mesa Lasithiou)	8,0	6,35	Designation: 779/B/10-6-76
K569	Thylakas (Agiou Nikolaou Kritsa)	7,86	7,86	Designation: 779/B/10-6-76
K865	Vathy - Almyros Dimou Agiou Nikolaou	0,92	0,92	Designation: 157989/3074/11.7.84 Amendment: 809/B/27-06-01 Amendment: 1108/B/23-08-02
K893	Gianna Koryfi Dimou Agiou Nikolaou	16,11	10,83	Designation: 222145/3854/02.07.77 Amendment: 809/B/27-06-01

[1]Source: http://cdr.eionet.europa.eu/gr/eea/cdda1/envviga8g

[2]Source: Own processing

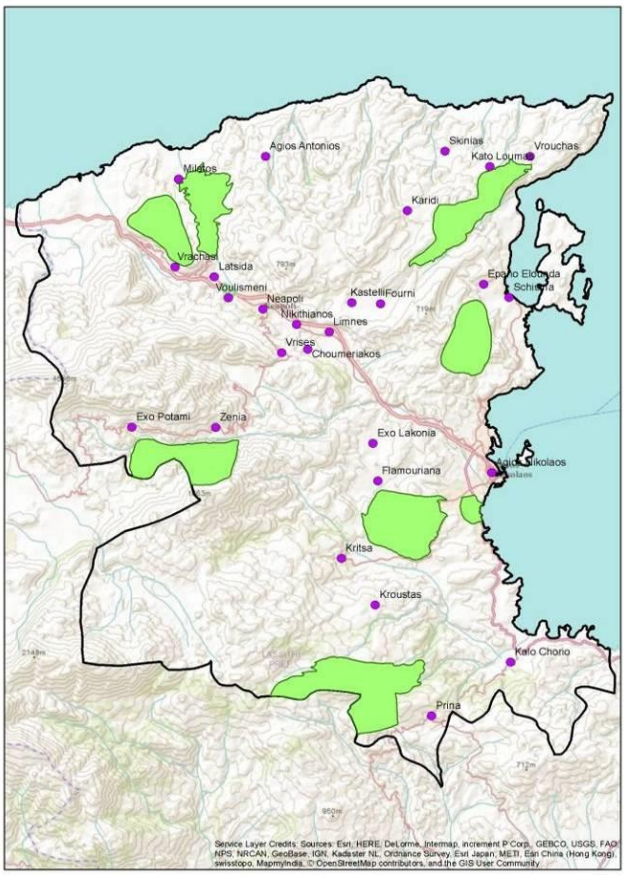


Fig. 38: Geodatabase Map Extract of the area of interest, depicting the boundaries of Ag. Nikolaos Municipality and the Wildlife refuges of the area

1.7.1.2 Protected forests

As mentioned above, protected forests are only located in the Municipality of Platanias (Fig. 39). Information regarding the area covered and the designation of these protected forests is given in Table 19.

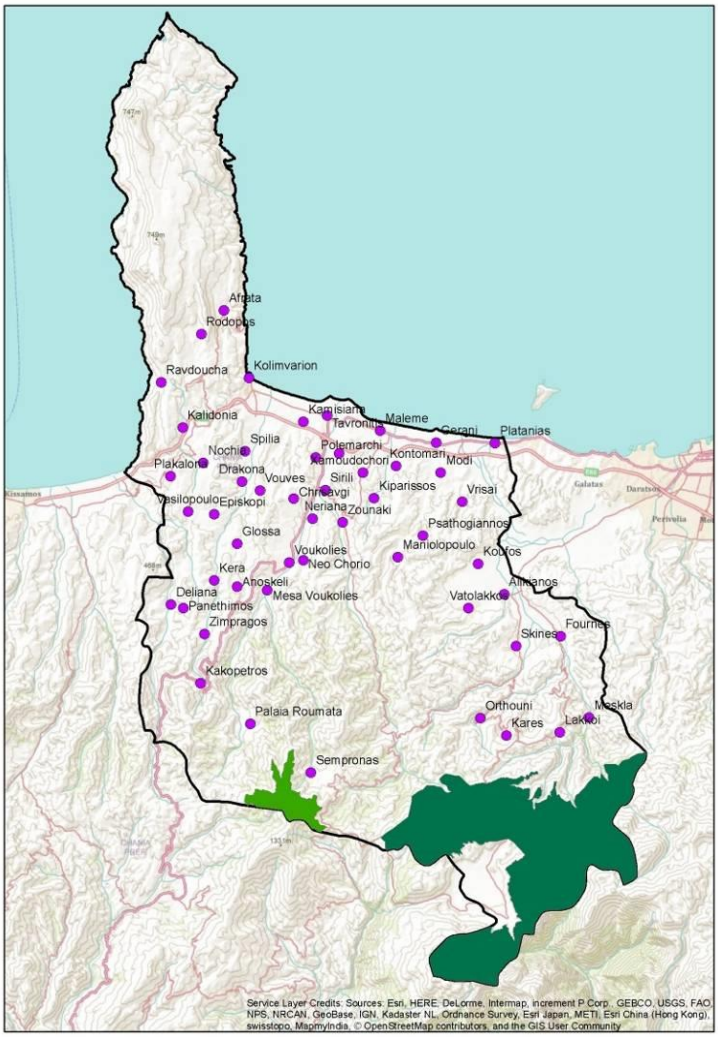


Fig. 39: Geodatabase Map Extract of the area of interest, depicting the boundaries of Platanias Municipality and the Protected Forests of the area

Table 19: The Protected Forests of Platanias

Code	Name	Total Area (sq.km)[1]	Area (sq.km) in Platanias[2]	Government Gazette No
341941	Prostateftiko dasos oreinou ogkou Apopigadi Selinou nomou Chanion	13,71	4,47	65/Δ/03-02-06
341920	Prostateftiko dasos oreinou ogkou Lefkon Oreon nomou Chanion	388,65	53,06	65/Δ/03-02-06

[1]Source: http://cdr.eionet.europa.eu/gr/eea/cdda1/envviga8g

[2]Source: Own processing

1.7.2 Small island wetlands

Small island wetlands are nationally protected areas, under Law 3937/2011 (60/A/31-03-11) and the Presidential Decree entitled "Adoption of the Small Island

Wetlands Inventory and definition of terms and restrictions for the protection of these small coastal wetlands" (229/ΑΑΠ/19-06-12). The necessity of conserving small island wetlands in the Mediterranean has been recognized in the Resolution XII.14/03-07-15 of the Conference of the Parties to the Convention on Wetlands (Ramsar, Iran, 1971) in response to the draft resolution submitted by Greece (www.ramsar.org/about/cop12-resolutions).
The small island wetlands of Municipality of Platanias are located near the coastline, as shown in Fig. 40. Relevant information is provided in Table 20.

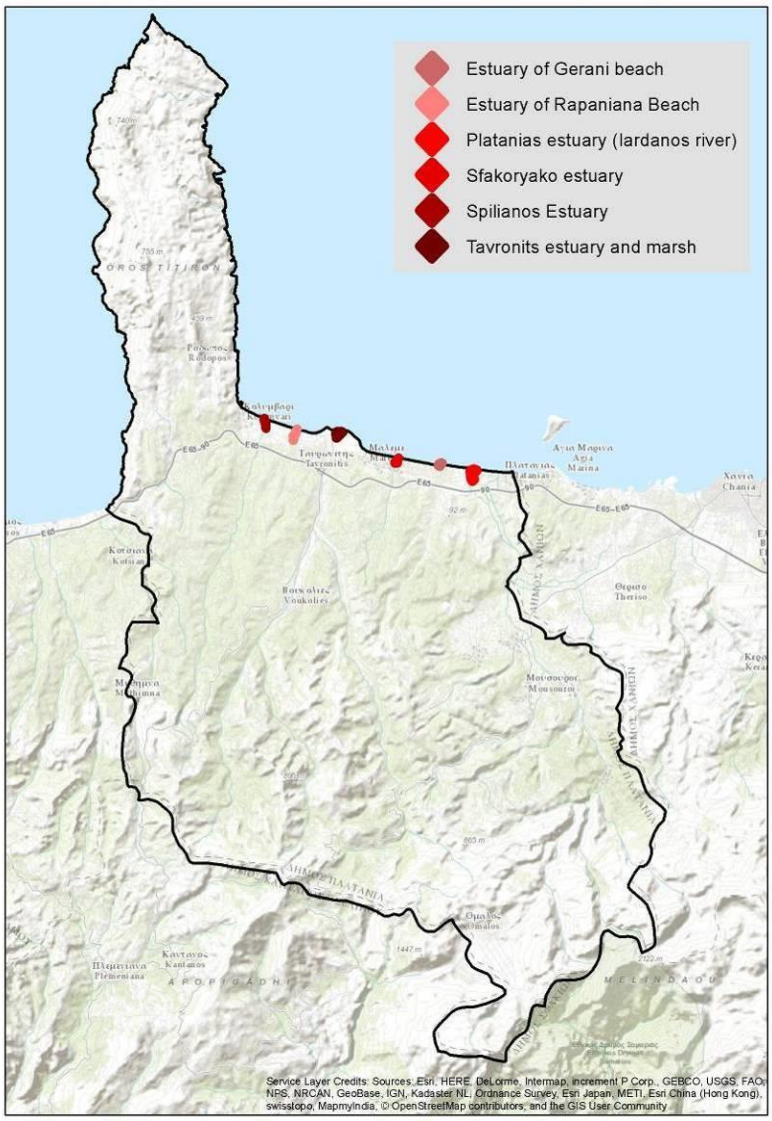
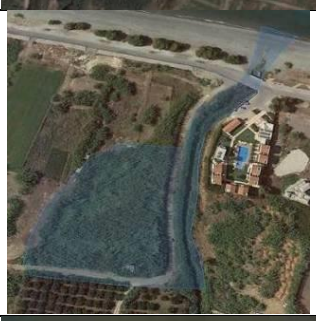


Fig. 40: Geodatabase Map Extract of the area of interest, depicting the boundaries of Platanias Municipality and the small island wetlands

Table 20: The small island wetlands of Platanias (source: www.oikoskopio.gr/ygrotopio/)

Name	Code	Area (ha)	Google Earth extract
Spilianos Estuary	Y434KRI205	11	
Estuary of Rapaniana Beach	Y434KRI204	12	
Tavronits estuary and marsh	Y434KRI203	56	
Sfakoryako estuary	Y434KRI202	13	
Estuary of Gerani beach	Y434KRI201	14	
Platanias estuary (Iardanos river)	Y434KRI200	71	

The inventory of the small island wetlands includes the sites located within the administrative boundaries of Municipality Ag. Nikolaos shown in Fig. 41. In this case small island wetlands are located both near the coastline and inland.

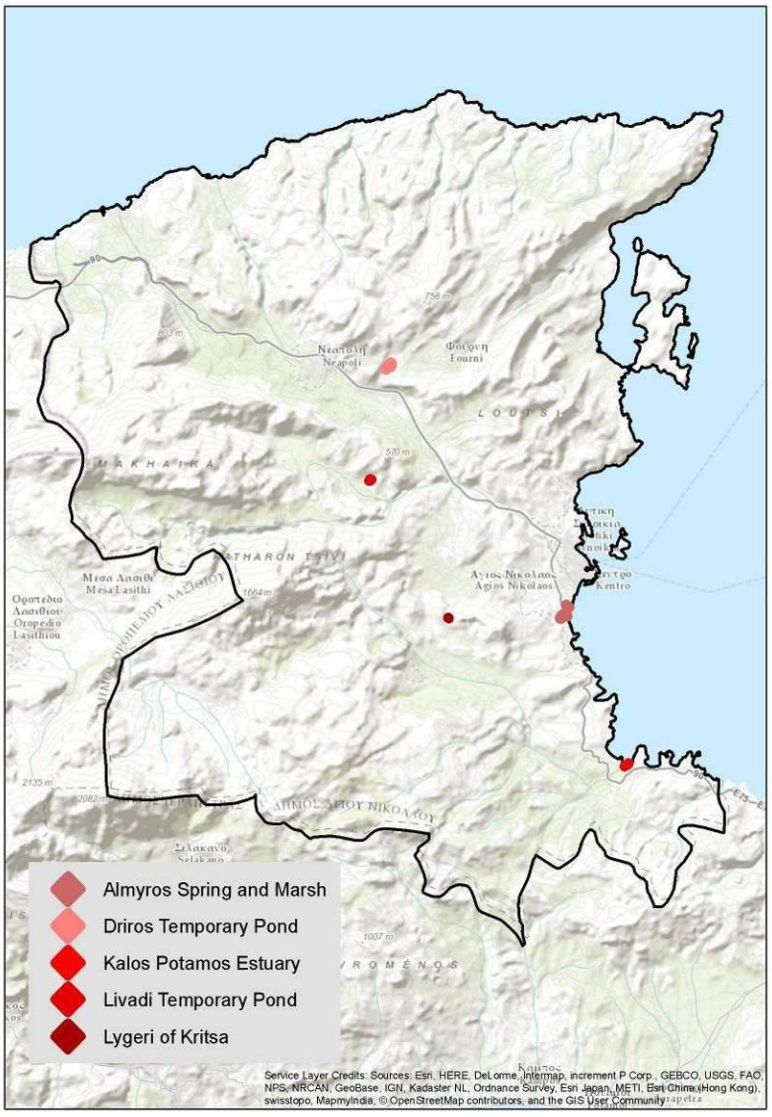


Fig. 41: Geodatabase Map Extract of the area of interest, depicting the boundaries of Ag. Nikolaos Municipality and the small island wetlands

Information on the small island wetlands located in Municipality of Ag. Nikolaos is provided in Table 21.

Table 21: The small island Wetlands of Ag. Nikolaos (source: http://www.oikoskopio.gr/ygrotopio/)

Name	Code	Area (ha)	Google Earth extract
Lygeri of Kritsa	Y432KRI058	2	

Name	Code	Area (ha)	Google Earth extract
Kalos Potamos Estuary	Y432KRI055	8	
Almyros Spring and Marsh	Y432KRI056	50	
Livadi Temporary Pond	Y432KRI063	7	
Driros Temporary Pond	Y432KRI069	35	

Relevant to the small island wetlands, located in Municipalities of Agios Nikolaos and Platanias, information, as provided in the approved River Basin Management Plan of GR13 Water District is summarized in Table 22.

Table 22: Further Information of the small island wetlands of both **Crete's areas**

Name	Code	Interrelated Systems		
		Surface waters (inland, transitional and coastal waters)	Groundwater bodies	Natura 2000 sites
Spilianos Estuary	Y434KRI205	GR1339C0002N	-	GR4340003
Estuary of Rapaniana Beach	Y434KRI204	GR1339C0002N	-	GR4340003
Tavronits estuary and marsh	Y434KRI203	GR3901R000301006N GR133901T0001N	-	GR4340003
Sfakoryako estuary	Y434KRI202	GR1339C0002N	-	GR4340003
Estuary of Gerani beach	Y434KRI201	GR1339C0002N	-	GR4340003
Platanias estuary (Iardanos river)	Y434KRI200	GR133901T0002N GR3901R000401011N	-	GR4340006
Lygeri of Kritsa	Y432KRI058	-	-	-

Kalos Potamos Estuary	Y432KRI055	GR1341C0012N	-	-
Almyros Spring and Marsh	Y432KRI056	GR1341R000101001N GR1341C0012N	GR1300114	
Livadi Temporary Pond	Y432KRI063	-	-	-
Driros Temporary Pond	Y432KRI069	-	-	-

1.7.3 Recreational (Bathing) waters

Recreational (bathing) waters' quality is monitored and assessed in conformance with the requirements of the Bathing Waters Directive (2006/7/EC). More in particular, an inventory of bathing waters has been prepared in line with the mandates of the Bathing Water Directive (www.bathingwaterprofiles.gr/).
Bathing waters located in the area of Municipality of Platanias and Ag. Nikolaos are presented in Table 23 and Table 24, respectively.

Table 23: Bathing waters of Platanias

Name	Code	Interrelated coastal systems
Gerani- Platanias	GRBW139323083	GR1339C0002N
Kolymvaria - Rapaniana	GRBW139323084	GR1339C0002N
Limanaki Platania	GRBW139325119	GR1339C0002N
Maleme	GRBW139323085	GR1339C0002N

Table 24: Bathing Waters of Ag. Nikolaos

Name	Code	Interrelated coastal systems
Agia Varvara	GRBW139310010	GR1341C0009N
Agios Nikolaos 1	GRBW139310009	GR1341C0012N
Agios Nikolaos 2	GRBW139310026	GR1341C0012N
Agios Nikolaos 3	GRBW139310022	GR1341C0012N
Agios Panteleimonas	GRBW139310029	GR1341C0012N
Almyros	GRBW139310021	GR1341C0012N
Ammos	GRBW139310012	GR1341C0012N
Ammos (Marina)	GRBW139310008	GR1341C0012N
Ammoudara	GRBW139310015	GR1341C0012N
Ammoudi	GRBW139310014	GR1341C0012N
Voulisma	GRBW139310018	GR1341C0012N
Gargadoros	GRBW139310031	GR1341C0012N
Chavania	GRBW139310035	GR1341C0012N
Chavania North	GRBW139310013	GR1341C0012N
Driros	GRBW139310011	GR1341C0011N
Elounda	GRBW139310027	GR1341C0012N
Elounda	GRBW139310019	GR1341C0011N
Kalo Chorio	GRBW139310030	GR1341C0012N
Karavostasi	GRBW139310034	GR1341C0012N
Kitroplateia	GRBW139310017	GR1341C0012N
Milatos	GRBW139310032	GR1341C0009N
Mirabello	GRBW139310007	GR1341C0012N

Name	Code	Interrelated coastal systems
Mpoufos	GRBW139310033	GR1341C0009N
Elounda Pigadakia	GRBW139310020	GR1341C0012N
Plaka	GRBW139310024	GR1341C0011N
Poros	GRBW139310036	GR1341C0012N
Poros North	GRBW139310028	GR1341C0012N
Sisi - Limani	GRBW139310016	GR1341C0009N
Schisma	GRBW139310025	GR1341C0011N

1.7.4 Water bodies for drinking water abstraction

The Bodies of water used for the abstraction of water intended for human consumption in the two areas of interest, as included in the approved River Basin Management Plan of GR13 Water District are presented in the following Table 25 and Table 26.

Table 25: Aquifers used for water abstraction in Platanias

Name	Code	Aquifer Type	Area (sq.km)[1]
Coastal karst aquifer of Spatha (Rodopos)	GR1300322	karstic	79.29
karst aquifer of NW Lefka Ori (Agyias)	GR1300031	Karstic	122.92
Karst aquifer of Topolia	GR1300011	karstic	97.19
Karst aquifer of S. Lefka Ori	GR1300034	karstic	482,03

[1]Source: River Basin Management Plans of GR13

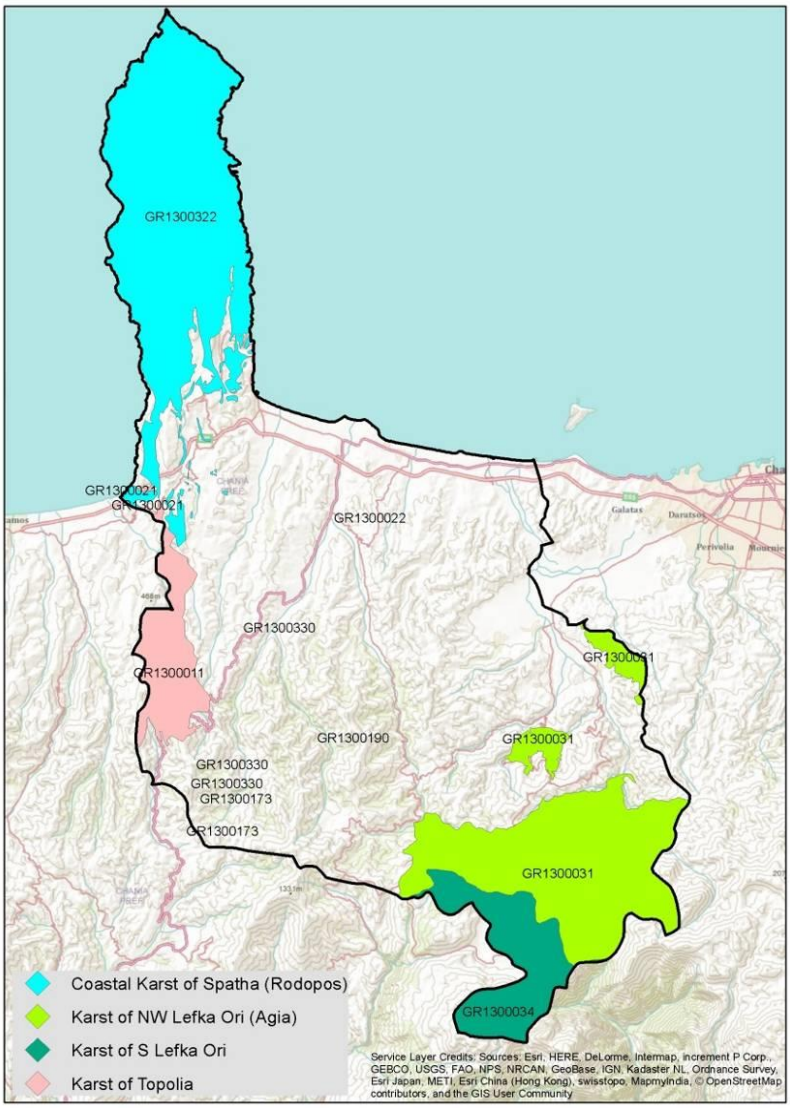


Fig. 42: Geodatabase Map Extract of the area of interest, depicting the boundaries of Platanias Municipality and the aquifers used for water abstraction

Table 26: Aquifers used for water abstraction in Ag. Nikolaos

Name	Code	Aquifer Type	Area (sq.km)[1]
Coastal karst of Sisi-Milatos-Elounda	GR1300116	karstic	90.18
Karst of Fourni - Elounda	GR1300115	karstic	80.98
Karst of NE Mount Dikti	GR1300113	karstic	86.75
Karst of Malia - Selena	GR1300112	karstic	92.51
Coastal karst of Malavra – Pachia Ammos	GR1300132	karstic	15.85

[1]Source: River Basin Management Plans of GR13

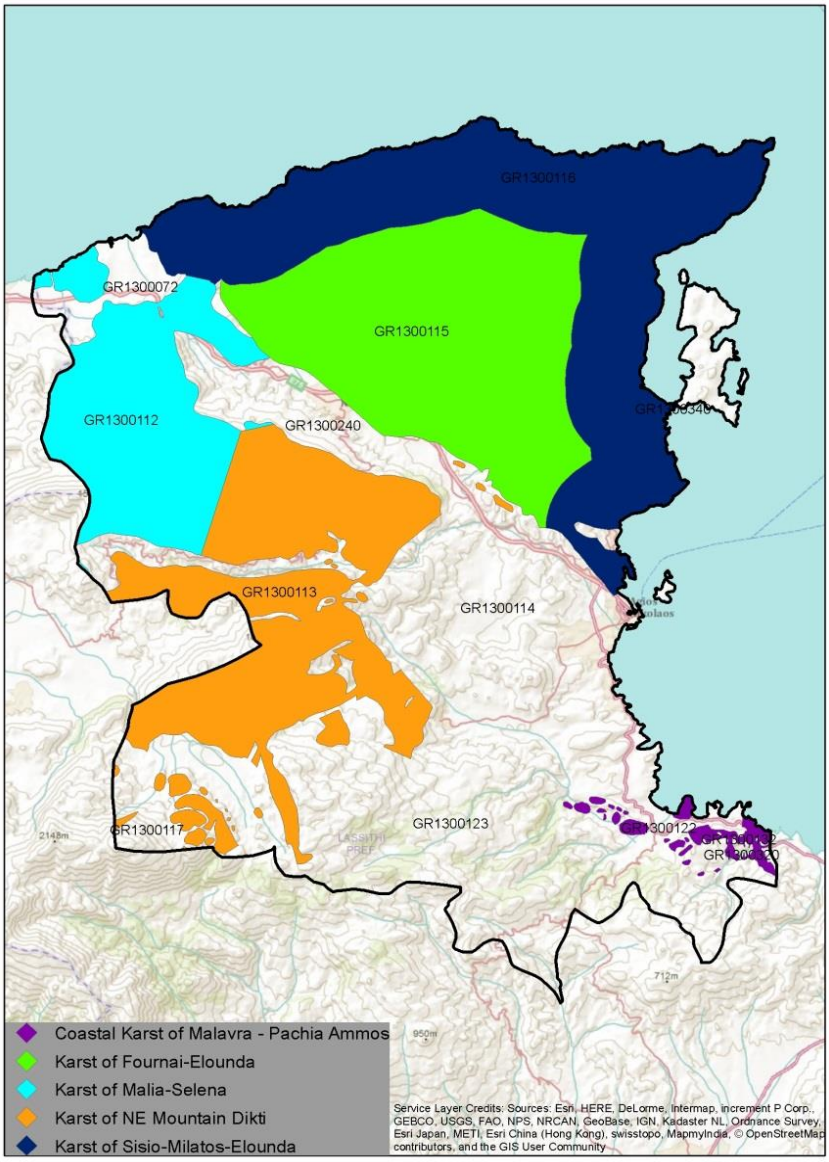


Fig. 43: Geodatabase Map Extract of the area of interest, depicting the boundaries of Ag. Nikolaos Municipality and the aquifers used for water abstraction

1.8 RIVER BASINS WITHIN THE CRETE WATER DISTRICT (GR13)

Crete, according to National Law 1739/1987 is an autonomous River Basin District (GR13) that also includes the surrounding small islands (Fig. 44).
According to the recently approved River Basin Management Plan (National Gazette 570B/08-04-2015) the River Basin District GR13 comprises three River Basins (also shown in fig.1), namely:

- Streams of Northern Part of Chania-Rethymno-Heraklio (GR39), total area 3.676,06 sq.km,
- Streams of Southern Part of Chania-Rethymno-Heraklio (GR40), total area 2.798,2 sq.km,
- Streams of Eastern Crete (GR41), total area 1.870,28 sq.km.

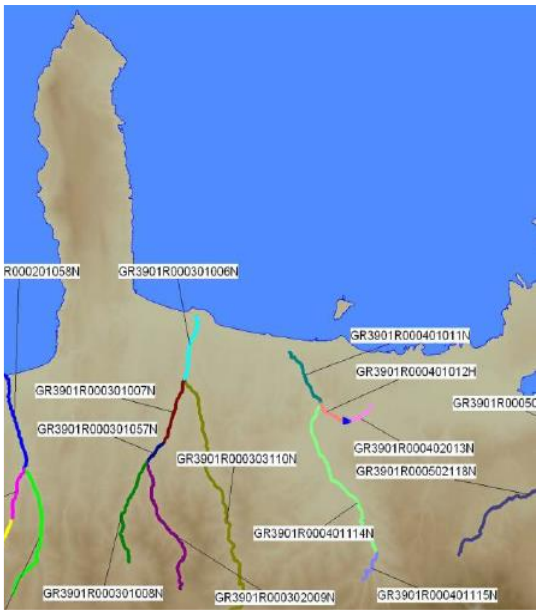
As shown in Fig. 44, the LIFE AgroClimaWater Project's areas of interest are located in two different river basins, i.e. GR 39 (Municipality of Platanias) and GR41 (Municipality of Ag. Nikolaos). It should be noted that the above is in accordance with the GR13 River Basin Management Plan, however, a small part of Platanias falls into GR40, while a small part of Ag. Nikolaos, also falls into GR39 (Fig. 44).

Fig. 44: Google Earth Map extract of Crete island, depicting the municipal boundaries of Platanias and Agios Nikolaos and the three River basins of GR13: GR39, GR40 & GR41

1.8.1 Surface water bodies

1.8.1.1 Rivers

Within the area of Municipality of Platanias the following rivers can be found:

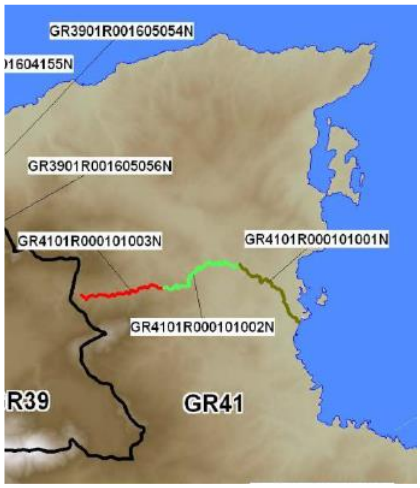


Code/ Type	Name	Length (m)
GR1339R000301006N / RM1	TAVRONITIS	4063
GR1339R000301007N / RM1	TAVRONITIS	4098
GR1339R000303110N / RM1	TAVRONITIS	1779
GR1339R000302009N / RM1a	TAVRONITIS	9006
GR1339R000301057N / RM1a	TAVRONITIS	1681
GR1339R000301008N / RM1a	TAVRONITIS	6720
GR1339R000401011N / RM2	KERITIS	3912
GR1339R000401114N / RM1	KERITIS	1098
GR1339R000401115N / RM1a	KERITIS	2407

Typology of Platanias Rivers (2013/480/EU)

- RM1: Small Mediterranean streams with catchment < 100 sq.km, mixed (except silicious) geology and highly seasonal flow regime
- RM1a: Small Mediterranean streams with catchment < 10 sq.km,
- RM2: Medium Mediterranean streams with catchment 100-1000 sq.km,

Moreover, both Tavronitis and Keritis river mouths are characterized as transitional waters and in particular as River Deltas.
As far as the Municipality of Ag. Nikolaos is concerned, the following rivers can be found (according to GR13 River Basin Management Plan):

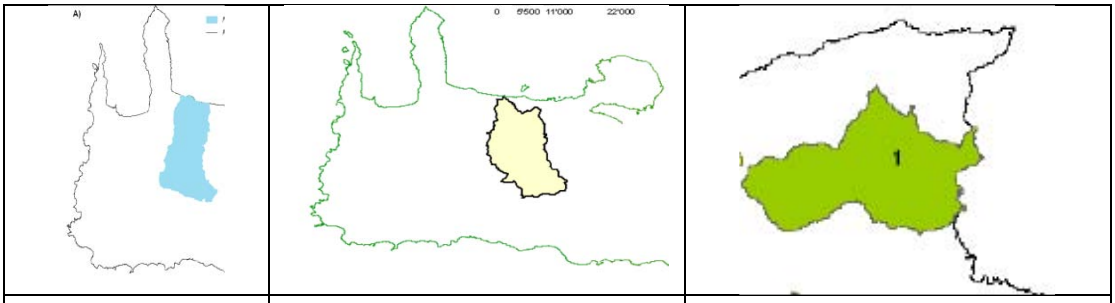


Code/ Type	Name	Length (m)
GR1341R000101001N RM5	ALMYROS LASITHI	6449
GR1341R000101002N RM5	ALMYROS LASITHI	7560
GR1341R000101003N RM4	ALMYROS LASITHI	6493

Typology of Ag. Nikolaos rivers (2013/480/EU):

- RM4: Mediterranean mountain streams of non silicious geology and highly seasonal flow regime
- RM5: Temporary streams

The surface waters of Platanias Municipality can be classified in the sub-basins of Tavronitis and Keritis (Fig. 45). This classification is mentioned in the approved River Basin Management Plan of Crete (GR13). Moreover, there are specific management plans for Tavronitis (Nikolaidis et al., 2012) and Keritis sub-basins (Nikolaidis et al., 2010). As far as the surface waters of Ag. Nikolaos Municipality are concerned, these according to the approved River Basin Management Plan of Crete (GR13) form one sub- basin, namely the Agios Nikolaos sub-basin (Fig. 45).



Tavronitis	Keritis	Agios Nikolaos
Municipality of Platanias		Municipality of Ag. Nikolaos

Fig. 45: Tavronitis (left) & Keritis (middle) sub-basin of the Municipality of Platanias and Agios Nikolaos sub-basin (right) of the Municipality of Agios Nikolaos

1.8.1.2 Surface water pressures

Based on GR13 River Basin Management Plan, it can be concluded that most of the surface waters of the two areas of interest (Municipalities of Platanias and Ag. Nikolaos) are subject to low anthropogenic pressures, while only in two rivers and in particular in GR3901R000401115N in Platanias and GR4101R000101003N in

Agios Nikolaos the pressures exercised can be characterized as moderate, possibly leading to eutrophication and deoxygenation of water (Table 27 & Table 28).

Table 27: Anthropogenic pressures on the surface waters of the Municipality of Platanias

Code	Name	Agglomerations with WWT	Agglomerations without a WWT	No of IPPC	No of facilities emitting Priority Substances	No of facilities emitting other substances	Livestock farms	Fish farms	P load from surface runoffs	No of mines	No of Seveso facilities	Percentage of urban areas	Percentage of agricultural	No of uncontrolled	Organic and nutrients load in surface	Total Rating	Pressure characterizatio n
GR3901R000401011N	KERITHS	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	low
GR3901R000401114N	KERITHS	0	0	1	0	0	1	0	0	0	0	0	2	0	0	4	low
GR3901R000401115N	KERITHS	0	1	2	0	0	2	0	1	0	0	0	2	0	0	8	moderate
GR3901R000301006N	TAVRONITHS	0	1	1	0	0	1	0	0	0	0	0	2	0	0	5	low
GR3901R000301007N	TAVRONITHS	0	0	1	0	0	2	0	0	0	0	0	1	0	0	4	low
GR3901R000303110N	TAVRONITHS	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	low
GR3901R000302009N	TAVRONITHS	0	1	1	0	0	2	0	0	0	0	0	1	0	0	5	low
GR3901R000301057N	TAVRONITHS	0	1	1	0	0	2	0	0	0	0	0	2	0	0	6	low
GR3901R000301008N	TAVRONITHS	0	1	1	0	0	1	0	0	0	0	0	2	0	0	5	low

Table 28: Anthropogenic pressures on the surface waters of the Municipality of Ag. Nikolaos

Code	Name	Agglomerations with WWT	Agglomerations withoutWWT	No of IPPC	No of facilities emitting Priority Substances	No of facilities emitting other substances	Livestock farms	Fish farms	P load from surface runoffs	No of mines	No of Seveso facilities	Percentage of urban areas	Percentage of agricultural areas	No of uncontrolled landfills	Organic and nutrients load in surface runoffs	Total Rating	Pressure characterization
GR4101R000101001N	ALMYROS LASITHI	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	low
GR4101R000101002N	ALMYROS LASITHI	0	0	1	0	0	2	0	0	2	0	0	0	0	0	5	low
GR4101R000101003N	ALMYROS LASITHI	1	0	1	0	0	2	0	0	2	0	0	2	0	0	8	moderate

1.8.1.3 Surface water status

Based on the analysis provided in the Water Management Plans of Tavronitis sub-basin (Nikolaidis et al., 2012) and Keritis- Therisos-Koiliaris sub-basins (Nikolaidis et al., 2010), the chemical status of surface water in both Tavronitis and Keritis sub-basins is considered as good.

However, according to the approved River Basin Management Plan of Crete Water District (GR 13), both Tavronitis and Keritis chemical status is largely unknown, with the exception of GR3901R000401011N (Keritis), whose chemical status is characterized as good. As far as ecological status is concerned, Keritis is classified as having good ecological status, with the exception of GR3901R000401011N (Keritis) which is classified as unknown, while Tavronitis' ecological status is largely unknown, with the exception of GR3901R000303110N (Tavronitis), which is classified as good.

Given the lack of data and studies concerning Agios Nikolaos sub-basin, the chemical and ecological status of the river is classified as unknown (Table 29).

Table 29: Ecological and Chemical Status of rivers of both Platanias & Ag. Nikolaos

Area	Code	Name	Ecological Status	Chemical Status
Platanias	GR3901R000401011N	KERITIS	Unknown	Good
	GR3901R000401114N	KERITIS	Good	Unknown
	GR3901R000401115N	KERITIS	Good	Unknown
	GR3901R000301006N	TAVRONITIS	Unknown	Unknown
	GR3901R000301007N	TAVRONITIS	Unknown	Unknown
	GR3901R000303110N	TAVRONITIS	Good	Unknown
	GR3901R000302009N	TAVRONITIS	Unknown	Unknown
	GR3901R000301057N	TAVRONITIS	Unknown	Unknown
	GR3901R000301008N	TAVRONITIS	Unknown	Unknown
Agios Nikolaos	GR4101R000101001N	ALMYROS LASITHI	Unknown	Unknown
	GR4101R000101002N	ALMYROS LASITHI	Unknown	Unknown
	GR4101R000101003N	ALMYROS LASITHI	Unknown	Unknown

1.8.1.4 Lakes

No Lakes are located within the project's areas of interest.

1.8.2 Groundwater bodies

The groundwater bodies identified in the area of Platanias Municipality are depicted in Fig. 46. Further information is provided on Table 30.

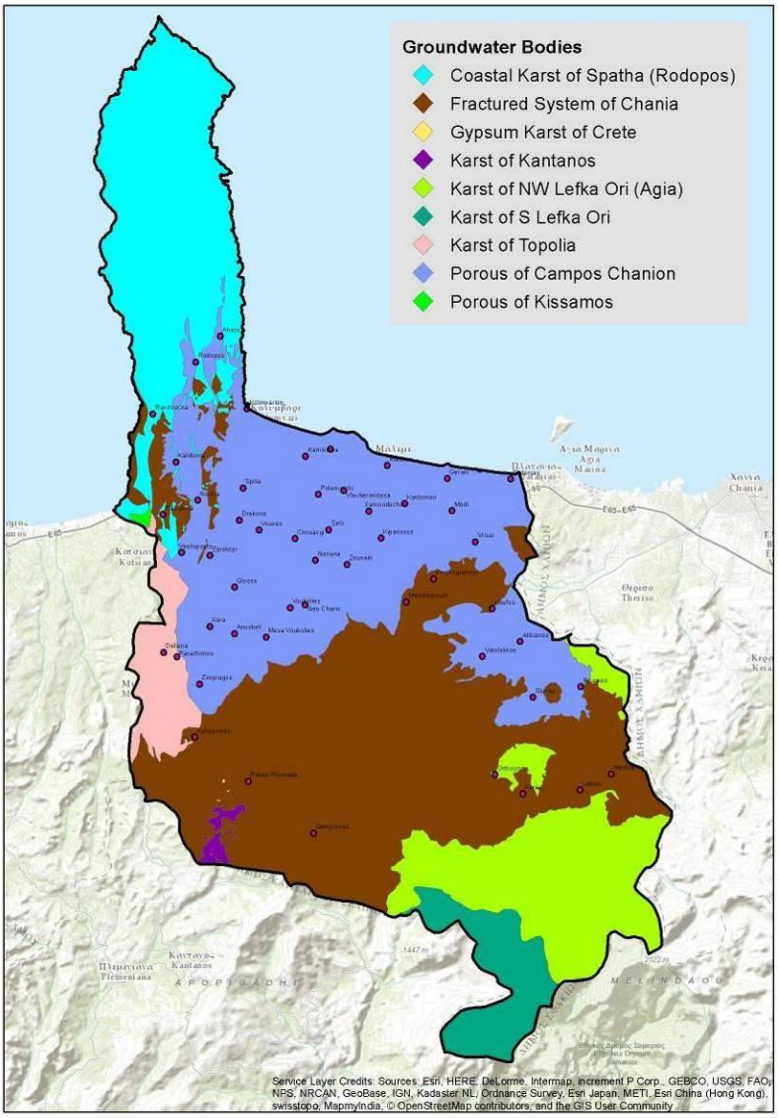


Fig. 46: Geodatabase Map Extract of the Municipality of Platanias, depicting the groundwater bodies identified in the area

Table 30: Description of Groundwater bodies of Platanias

Code	Name	Aquifer Type	Area (sq.km)
GR1300322	Coastal karst aquifer of Spatha (Rodopos)	karstic	79.29
GR1300022	Porous aquifer of Campos Chanion	porous	279.78
GR1300173	karst aquifer of Kantanos	karstic	10.80
GR1300031	karst aquifer of NW Lefka Ori (Agyias)	karstic	122.92
GR1300190	Fractured Rock aquifer of Chania	Fractured rock	582.04
GR1300011	Karst aquifer of Topolia	karstic	97.19
GR1300021	Porous of Kissamos	porous	38.43
GR1300034	Karst aquifer of S. Lefka Ori	karstic	482,03
G31300330	Gypsum karst aquifer of Crete	karstic	17.87

Within the area of Municipality of Agios Nikolaos the groundwater bodies depicted in Fig. 47 have been identified.

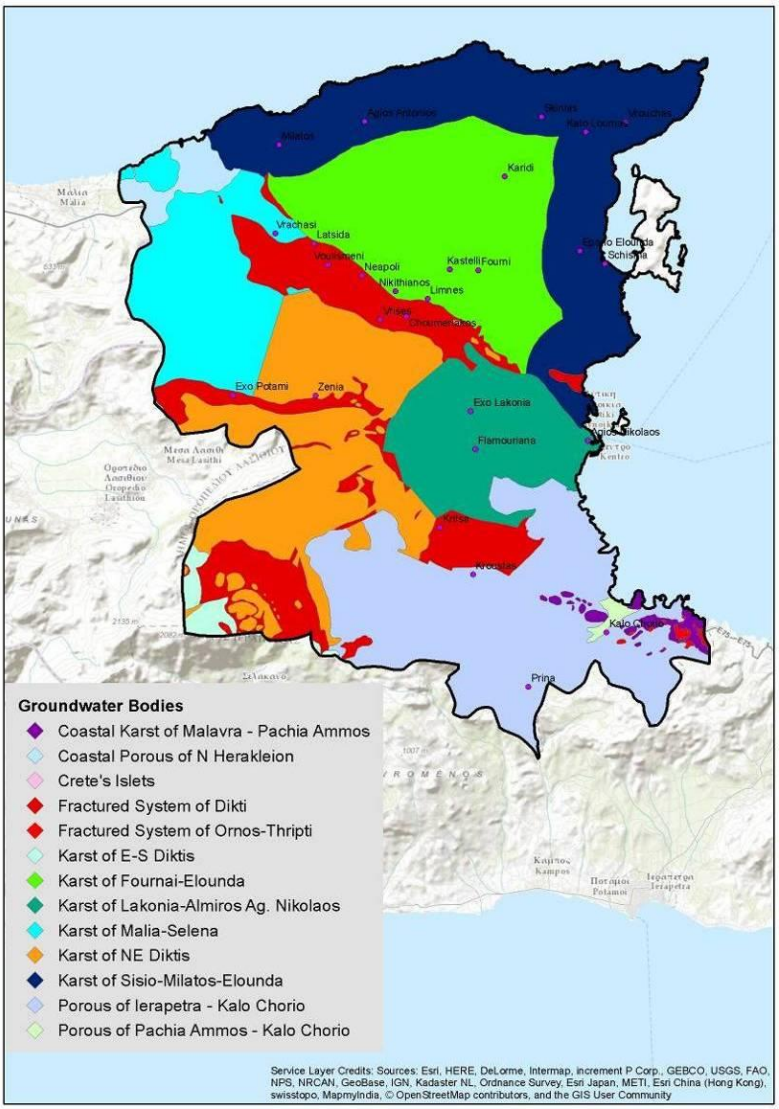


Fig. 47: Geodatabase Map Extract of the Municipality of Ag. Nikolaos, depicting the groundwater bodies identified in the area

Further information is provided on Table 31.

Table 31: Description of Groundwater bodies of Ag. Nikolaos

Code	Name	Aquifer Type	Area (sq.km)
GR1300116	Coastal karst of Sisio-Milatos-Elounda	karstic	90.18
GR1300115	Karst of Fournai – Elounda	karstic	80.98
GR1300240	Fractured rock aquifer of Mount Dikti	fractured rock	269.37
GR1300114	Karst of Lakonia-Almyros – Ag. Nikolaos	karstic	43.57
GR1300113	Karst of NE Mount Dikti	karstic	86.75
GR1300123	Porous aquifer of Ierapetra (Neogene)	porous	260.97
GR1300072	Coastal Porous of N. Herakleion	porous	111.7
GR1300112	Karst of Malia - Selena	karstic	92.51
GR1300122	Porous of Pachia Ammos – Kalo Chorio	porous	27.08
GR1300132	Coastal karst of Malavra – Pachia Ammos	karstic	15.85
GR1300320	Fractured rock aquifer of Ornos – Thripti	fractured rock	125.94
GR1300340	Crete's Islets	karstic	43.42

1.8.2.1 Groundwater status

Groundwater bodies, within the administrative boundaries of Platanias Municipality, in general do not experience significant anthropogenic pressures, except for the Fractured Rock Aquifer of Chania (GR1300190) that is locally over- exploited (Table 32).

Table 32: Pressure impacts on Groundwater bodies of Platanias

Code	Name	Anthropogenic Pressures / Impacts	Natural Pressures/ impacts
GR1300322	Coastal karst aquifer of Spatha (Rodopos)	No	-
GR1300022	Porous aquifer of Campos Chanion	No	-
GR1300173	Karst aquifer of Kantanos	No	-
GR1300031	Karst aquifer of NW Lefka Ori (Agyias)	No	-
GR1300190	Fractured Rock aquifer of Chania	Local over- exploitation	-
GR1300011	Karst aquifer of Topolia	No	-
GR1300021	Porous of Kissamos	Local salinization at the coastal zone	-
GR1300034	Karst aquifer of S. Lefka Ori	No	-
G31300330	Gypsum karst aquifer of Crete	No	Excess sulfate values due to layers of gypsum

Groundwater bodies in Municipality of Agios Nikolaos are subject to more pressures stemming from human activities that lead to local over – exploitation of the area's aquifers. Moreover, the coastal area experiences naturally driven salinization of the groundwater (Table 33).

Table 33: Pressure impacts on Groundwater bodies of Agios Nikolaos

Code	Name	Anthropogenic Pressures / Impacts	Natural Pressures/ impacts
GR1300116	Coastal karst of Sisi-Milatos-Elounda	No	Excess chloride values attributed to natural salinization (vicinity of the karst aquifer to the sea)
GR1300115	Karst of Fourni - Elounda	Marginal local over-exploitation	-
GR1300240	Fractured rock aquifer of Mount Dikti	Local over- exploitation	-
GR1300114	Karst of Lakonia-Almyros – Ag. Nikolaos	No	Excess chloride values attributed to natural salinization (vicinity of the karst aquifer to the sea)
GR1300113	Karst of NE Mount Dikti	No	-
GR1300123	Porous aquifer of Ierapetra (Neogene)	Local over- exploitation in the coastal zone	-
GR1300072	Coastal Porous of N. Herakleion	Over-Exploitation. Groundwater level depletion. Salinization (Cl- up to 830 mg/l)	-

Code	Name	Anthropogenic Pressures / Impacts	Natural Pressures/ impacts
GR1300112	Karst of Malia - Selena	Local over-exploitation at the coastal zone	-
GR1300122	Porous of Pachia Ammos – Kalo Chorio	Marginal over-exploitation	-
GR1300132	Coastal karst of Malavra – Pachia Ammos	No	Excess chloride values attributed to natural salinization (vicinity of the karst aquifer to the sea)
GR1300320	Fractured rock aquifer of Ornos – Thripti	No	-
GR1300340	Crete's Islets	No	Excess chloride values attributed to natural salinization (vicinity of the karst aquifer to the sea)

Overall, the quantitative and chemical status of the groundwater bodies located in Municipalities of Platanias and Ag. Nikolaos according to the approved River Management Plan of Crete (GR13) is presented in the following tables, respectively.

Table 34: Quantitative and Qualitative Status of Platanias Municipality

Code	Name	Quantitative Status	Qualitative Status	Comments
GR1300322	Coastal karst aquifer of Spatha (Rodopos)	Good	Good	Naturally driven salinization effects
GR1300022	Porous aquifer of Kampos Chanion	Good	Good	-
GR1300173	Karst aquifer of Kantanos	Good	Good	-
GR1300031	Karst aquifer of NW Lefka Ori (Agyias)	Good	Good	-
GR1300190	Fractured Rock aquifer of Chania	Good	Good	Local over- exploitation of low water capacity aquifers
GR1300011	Karst aquifer of Topolia	Good	Good	-
GR1300021	Porous of Kissamos	Good	Good	Local salinization at the coastal zone
GR1300034	Karst aquifer of S. Lefka Ori	Good	Good	-
G31300330	Gypsum karst aquifer of Crete	Good	Good	Increased background values due to layers of gypsum

Table 35: Quantitative and Qualitative Status of Ag. Nikolaos Municipality

Code	Name	Quantitative Status	Qualitative Status	Comments
GR1300116	Coastal karst of Sisi-Milatos-Elounda	Good	Good	Naturally driven salinization effects

GR1300115	Karst of Fourni - Elounda	Good	Good	Marginal local over - exploitation
GR1300240	Fractured rock aquifer of Mount Dikti	Good	Good	Local over-exploitation of low water capacity aquifers
GR1300114	Karst of Lakonia-Almyros – Ag. Nikolaos	Good	Good	Naturally driven salinization effects
GR1300113	Karst of NE Mount Dikti	Good	Good	-
GR1300123	Porous aquifer of Ierapetra (Neogene)	Good	Good	Local over-exploitation at the coastal zone during summer)
GR1300072	Coastal Porous of N. Herakleion	Bad	Bad	Over- exploitation, salinization
GR1300112	Karst of Malia - Selena	Good	Good	Local over-exploitation of the coastal zone during summer
GR1300122	Porous of Pachia Ammos – Kalo Chorio	Good	Good	Marginal over-exploitation
GR1300132	Coastal karst of Malavra – Pachia Ammos	Good	Good	Increased background values due to natural salinization
GR1300320	Fractured rock aquifer of Ornos – Thripti	Good	Good	-
GR1300340	Crete's Islets	Good	Good	Increased background values due to natural salinization

1.9 RIVER SUB-BASINS WITHIN THE TARGETED AREAS OF PLATANIAS AND AG. NIKOLAOS MUNICIPALITIES

Considering the approved River Basin Management Plan of Crete (GR13) the specifically characterize river sub-basins in the areas of interest does not, namely Platanias and Ag. Nikolaos Municipalities, since in both cases the sub-basins identified cover only parts of the areas of interest. For this reason, the project's scientific team proceeded with sub-basins identification within the areas of interest.

1.9.1 Sub-basins within Platanias Municipality

The sub-basins within the boundaries of Platanias Municipality were designed using the hydrographic network and geomorphological condition (contours) of the area. In short, the etching of the watershed1 was conducted, resulting in the sub-basins depicted in Fig. 48. As a basis, the River Basin Management Plan of Crete (GR13), as well as the specific management plans for Tavronitis (Nikolaidis et al., 2012) and Keritis sub-basins (Nikolaidis et al., 2010) were utilized.

[1] The watershed is the hypothetical line that connects the highest points of the earth's tumps and separates the rainwater's flow.

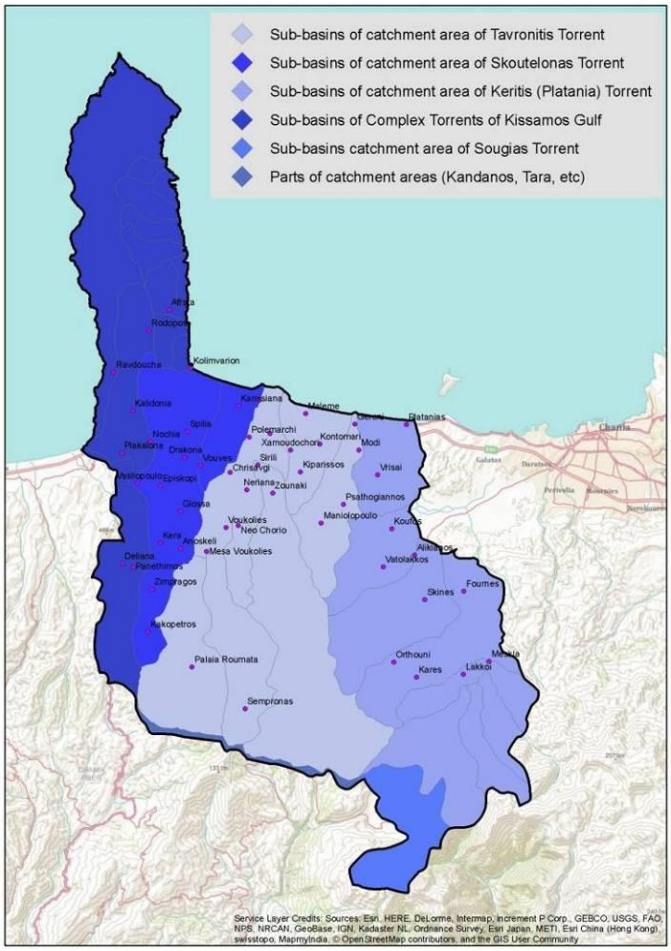


Fig. 48: Geodatabase Map Extract of the Municipality of Platanias, depicting the sub-basins in the area

As shown in Fig. 48 there are five main river sub-basins within the area of Platanias Municipality, each of which can be further divided into smaller sub-basins. The five main river sub-basins of the area include the catchment area of Complex torrents of Kissamos, the catchment area of Skoutelonas torrent, the catchment area of Tavronitis, the catchment area of Keritis, as well as part of the catchment area of Sougias torrent. It should be noted here, that the Tavronitis catchment area is depicted as designed in the specific management plan for Tavronitis (Nikolaidis et al., 2012) was utilized.

1.9.2 Sub-basins within Ag. Nikolaos Municipality

According to the approved River Basin Management Plan of Crete (GR13), only one river sub-basin is mentioned within the administration boundaries of Agios Nikolaos Municipality, namely Agios Nikolaos (Fig. 49). Agios Nikolaos river sub-basin covers a vast area characterized by broad elevation differences, which is largely inconvenient for the project's purposes. Moreover, there are no scientific studies on the sub-basin of Agios Nikolaos and thus, no data available.

Fig. 49: Agios Nikolaos River Basin

Furthermore, as shown in the above figure, this sub-basin does not cover the whole area of interest. For the above reasons, the 1st-order mountainous water basins of Greece have been utilized (http://labs.geodata.gov.gr/en/dataset/oreines-lekanes-aporroes-1es-taxes/). These are shown in Fig. 50.

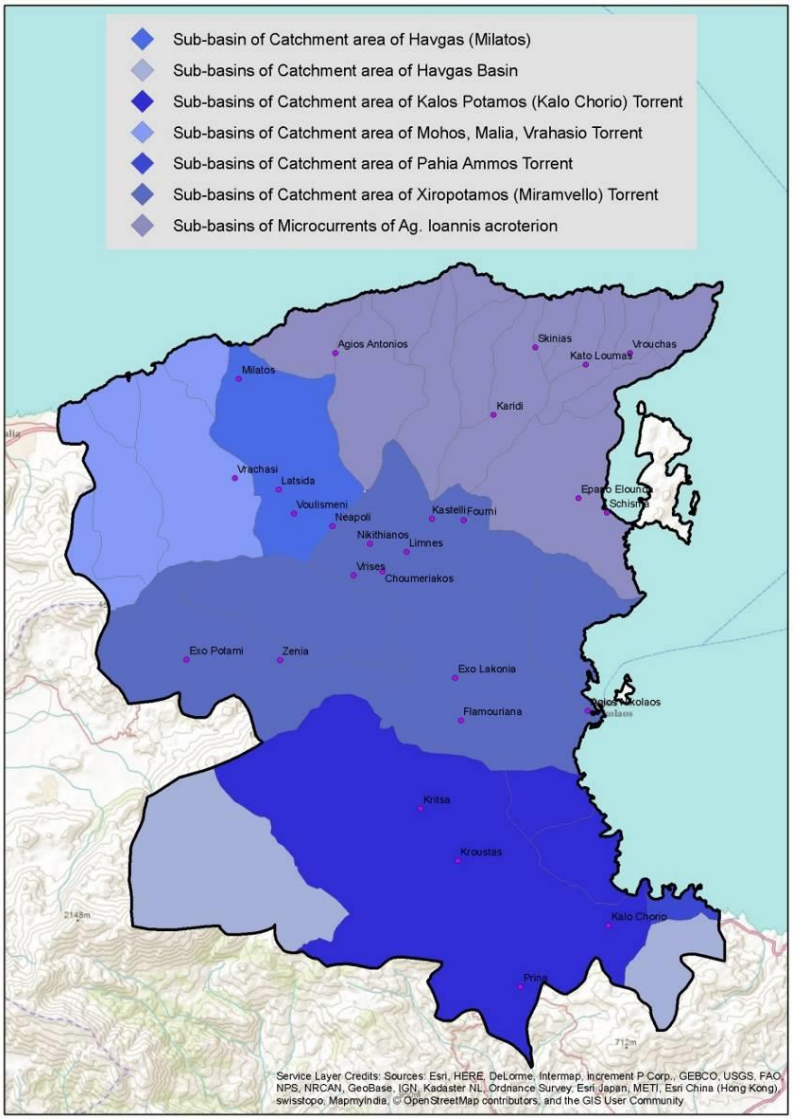


Fig. 50: Geodatabase Map Extract of the Municipality of Ag. Nikolaos, depicting the sub-basins in the area

As shown in the above figure, there are seven main river sub-basins within the area of Ag. Nikolaos Municipality, each of which can be further divided into smaller sub-basins. These include part of the catchment area of Mohos, Malia, Vrahasio torrent, the catchment area of Havgas (Milatos), Microcurrents of Ag. Ioannis Acroterion, the catchment area of Xiropotamos (Mirabello) torrent, the catchment area of Kalos Potamos (Kalo Chorio) torrent, part of the catchment area of Pachia Ammos and part of the catchment area of Havgas basin.

1.10 RESPONSIBLE BODIES ON WATER SERVICES

Water services in the project's target areas are provided by a number of different public and cooperative organizations, each of which is responsible for a particular geographic area and use. In most cases, drinking water services are provided by municipal water supply and sewerage enterprises (DEYA) established under Law No 1069/1980 (OJ 190A) as public benefit, nonprofit legal entities, governed by private law. DEYAs are in general responsible for providing water for potable, industrial and touristic use. In some cases, DEYAs are also responsible for providing water for irrigation purposes in areas not otherwise served. Moreover, irrigation water services, in some cases can also be provided by the municipality

In most agricultural areas, however, irrigation water is provided by independent legal entities governed by private law, established under L.D. No 3881/1958 (OJ 181A), known as TOEB. TOEB is a local agricultural cooperative organization − project management body responsible for the distribution of irrigation water to its farmer members, within its area of responsibility.

1.10.1 Platanias Municipality

Drinking water in all agglomerations of Platanias Municipality is provided by DEYA Boreiou Aksona (DEYABA) Municipal Enterprise, within the responsibilities of which water supply for irrigation purposes is also included (OJ 507B/2011).

Irrigation water on the other hand is supplied by:

- TOEB Agias Kolymvariou
- TOEB Alikianou
- TOEB Agias Marinas - Platania
- TOEB Vatolakkou
- TOEB Fournai
- TOEB Mesklon
- TOEB Koufou
- O.A.K. S.A.
- Municipality of Platanias.

The area of responsibility of the above legal entities is depicted in Fig. 51.

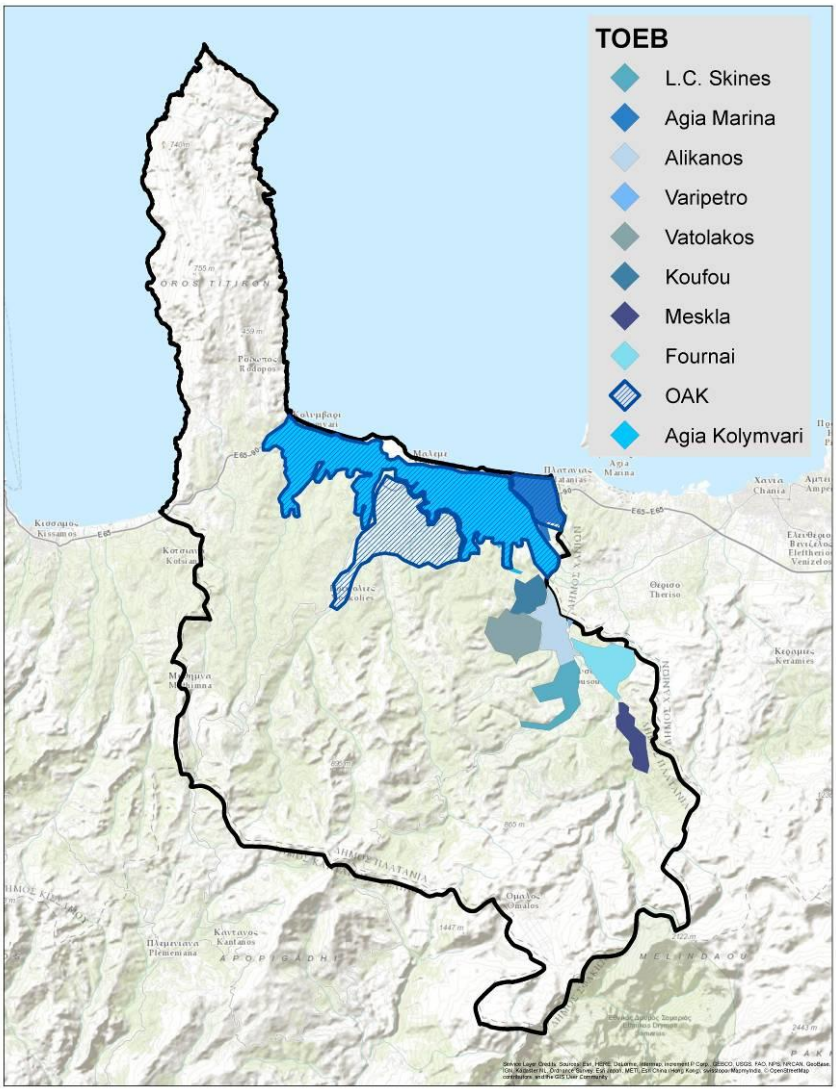


Fig. 51: Geodatabase Map Extract of Platanias, depicting the water bodies area of responsibility in Platanias Municipality

1.10.2 Agios Nikolaos Municipality

Drinking water in all agglomerations of Ag. Nikolaos Municipality is provided by DEYA Agiou Nikolaou (DEYAAN) Municipal Enterprise. DEYAAN is also responsible for providing water for hotels, enterprises, public services, livestock farms and a number of other uses such as stadiums, fire hydrants, parks and public areas. It should be noted here that DEYAAN does not supply irrigation water to farmers. Irrigation water in Ag. Nikolaos Municipality is supplied by two TOEBs, namely TOEB Merambello and TOEB Kalou Choriou, as well as by the Municipality of Ag. Nikolaos, in areas not covered by the irrigation networks of the above organisations. TOEB Merambello supplies water for irrigation purposes to its members located in the agglomerations of Kritsa, M. Lakonia, E. Lakonia, Limnes, Nikithiano, Choumeriako, A. Konstantinos and Drasi. Municipality of Ag. Nikolaos, on the other hand, provides irrigation water to farms located in the areas of Kroustas, E. Lakonia, Vrisses, Prina, Elounda, Skinias, Vrouxas, Louma and Limnes. Last, TOEB Kalou Choriou supplies irrigation water to its members located mainly in the area of Kalo Chorio Local Community.

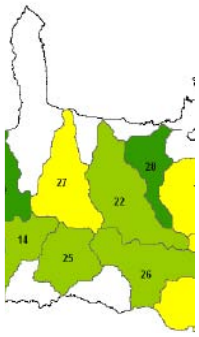
1.11 WATER CONSUMPTION

1.11.1 Water consumption in GR13 Water District

Total water abstraction in GR13 Water District (Crete region) is about 421,4 10^6 m^3/yr and are distributed as follows: 344,10 10^6 m^3/yr for agricultural purposes (cultivations and livestock farming), accounting for about 82% of total consumption and 77,3 10^6 m^3/yr for human consumption (potable water), tourism and industry, accounting for the remaining 18%.

An estimation of the water consumption within the areas of interest is given below. Based on the approved River Basin Management Plan of Grete (GR13), within the Municipality of Platanias two main sub-basins have been identified (Tavronitis and Keritis), while within Municipality of Ag. Nikolaos, there is only one main sub-basin, namely Agios Nikolaos sub-basin (Table 36).

Table 36: Sub-basins of the Municipalities of Platanias and Ag. Nikolaos respectively

	Sub-basin No	Sub-basin Name
	27	Tavronitis
	22	Platanias (Keritis)
	1	Agios Nikolaos

Water consumptions (m^3/yr) for the three sub-basins mentioned in the River Basin Management Plan of Crete (GR13) are presented on Table 37.

Table 37: Water Consumptions (m^3/yr) of the three sub-basins mentioned in the River Basin Management Plan of GR13

Sub- basin	Drinking water	Livestock farming	Irrigation	Oil Mills	Industry / SMEs	Total
Tavronitis	581.881	154.077	9.557.346	24.237	0	10.317.541
Platanias (Keritis)	711.017	117.428	12.263.501	31.476	0	13.123.422
Agios Nikolaos	2.273.438	122.804	5.183.584	20.927	3.333	7.604.086

Based on the data presented on Table 37 irrigation (for agricultural purposes) accounts for 92.6% of total water consumption in Tavronitis sub-basin, 93.4% in Keritis sub-basin and 68.2% in Agios Nikolaos sub-basin.

1.11.2 Platanias Municipality

1.11.2.1 Drinking Water

As mentioned before, drinking water in Municipality of Platanias is supplied by DEYABA from a number of sources within the administrative boundaries of the Municipality. As shown in Fig. 52 DEYABA owns 19 boreholes, with a total maximum allowed annual abstraction quantity of 1.260.237 m^3 of drinking water, 4 springs (68.803 m^3), 2 wells (16.871 m^3) and 30 more water abstraction sources, located in various agglomerations, with a total maximum allowed annual abstraction quantity of 282.195 m^3 of drinking water.

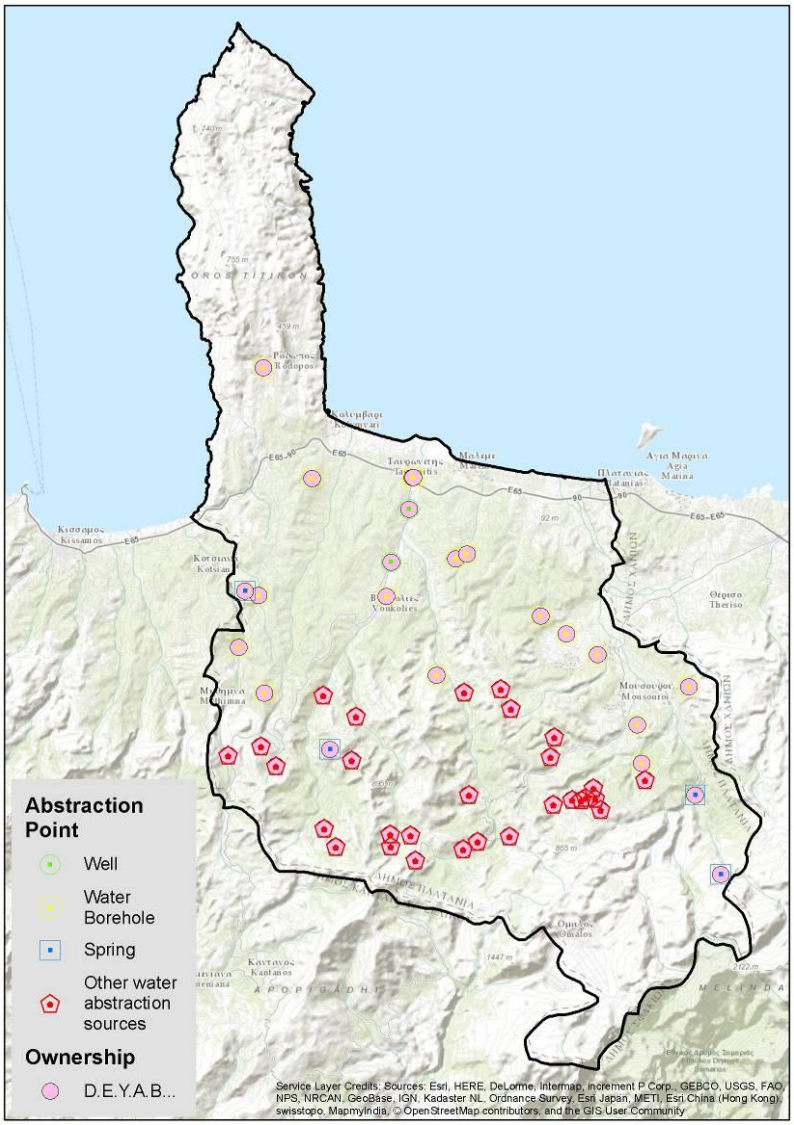


Fig. 52: Geodatabase Map Extract of Platanias, depicting the abstraction points for potable use based on the water usage legal permits issued.

A significant drinking water volume is abstracted from springs, owned by OAK and located in Myloniana (Municipal Unit of Mousoures). In the past years, about 900.000m^3 were annually supplied by OAK (Platanias O.P., 2015).

Based on data provided by Municipality of Platanias, the mean annual drinking water consumption of the years 2011-2014 in the municipality is about 2 million m^3 (Table 38).

Table 38: Mean annual consumption of drinking water (data provided by Platanias Municipality)

Administrative Unit	Inhabitants	Drinking water consumption m^3/yr
Municipal Unit of Voukolies	3116	303.161
Municipal Unit of Kolymvari	4.457	596.571
Municipal Unit of Mousoures	4.026	340.307
Municipal Unit of Platanias	5275	796.738
Municipality of Platanias	16874	2.036.778

1.11.2.2 Irrigation

As mentioned before, irrigation water in Municipality of Platanias is supplied by a number of legal entities among which Municipality of Platanias, OAK, as well as the respective TOEBs located in the area of the municipality. Based on information provided by Municipality of Platanias irrigation data per responsible body is presented on Table 39.

Table 39: Mean annual consumption of irrigation water

Water supply body	Mean irrigation water consumption (m^3/year)
TOEB Agias Kolymvariou (Tavroniti)	5.7×10^6
TOEB Alikianou	1.3×10^6
TOEB Agias Marinas - Platania	2×10^6
TOEB Vatolakkou	1.91×10^6
TOEB Fournai	1.1×10^6
TOEB Mesklon	0.4×10^6
TOEB Koufou	0.55×10^6
O.A.K. S.A.	4×10^6

The area of responsibility of the above bodies is shown in Fig. 51.
Based on published water usage legal permits, OAK manages 5 wells and 2 boreholes, with a total maximum allowed annual abstraction quantity of water equal to 5.232.000 m^3, Municipality of Platanias manages 2 boreholes and a surface water pumping station, with a total maximum allowed annual abstraction quantity of water equal to 138.300 m^3, TOEB Agias Marinas manages 1 well with a total maximum allowed annual abstraction quantity of water equal to 552.000 m^3, while TOEB Fournai owns a water tank (Fig. 53).

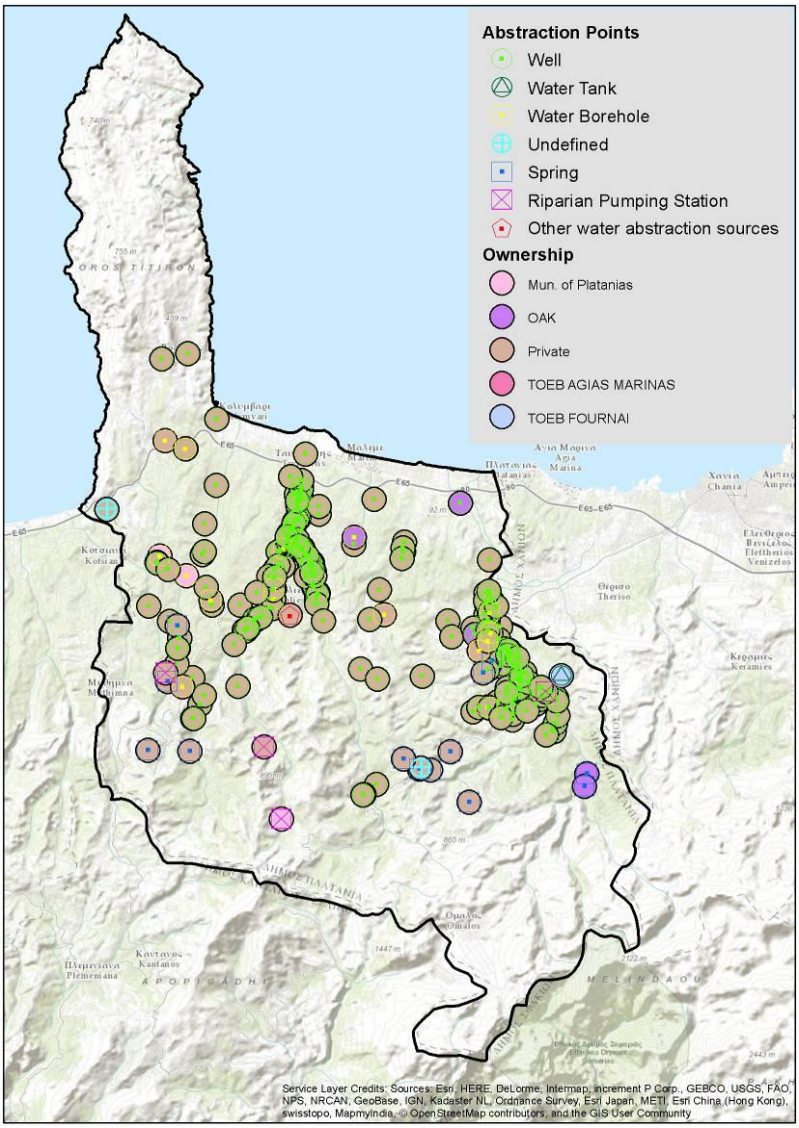


Fig. 53: Geodatabase Map Extract of Platanias, depicting the abstraction points for irrigation use in Platanias based on the water usage legal permits issued

However, based on information provided by Municipality of Platanias, the municipality manages 48 water boreholes for irrigation, with a maximum possible annual water quantity supplied by Municipality of Platanias for strictly irrigation purposes equal to 6,84 million m^3, 11 of which are also utilized for the abstraction of 378.000 m^3 (max) drinking water. Municipality of Platanias also manages 2 wells and 7 more water abstraction sources for irrigation water supply. The overall maximum possible annual water quantity supplied by Municipality of Platanias for strictly irrigation purposes is about 8,34 million m^3, while an extra quantity of about 640.000 m^3 is supplied for drinking water purposes.

Based on information provided by Municipality of Platanias, the mean annual irrigation water consumption of years 2011-2014 in the various agglomerations is presented on Table 40.

Table 40: Mean annual consumption of irrigation water for the years 2011-2014 (data provided by Platanias Municipality)

Administration Unit	Mean Annual Consumption (m^3/yr)
Municipal Unit of Kolymvari	601.918
Kolymvari	16.352
Spilia	59.404
Vasilopoulo	33.270
Drakona	53.789
Glossa	36.753
Episkopi	79.460
Afrata	38.825
Panethimos	27.259
Rodopos	67.951
Nochies	50.396
Kalidonia	72.078
Vouves	32.623
Deliana	5.159
Kares Kissamou	28.601
Municipal Unit of Platanias	282.220
Deres	64.135
Manoliopoulo	85.487
Zounaki	60.041
Limni	72.557
Municipal Unit of Voukolies	222.330
Neo Chorio Kidonias	9.255
Neriana	41.707
Polemarchi	28.370
Gavalomouri	18.832
Palaia Roumata	14.734
Anoskeli	4.414
Chrisavgi	105.018
Municipal Unit of Mousoures	779.282
Skines	573.081
Psathogiannos	186.893
Prases	19.307
Total	1.885.749

Furthermore, based on information provided by Municipality of Platanias, it owns 4 more water boreholes which are currently unused.

Based on published water usage legal permits, in the area of Platanias Municipality there are 14 private water boreholes, with a total maximum allowed annual abstraction quantity of 197.350 m^3 of water. There also exist about 216 privately owned wells, with a total maximum allowed annual abstraction quantity of 1.195.241 m^3 of water and about 15 springs, with a total maximum allowed annual abstraction quantity of 58.235 m^3 of water. The above water resources are utilized for the irrigation of olives, citrus, vegetables, vineyards, avocado etc. Lastly, there is also one privately owned water

abstraction source, with a total maximum allowed annual abstraction quantity of 3.715 m^3 of water and three riparian pumping stations (6.500 m^3/year).

1.11.2.3 Other Water Uses

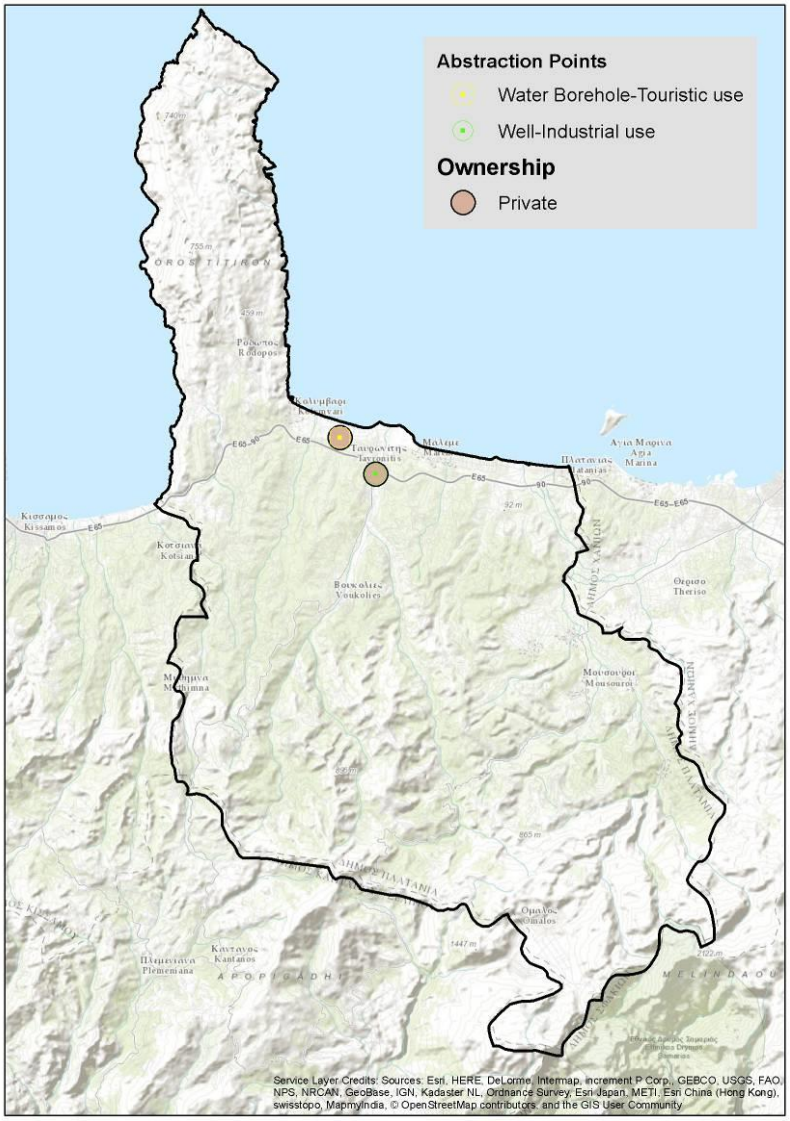


Fig. 54: Geodatabase Map Extract of the area of interest, depicting the abstraction points for other uses in Platanias

Within the administrative boundaries of Municipality of Platanias, there is also 1 privately owned borehole for touristic use (irrigation of parks and filling of swimming pools), with a maximum allowed annual abstraction quantity of 23.750 m^3 of water and 1 privately owned well for industrial use (2.000 m^3/year).

1.11.3 Ag. Nikolaos Municipality

1.11.3.1 Drinking water

Drinking water in Municipality of Ag. Nikolaos is provided by DEYAAN Municipal Enterprise. Based on data provided by DEYAAN mean annual consumption of drinking

water is about 3.1 x 10^6 m^3/yr. In 2013, total consumption of drinking water distributed via DEYAAN water supply network was 3.167.370 m^3, allocated in the main water uses as presented in Table 41.

Table 41: Total consumption of potable water in the main water uses in Ag. Nikolaos Municipality

Water Uses	% Total Consumption
Residences	58,5
Hotel	23,0
Enterprises	12,0
Public Services	4,5
Stadiums	0,9
Livestock farms- poultry	0,8
Other (Churches, fire hydrants etc.)	0,3

Drinking Water Consumption per agglomeration served by DEYAAN's water supply network for 2013 is presented on Table 42.

Table 42: Drinking Water Consumption per agglomeration in Ag. Nikolaos Municipality

Agglomeration	Water Consumption (m^3)
Ag. Nikolaos	1.446.458
Elounda	555.690
K. Chorio	130.145
Kritsa	163.670
Kroustas	23.213
M. Lakonia	19.285
E. Lakonia	20.182
Limnes	19.702
Prina	7.127
Potamoi	2.891
Zenia	4.088
Skinias	6.863
Louma	6.706
Vrouxas	46.902
Neapoli	163.450
Vrisses	15.523
Voulismeni	19.695
Latsida	19.880
Nikithiano	4.527
Vrachasi - Milatos - Sisi	418.543
Choumeriako	23.163
Fourni	21.098
Kasteli	9.811
Karydi	5.343
A. Antonios	13.415

Total	3.167.370

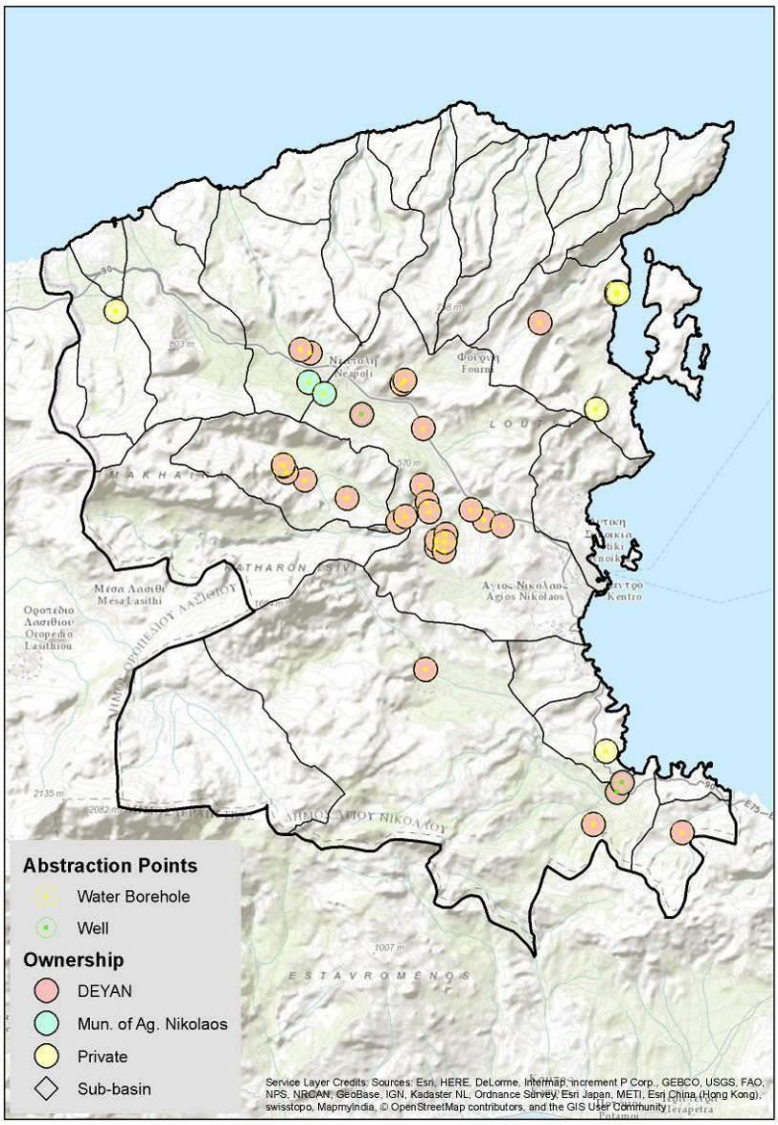


Fig. 55: Geodatabase Map Extract of the area of interest, depicting the abstraction points for potable use in Ag. Nikolaos

DEYAAN manages 34 boreholes, with a total maximum allowed annual abstraction quantity of 4.985.680 m^3 of drinking water. There also exist 23 private boreholes for drinking water and other uses, with a total maximum allowed annual abstraction quantity of 118.147 m^3.

1.11.3.2 Irrigation water

Irrigation water in Municipality of Ag. Nikolaos is provided by TOEB Merambello, TOEB Kalou Choriou, Municipality of Ag. Nikolaos and a number of private owned boreholes. Both Municipal and TOEB's irrigation networks consist of underground pipes developed around the boreholes, each of which is used exclusively for the irrigation of the surrounding area.

Municipality of Ag. Nikolaos manages 64 boreholes with legal permits that allow the annual abstraction of 938.890 m^3 water (max). Mean annual consumption of irrigation

water provided by Municipality of Ag. Nikolaos, for the agglomerations served by the municipal water supply network is presented in Table 43.

Table 43: Mean annual consumption per agglomeration by the municipal water supply network in Ag. Nikolaos Municipality

Agglomeration	Mean annual consumption (m^3/yr)
Kroustas	48.897
E. Lakonia	100.104
Vrisses	30.915
Prina	48.006
Elounda	116.242
Skinias	82.852
Vrouxas	93.350
Louma	67.080
Limnes	10.780
Total	598.226

The above quantity of water is utilized for the irrigation of olive groves (except for the irrigation of 0,1 ha of vegetables).
TOEB Merambello manages 19 boreholes with legal permits that allow the annual abstraction of 3.836.000 m^3 (max). Mean annual consumption of irrigation water provided by TOEB Merambello, for the agglomerations served by TOEB's irrigation water supply network is presented in Table 44.

Table 44: **Mean annual consumption per agglomeration by TOEB Merambello's** irrigation water supply network

Agglomeration	Mean annual consumption (m^3/yr)
Kritsa	477.110
M. Lakonia	332.767
E. Lakonia	246.965
Limnes	107.624
Nikithiano	39.264
Choumeriako	69.580
A. Konstantinos	47.672
Drasi	26.713
Total	1.414.593

The above quantity of water is utilized for the irrigation of olive groves.

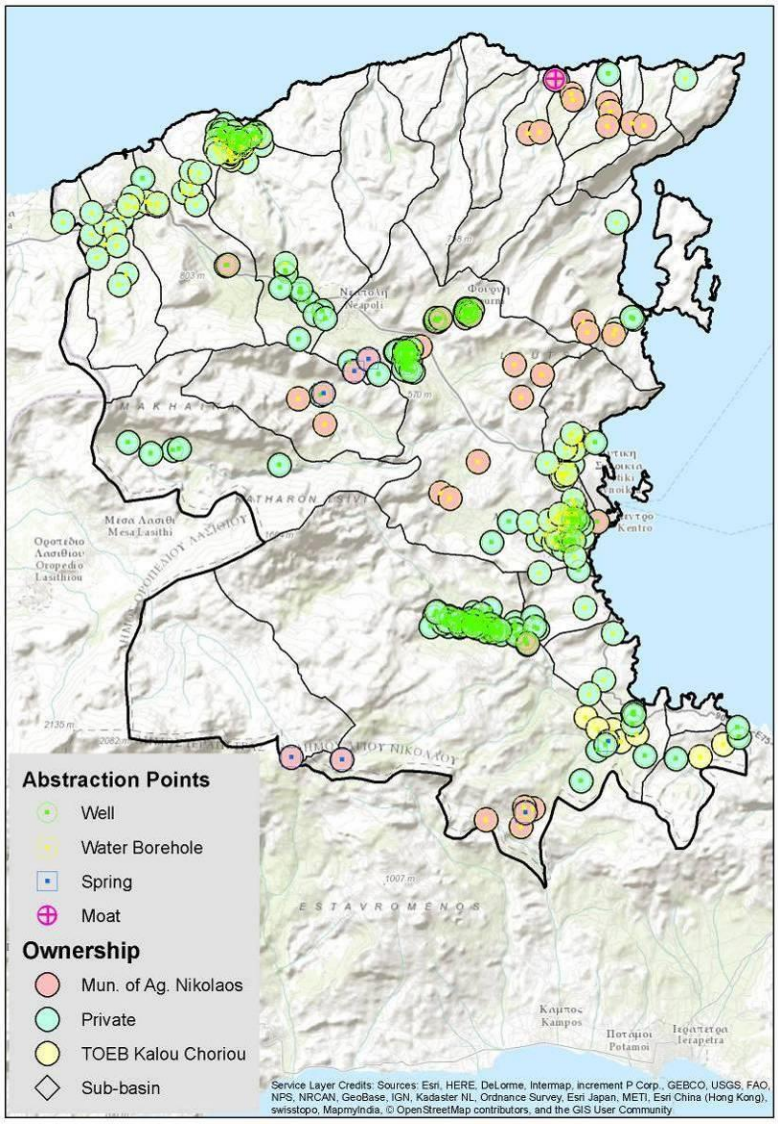


Fig. 56: Geodatabase Map Extract of the area of interest, depicting the abstraction points for irrigation use in Ag. Nikolaos

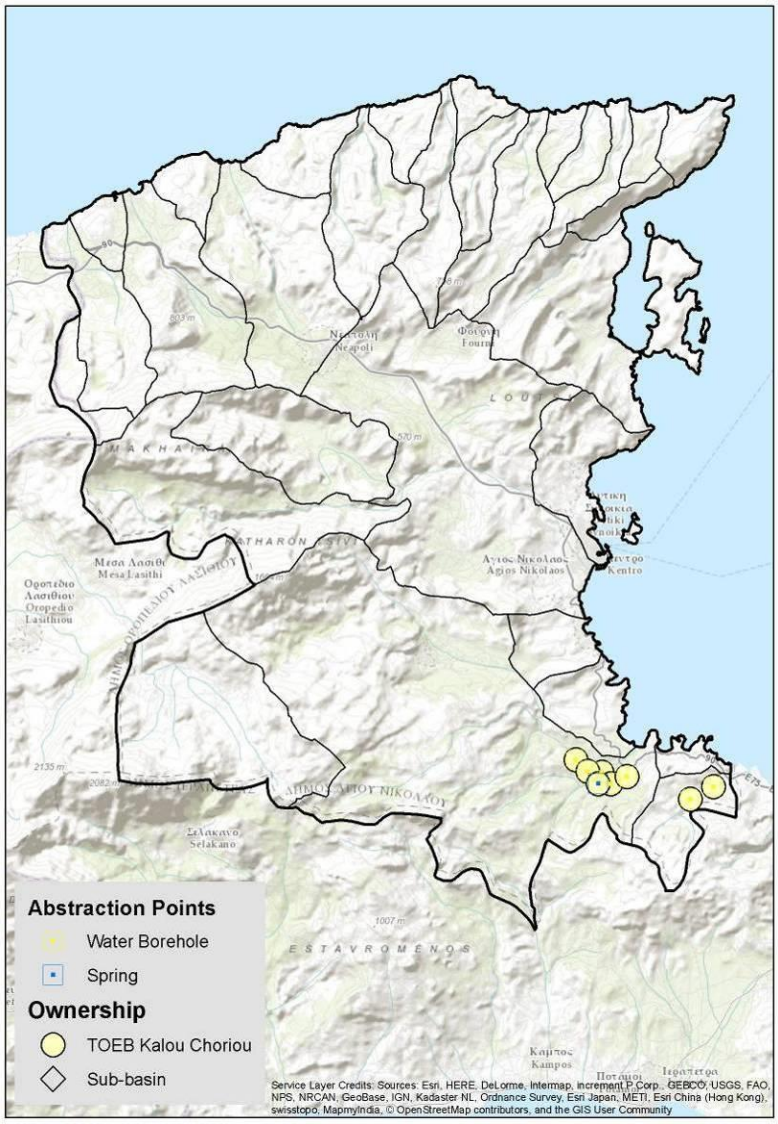


Fig. 57: Geodatabase Map Extract of the area of interest, depicting the abstraction points of TOEB Kalou Choriou in Ag. Nikolaos

TOEB Kalou Choriou manages 7 boreholes (one of which reserved), with legal permits that allow the annual abstraction of 555.500 m^3 (max), without accounting for the 40.000 m^3 of the reserved borehole, that are to be abstracted in case of damage in one of the rest boreholes. TOEB also exploits 1 spring located in Kalo Chorio with a maximum allowed abstraction quantity of 1.000.000 m^3 per year for irrigation purposes. The water supply network of TOEB Kalou Choriou provides irrigation to cultivations of olives, citrus, vegetables and vineyards.

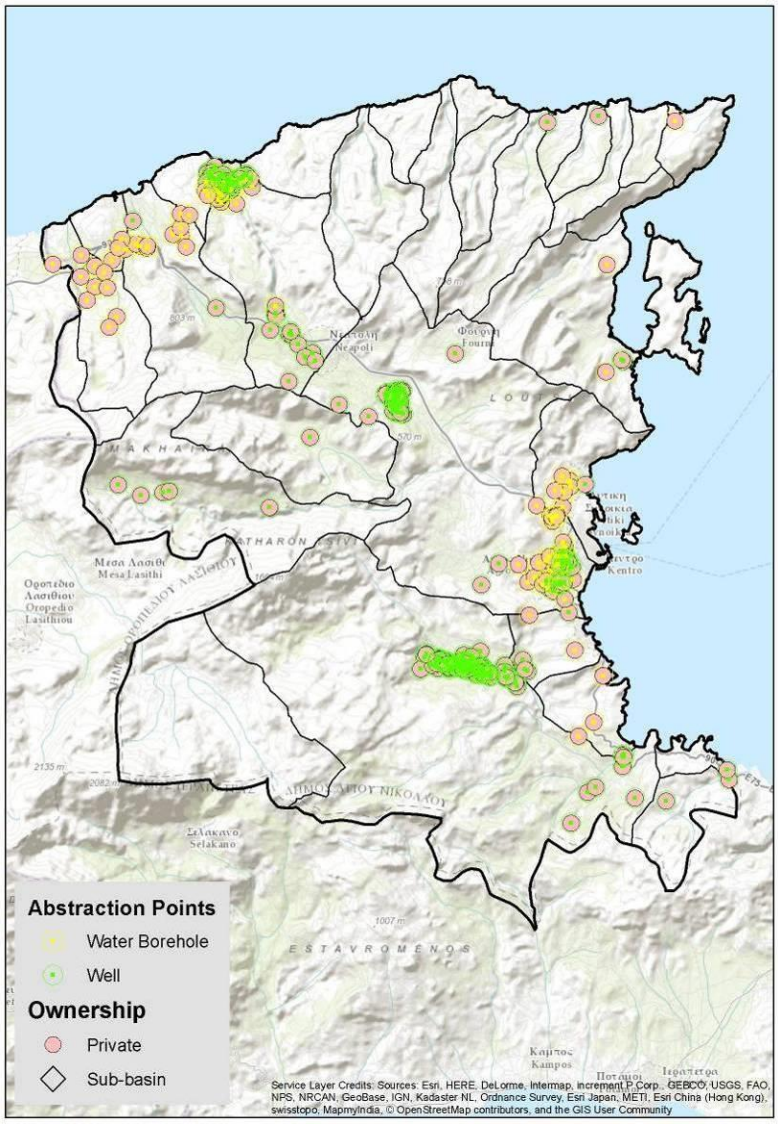


Fig. 58: Geodatabase Map Extract of the area of interest, depicting the private abstraction points in Ag. Nikolaos

Last, within the geographic boundaries of Ag. Nikolaos Municipality 81 private boreholes also exist, used mainly for the irrigation of olive groves, as well as small farms of vegetables and citrus, with a total maximum allowed annual abstraction quantity of 1.114.288 m^3 of water. There also exist 288 private wells, used also for the irrigation of olive groves and vegetables, with a total maximum allowed annual abstraction quantity of 545.365 m^3 of water.

1.11.3.3 Other water uses

Within the administrative boundaries of Ag. Nikolaos Municipality, there is also 1 private well abstracting water for an oil mill with maximum allowed annual abstraction quantity of 1.000 m^3. Last, it should be noted that in the past 2-3 years, 19 legal permits have been issued for the drilling of 53 privately owned water boreholes for geothermal exploitation.

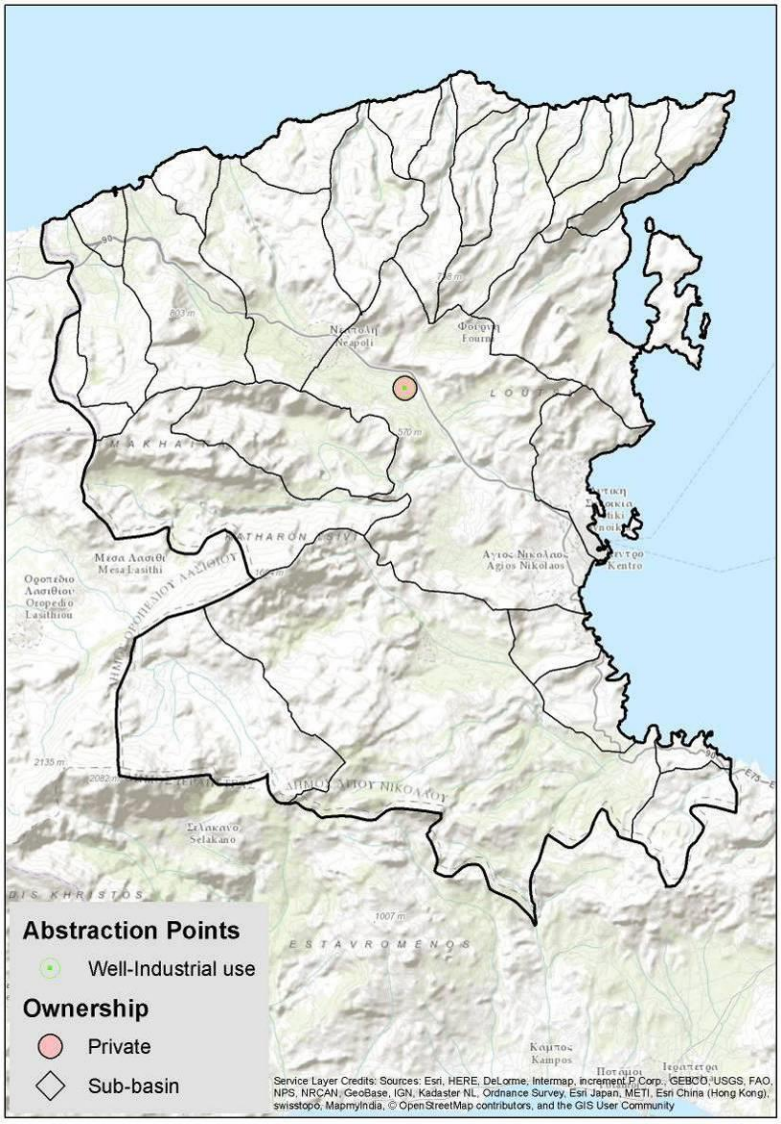


Fig. 59: Geodatabase Map Extract of the area of interest, depicting the abstraction points for other water uses in Ag. Nikolaos

1.12 RESPONSIBILITIES OF PROJECT'S FARMERS' ORGANIZATIONS

The Farmers' Organizations participating in the LIFE AgroClimaWater project are the following:

- Mirabello,
- KEDHP, and
- AFI (as presented in Chapter 4.12)

The main responsibilities of each organization are explained and presented in the next paragraphs.

1.12.1 Mirabello Farmers' Organization

The Agricultural Cooperative Partnership Mirabello Union S.A. (Mirabello) is based in Neapoli in Ag. Nikolaos Municipality. It consists of seven Farmers' Associations (Fig. 60):

- Kritsa

- Fourni
- Latsida
- Elounda
- Prina
- Kalou Choriou
- Krousta

The farmer members of Mirabello are approximately 2.000. These farmers own 10.000 parcels, where olive groves are cultivated and about 1000 parcels where vineyards are cultivated.

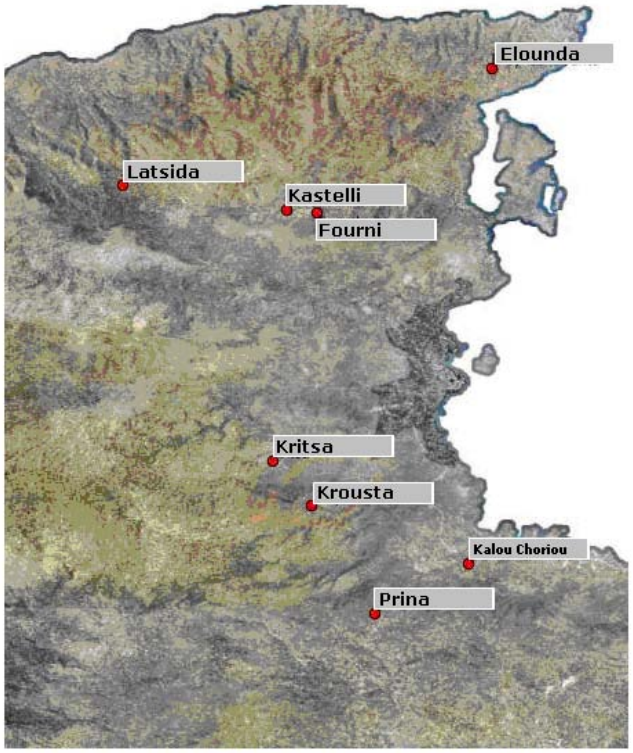


Fig. 60: Location of the Farmers Associations of Mirabello

The main activities that Mirabello is responsible for are:

- Collection, storage, standardization and marketing of olive oil,
- Trade in agricultural supplies from three shops located in Neapoli, Agios Nikolaos and Elounda,
- Serving farmers on issues concerning Community aid funds,
- Examination of oil samples and elaboration of the corresponding test reports,
- Assessment of virgin olive oil, and
- Implementation of the Integrated Management for Olive cultivation, where they operate as advisors for any technical issue that may arise.

1.12.2 Platanias Municipality Development Enterprise (KEDHP)

The Platanias Municipality Development Enterprise (KEDHP) is based in the Municipality of Platanias. It was set up after the merger of four former Legal Entities (Platanias Municipality Development Enterprise, Kolymvari Municipality Development Enterprise, Voukolies Municipality Development Enterprise and Mousoures Municipality Development Enterprise).

The main objective of KEDHP is the planning of actions and the provision of services referred to areas of social protection and solidarity, environment, education and culture. Analytically, as far as the environment is concerned, KEDHP is responsible for the following:

- Olive fly control,
- Elaboration and implementation of research and technology,
- Elaboration of local programs for upgrading the physical architectural and cultural environment in the context of national and European policies,
- Management and adoption of restoration and environmental protection measures
- Design and implementation of programs concerning the protection and management of water resources, soil and air quality and pollution abatement,
- Implementation of environmental national and European programs,
- Development and promotion of the regional products,
- Protection of sea coast and streams
- Development and implementation of integrated management systems in the cultivation of olives, vines and other local products

2. SELECTION OF LIFE AGROCLIMAWATER PILOT SUB-BASINS IN CRETE REGION, GREECE

2.1 PILOT SUB-BASIN SELECTION METHOD

For the selection of the pilot sub-basins a two stage evaluation process has been implemented, further detailed below. To this end, two stage criteria have been utilized, 1st stage criteria for the preliminary selection of the sub-basins, where the 2nd stage criteria would be implemented for the final selection of the pilot sub − basins in each area of interest.

2.1.1 1st Stage evaluation

2.1.1.1 1st Stage criteria

1st stage evaluation was performed based on the following criteria:

A.1 Available crops
A.2 Acceptance of the project by the F.ORs' farmers
A.3 Agricultural management systems already implemented by farmers
A.4 Availability of Data for 2nd stage evaluation (criteria).

A.1. Available crops: Availability of the key crops that have been selected for each area, i.e.: Mirabello: Olive, Platanias: Olive and Citrus, Metapontino: Olive, Citrus and Peach. The following ranking was utilized:

Table 45: Ranking according to criterion A1

One of the key crops non-available	One of the key crops in low availability (as compared to the typical for the area)	All crops available at close, or higher percentages than the typical
0	5	15

A.2**. Acceptance of the project by the F.ORs' f**armers: the particular criterion was assessed by participant FORs according to their previous cooperation with local farmers. The farmers' interest in participating to the project, as already expressed during the proposal drafting, was also taken into account. Rating performed by FORs was based on the following ranking:

Table 46: Ranking according to criterion A2

Lack of acceptance	Weak acceptance	Medium acceptance	Strong acceptance
0	5	10	15

A.3. Agricultural management systems already implemented by farmers: The particular criterion was set in order to assess knowledge/ experience of farmers located in a sub-basin in agricultural management systems implementation, to facilitate conformance with the AWMS that will be established by participating FORs. The following ranking was utilized:

Table 47: Ranking according to criterion A3

Lack of knowledge/ experience	Low knowledge/ experience	Medium knowledge/ experience	High knowledge/ experience
0	5	10	15

A.4. Availability of Data for 2nd stage evaluation (criteria): the availability of Data for the pilot basin is important for the impact assessment that is going to take place in action C.2 as well as in D Actions in order to come in reliable conclusions about the effectiveness of AWMS on the enhancement of water efficiency and adaptation to climate change. The following ranking was utilized:

Table 48: Ranking according to criterion A4

Lack of data	Low data availability	Medium data availability	High data availability
0	5	10	15

2.1.1.2 1st Stage evaluation procedure

The 1st stage evaluation procedure followed is summarized below.
Step 1: River basins that got an A.4 score of zero were automatically withdrawn from evaluation at step 2.
Step 2: River basins that passed step 1 were rated according to the following ranking formula:

$$Ranking = score\ A.1 * X_{A,1} + score\ A.2 * X_{A,2} + score\ A.3 * X_{A,3} + score\ A.4 * X_{A,4,}$$

where $X_{A,i}$ denotes the respective weighting factor.
The 1st stage criteria and the respective weighting factors are summarized on the following table.

Table 49: 1st Stage criteria and the respective weighing factors

ID	Description	Score	Weighing factor
A.1	Available crops		X_1=0.30
A.2	Acceptance of the project by the F.ORs' farmers		X_2=0.30
A.3	Farmers' Knowledge in implementation of Agricultural management systems		X_3=0.20
A.4	Availability of Data for 2nd stage evaluation		X_4=0.20

2.1.2 2nd Stage evaluation

The river basin rated with the highest score in 1st stage evaluation, was further evaluated during the second stage evaluation. The 2nd stage criteria mentioned below were used for selecting the sub-basin, within the selected basin, considered as the most representative for the implementation of AgroClimaWater project.

2.1.2.1 2nd Stage criteria

The sub-basins were rated using the following criteria:
B.1 Slope (deviation from typical)
B.2 Kind of crops cultivated in relation with the proposed

B.3 Agricultural practices applied so far
B.4 Climate conditions (higher temperatures and lower precipitation)
B.5 Water availability (including both irrigated and rainfed orchards)
B.6 Water quality
B.7 Soil data (if available) e.g. soil water holding capacity according to European Soil Database
B.8 Elevation zone (low land: 0-200m and semi-mountainous areas: 200-800m)

B.1 Slope: the particular criterion, considers the deviation of the average slope of the sub-basins from the average slope of the targeted area. The following ranking was utilized:

Table 50: Ranking according to criterion B1

Deviation from the average slope				
25%	20%	15%	10%	5%
0	5	10	15	20

B.2 Types of crops cultivated: Similar to criterion B.2.
The following ranking was utilized:

Table 51: Ranking according to criterion B2

One of the key crops non-available	One of the key crops in low availability (as compared to the typical for the area)	All crops available at close, or higher percentages than the typical
0	10	20

A ranking of zero in criterion B.2 leads to an exclusion of the respective sub-basin from further evaluation.

B.3 Agricultural practices applied so far: Similar to criterion B.3.
The following ranking was utilized:

Table 52: Ranking according to criterion B3

Lack of knowledge/ experience	Low knowledge/ experience	Medium knowledge/ experience	High knowledge/ experience
0	5	10	15

B.4 Climate conditions: Temperature and rainfall data were used to evaluate the sensitivity of crops in the sub-basin to water stress and the upcoming climate change. The following ranking was utilized:

Table 53: Ranking according to criterion B4

Average Temperature <-20% of typical and Percipitation >+20% of typical	Average Temperature and Percipitation **±20% from** typical	Average Temperature >+20% of typical and Percipitation <-20% of typical
5	10	20

B.5. Water availability: Deviation from the typical situation for each area was considered as disadvantage. A sub-basin that includes all typical situations (e.g. rainfed, partially and fully irrigated for olive trees) was considered as ideal. The following ranking was utilized:

Table 54: Ranking according to criterion B5

No, or limited availability of water for irrigation	Typical water availability for the area	Water availability too high from the typical
5	20	5

B.6. Water quality: This criterion was utilized for rating the quality of available water according to the standards of the key crops. The following ranking was utilized:

Table 55: Ranking according to criterion B6

High quality water	Medium quality water	Low quality water
5	10	20

B.7. Soil data: Depending on soil data availability in each area, criteria like soil water holding capacity, pH and other basic properties were used to evaluate deviation from typical situation for the area. The following ranking was utilized:

Table 56: Ranking according to criterion B7

Deviation from typical >30%	Deviation from typical <30%
5	20

B.8. Elevation zone: the particular criterion accounts for the elevation zones included in each sub-basin. In cases that more than one elevation zones (according to European standard classification) were included in the pilot area, an advantage was given to the sub-basin that included the 2 most typical elevation zones for the area. If all cultivated land in the pilot area belonged to a single elevation zone, this criterion was excluded (a zero score was given to all sub-basins). The following ranking was utilized:

Table 57: Ranking according to criterion B8

Non-including the 2 most typical elevation zones	Including the 2 most typical elevation zones
0	20

2.1.2.2 2nd stage evaluation procedure

The 2nd stage evaluation was calculated according to the formula:

$$Ranking = score\ B1 * X_{B,1} + score\ B.2 * X_{B,2} + score\ B.3 * X_{B,3} + score\ B.4 * X_{B,4} + score\ B5 * X_{B,5} + score\ B.6 * X_{B,6} + score\ B.7 * X_{B,7} + score\ B.8 * X_{B,8},$$

where $X_{B,i}$ denotes the respective weighting factor.

The 2nd stage criteria and the respective weighting factors are summarized on the following table.

Table 58: 2nd Stage criteria and the respective weighing factors

ID	Description	Score	Weighing factor
B.1	Slope (deviation from typical)		0.1
B.2	Kind of crops cultivated in relation with the proposed		0.2
B.3	Agricultural practices applied so far		0.1
B.4	Climate conditions (higher temperatures and lower precipitation)		0.1
B.5	Water availability (including both irrigated and rainfed orchards)		0.2
B.6	Water quality		0.1
B.7	Soil data (if available) e.g. soil water holding capacity according to European Soil Database		0.1
B.8	Elevation zone (low land: 0-200m and semi-mountainous areas: 200-800m)		0.1

The sub-basin receiving the highest score will be used for the implementation of the AgroClimaWater practices.

2.2 SELECTION OF PILOT SUB-BASINS

The selection criteria presented in section 2.1 were used for the selection of the pilot areas in Platanias and Mirabello. This section concerns the evaluation and the scores received for each sub-basin within the two Stages of the selection procedure.

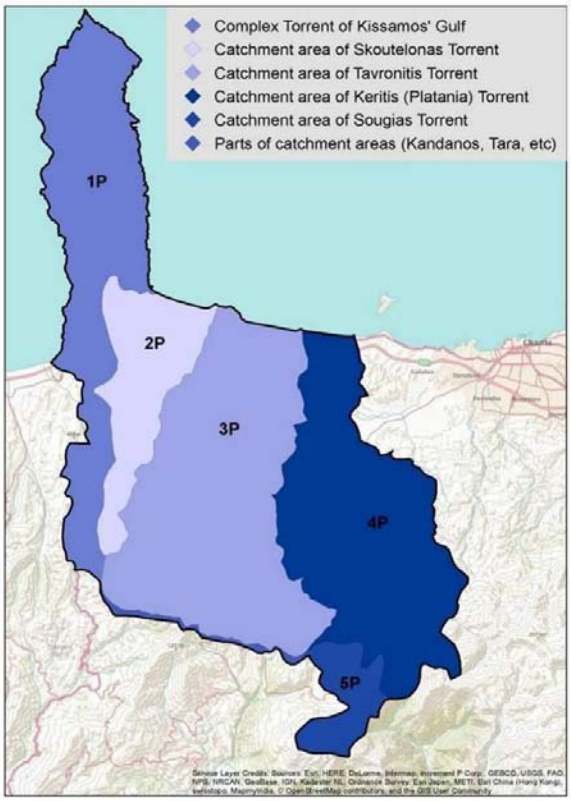


Fig. 61: Geodatabase Map extract showing the five river basins in the Municipality of Platanias

2.2.1 Sub-basins evaluation within the Municipality of Platanias

2.2.1.1 1st Stage evaluation

The Municipality of Platanias included 5 basins, coded as 1P, 2P, 3P, 4P and 5P (Fig. 61). All of them were initially included in the evaluation procedure, although basin 5P was clearly within the mountainous zone, with limited cultivated land available. The scoring procedure for each of the four evaluation criteria is presented in detail in the following paragraphs.

A.1 Available pilot crops

The main tree crops in the area of Platanias are traditionally olive and citrus trees. In recent years, the cultivation of avocado is expanding and due to similar requirements for soil properties, avocados are mostly planted within the citrus cultivation zone. Since this is a continuous process, there is a lack of updated data and therefore land use maps usually present areas of fruit tree cultivation that refers to both citrus and avocado plantations. The land use map for the area of Platanias is presented in Fig. 62. It is clear that olive is the dominant tree crop cultivated in basins 1P, 2P, 3P and 4P, while the citrus cultivation zone is mainly located in areas 3P and 4P.

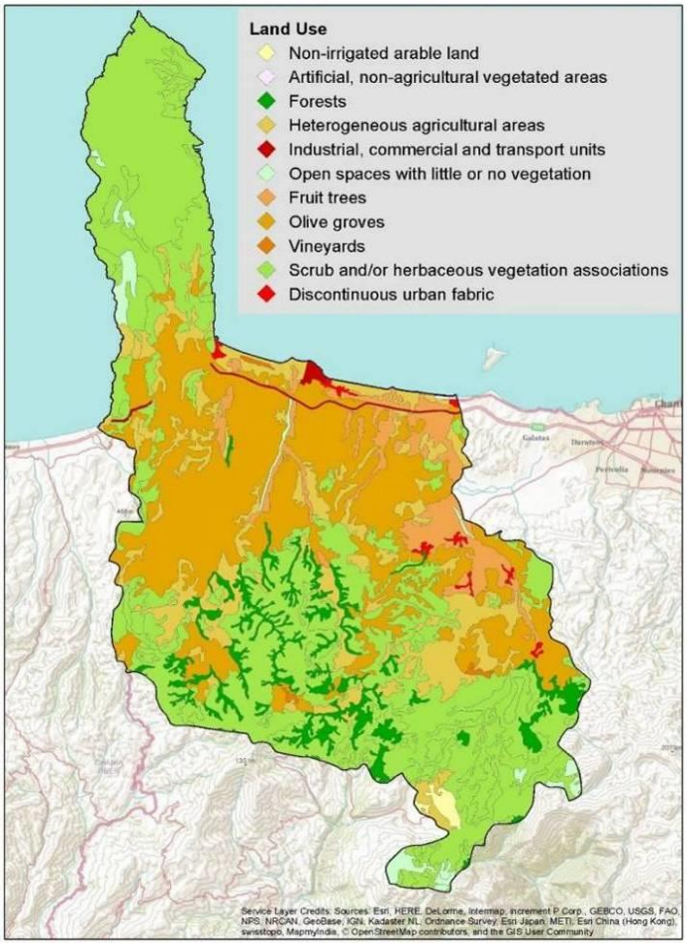


Fig. 62: Geodatabase Map extract depicting the land uses within the Municipality of Platanias, including olive and citrus cultivation areas

Based on the land use data presented in Fig. 62, the status in the five basins is presented on Table 59.

Table 59: Data on olive and citrus tree cultivation within the basins of Platanias

Basin	Parameter	Area (sq.km)	Percentage of total area (%)	Olive/Citrus ratio
1P	Total	116,38		--
	Olive orchards	18,35	15,77	
	Citrus orchards	0	0,00	
2P	Total	51,87		20,26
	Olive orchards	35,45	68,34	
	Citrus orchards	1,75	3,37	
3P	Total	165,31		6,81
	Olive orchards	52,97	32,04	
	Citrus orchards	7,78	4,71	
4P	Total	136,93		1,96
	Olive orchards	33,94	24,79	
	Citrus orchards	17,33	12,66	
5P	Total	20,86		--
	Olive orchards	0	0.0	
	Citrus orchards	0	0.0	
Total	Total	491		5,24
	Olive orchards	140,71	28,64	
	Citrus orchards	26,86	5,47	

According to the data presented above the scoring for the criterion of crop availability is presented on Table 60.

Table 60: Recorded score based on the criterion of pilot crop availability in Platanias

River Basin	1P	2P	3P	4P	5P
Score	0	5	15	15	0

The criterion of crop availability has been defined as the most important for considering a pilot basin for further evaluation. Therefore, basins 1P and 5P that had no availability of citrus or olive orchards were excluded from further evaluation. Basin 2P scored lower than areas 3P and 4P since the olive/citrus ratio was significantly lower than the typical for the area of Platanias.

A.2 Acceptance of the project by the FOR farmers

The evaluation for the criterion of farmer acceptance was based on the following two factors: a. the group of farmers that signed the form of initial intention to participate in the project upon its submission, and b. the group of farmers that responded and participated in the initial informative workshop in September 2015. Most farmers that expressed an interest to be informed about the project were located in basins 2P and 3P, with basin 4P having the least number of interested farmers. Therefore, the scoring for this criterion was formulated as presented on Table 61.

Table 61: Recorded score based on the criterion of project acceptance by FOR farmers in Platanias

River Basin	2P	3P	4P
Score	15	15	5

A.3 Agricultural management systems already implemented by farmers

The area of Platanias is just a part of the Chania Prefecture, and therefore is a quite limited area in order to observe significant differences among the practices applied by

farmers, in the degree that these can be observed among areas at different parts of the country. In general, farmers are growing olives and citrus in a traditional and empirical way and only recently there are groups that have joined the integrated management schemes that include application of agricultural practices in an environmentally friendly way. Therefore, there is no variation among the different basins and farmers could be characterized as having medium knowledge/experience in implementing agricultural management systems. The scoring for this criterion is presented on Table 62.

Table 62: Recorded score based on the criterion of agricultural management system implementation in Platanias

River Basin	2P	3P	4P
Score	10	10	10

A.4 Availability of data for 2nd stage evaluation

Limitations in the availability were mostly focused on data about meteorological parameters, soil properties and water use. In general, and based upon the preliminary experience of collecting data for various Actions of the AgroClimaWater project, more data were available for basins 3P and 4P. Therefore, the scoring for this criterion is presented on Table 63.

Table 63: Recorded score based on the criterion of data availability in Platanias

River Basin	2P	3P	4P
Score	5	10	10

Overall scoring at Evaluation Stage I and basin selection for 2nd Stage

Based on the scoring for each criterion and the weighing factors that have been defined, the following overall scoring was calculated for each basin:

- Basin 1P: Due to lack of pilot crops → Overall score = 0
- Basin 2P: 5*0.30 + 15*0.30 + 10*0.20 + 5*0.20 → Overall score = 9
- Basin 3P: 15*0.30 + 15*0.30 + 10*0.20 + 10*0.20 → Overall score = 13
- Basin 4P: 15*0.30 + 5*0.30 + 10*0.20 + 10*0.20 → Overall score = 10
- Basin 5P: Due to lack of pilot crops → Overall score = 0

Therefore, the basin that was selected to be evaluated for 2nd Stage was the river basin 3P.

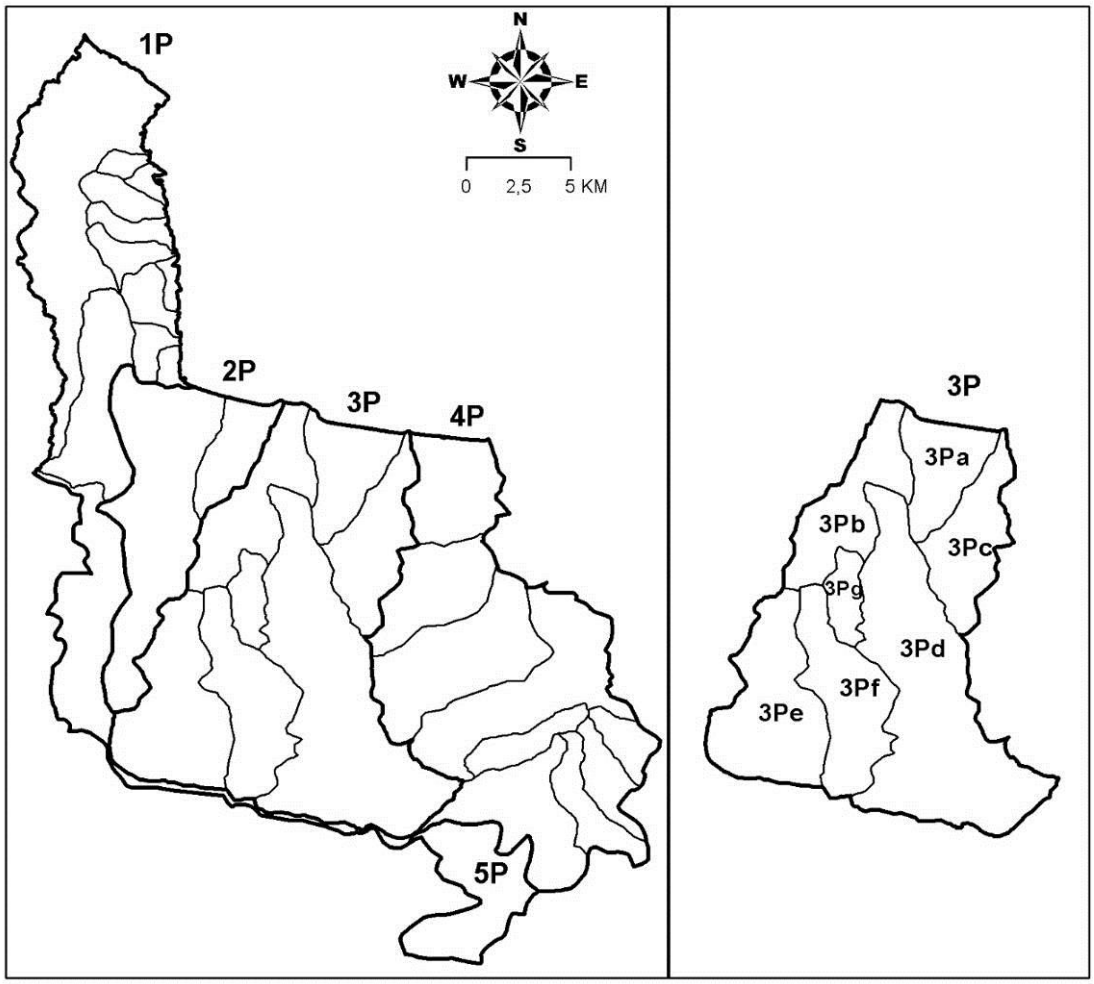


Fig. 63: Sub-basins in Platanias Municipality (left) with depiction of the sub-basins in the selected basin 3P

2.2.1.2 2nd Stage evaluation

The selected river basin 3P corresponds to the Tavronitis river basin and adjacent coastal areas to the East. It is characterized by extensive cultivation of olive trees in its Northern half, with citrus cultivation mostly located in its northeastern coastal zone with some extra scattered strips characterized by favorable soil and climatic conditions (Fig. 62). Basin 3P is divided into seven sub-basins, namely 3Pa to 3Pg, as shown in Fig. 63. The Stage II evaluation for the sub-basins of the selected river basin is presented in the following paragraphs.

Available pilot crops

Based on the land use data in Platanias area presented in Fig. 62 the situation in Tavronitis basin is presented on Table 64. According to the crop availability in each sub-basin, the scoring for this criterion is presented on Table 65. Citrus orchards were not available in sub-basins 3Pe and 3Pf and therefore these sub-basins were excluded from further evaluation.

Table 64: Data on olive and citrus tree cultivation within the basins of Platanias

Basin	Parameter	Area (sq.km)	Percentage of total area (%)	Olive/Citrus ratio
3Pa	Total	13,86		3,74
	Olive orchards	8,48	61,18	
	Citrus orchards	2,27	16,38	
3Pb	Total	19,43		8,45
	Olive orchards	14,62	75,24	
	Citrus orchards	1,73	8,9	
3Pc	Total	58,79		6,14
	Olive orchards	7,61	12,94	
	Citrus orchards	1,24	2,11	
3Pd	Total	17,52		4,30
	Olive orchards	10,03	57,25	
	Citrus orchards	2,33	13,30	
3Pe	Total	28,52		--
	Olive orchards	7,74	27,14	
	Citrus orchards	0	0,00	
3Pf	Total	21,79		--
	Olive orchards	1,85	8,49	
	Citrus orchards	0	0,00	
3Pg	Total	5,4		12,00
	Olive orchards	2,64	48,89	
	Citrus orchards	0,22	4,07	
Total	Total	165,31		6,81
	Olive orchards	52,97	32,04	
	Citrus orchards	7,78	4,71	

Table 65: Recorded score based on the criterion of crop availability in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pe	3Pf	3Pg
Score	15	15	15	15	0	0	15

Slope

The slope distribution in cultivated areas of Platanias Municipality is presented on the map of Fig. 64. Based on these GIS data, the average slope in the sub-basins of area 3P is presented on Table 66, as compared to the average slope for the area of Platanias. These values determined the scoring for the slope criterion, which is presented on Table 67.

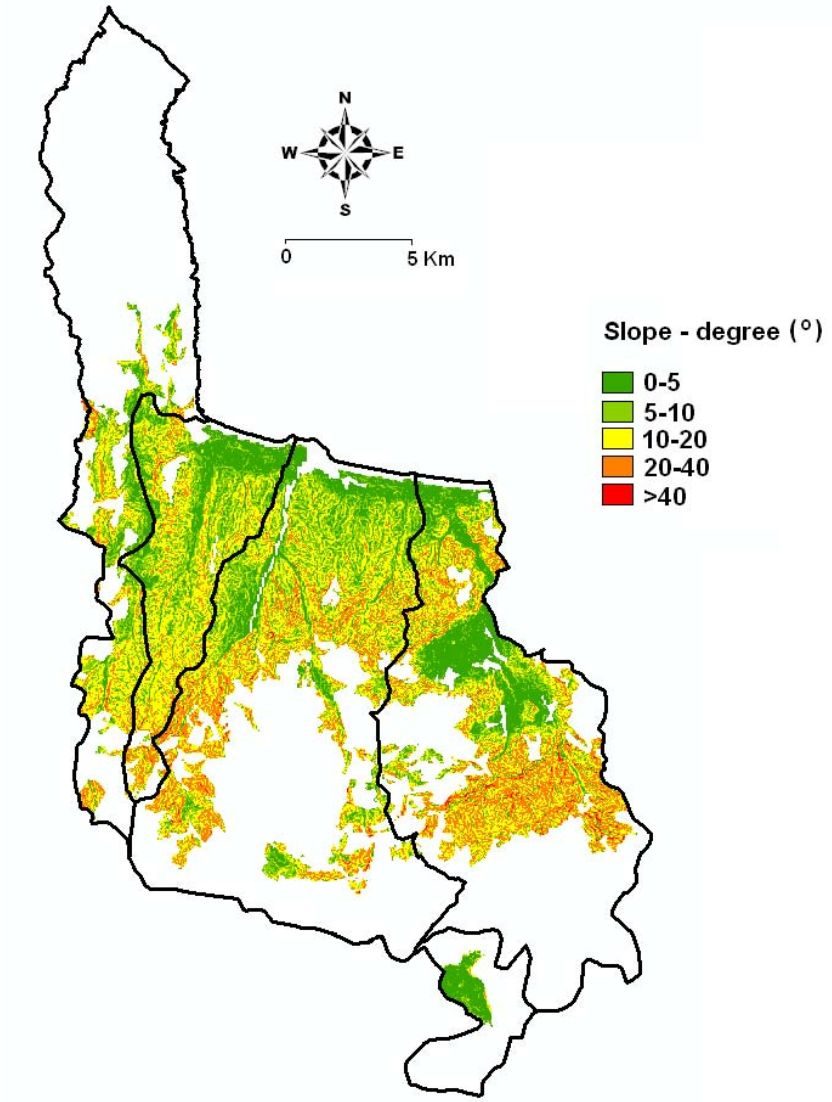


Fig. 64: Slopes in cultivated areas of Platanias Municipality

Table 66: Average slope in cultivated land in Tavronitis area sub-basins, as compared to mean slopes for basin 3P and the Municipality of Platanias

Sub-basin	3Pa	3Pb	3Pc	3Pd	3Pg
Mean slope	7.5	9.1	14.2	13.2	15.5
Mean slope for basin 3P			12.8		
Mean slope for Platanias area			12.4		

Table 67: Recorded score based on the criterion slope in cultivated land in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	20	20	20	20	20

Agricultural management systems already implemented by farmers

As already mentioned, there is no clear variation among the different sub-basins and farmers could be characterized as having medium knowledge/experience in implementing agricultural management systems. The scoring for this criterion is presented on Table 68.

Table 68: Recorded score based on the criterion of agricultural management system implementation by farmers in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	10	10	10	10	10

Climate conditions

The availability of meteorological data is limited and data are mostly available for the coastal zone. No data are available for the southern parts of the basin 3P and therefore it was not easy to assess deviation from typical for each single sub-basin. However, the area in basin 3P is relatively small to expect great deviations among sub-basins as compared to the mean for the whole river basin. It is reasonable that precipitation is increasing and mean temperature is decreasing by elevation, therefore the climate change effects of lower water availability at farm level (not including irrigation) and higher temperatures are expected to be more intense in the coastal areas, i.e. sub-basins 3Pa, 3Pb and 3Pc, as compared to sub-basins 3Pd and 3Pg. However, with no support by meteorological data, any scoring would be arbitrary and therefore for completing the procedure, a similar score was given for all sub-basins (Table 69).

Table 69: Recorded score based on the criterion of climate conditions in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	10	10	10	10	10

Water availability

The availability of water for irrigation, as compared to the olive growing area in basin 3P is presented in Fig. 65. For citrus crops, availability of irrigation water is necessary for cultivation and there are no citrus orchards in rainfed areas. Based on data presented in Fig. 65, the scoring for the water availability criterion is presented on Table 70. It is clear that coastal sub-basins scored higher since both rainfed and irrigated orchards could be found in these areas, while sub-basins 3Pc and 3Pg scored lower since olive tree is cultivated almost exclusively under rainfed conditions and this would create problems in implementation of the AgroClimaWater management practices.

Table 70: Recorded score based on the criterion of irrigation water availability in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	20	20	5	20	5

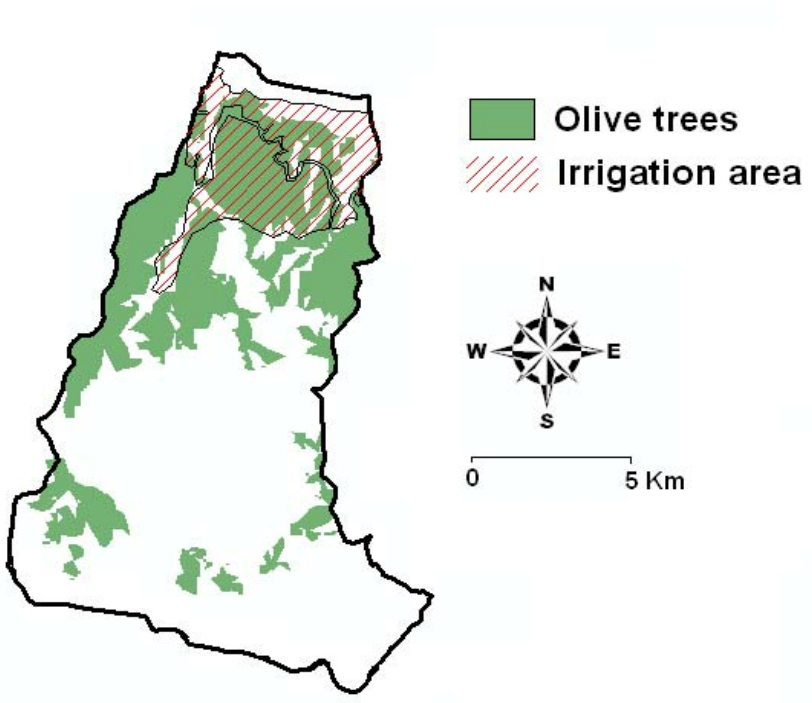


Fig. 65: Projection of the available main irrigation network as compared to the olive cultivation areas in basin 3P (Tavronitis basin)

Water quality

In general, the water available for irrigation within the Municipality of Platanias is currently of good quality. Therefore, a low score was recorded for all sub-basins (Table 71), although for sub-basins 3Pc and 3Pg this is an artifact, since the irrigation water availability is limited. However, despite the low water availability, there are not any recorded cases of low quality irrigation water in these sub-basins, since they are away from the coastal areas that are more prone to sea intrusion in ground water.

Table 71: Recorded score based on the criterion of irrigation water quality in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	5	5	5	5	5

Soil data

Based on previous work at IOTSP, sub-basins 3Pa and 3Pb seem to be the most representative of the typical situation in Platanias area, since they include marls, alluvial deposits and schists, while in other sub-basins only one of these soil categories is the dominant one. Therefore, the scoring for this criterion is presented on Table 72.

Table 72: Recorded score based on the criterion of soil data availability in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	20	20	5	5	5

Elevation zone

The map of elevation zones included in different sub-basins of river basin 3P are presented in Fig. 66. The two dominant elevation zones for cultivated land in the area of Platanias are those of 0-200 m and 200-800 m. It is clear that sub-basins in the North include mostly low elevation areas (0-200 m), while sub-basins in the southern part

include mostly areas in the semi-mountainous zone (200-800). However, both elevation zones are included in all 5 sub-basins and therefore scoring is similar for all (Table 73).

Table 73: Recorded score based on the criterion of elevation zone in Tavronitis area sub-basins

Basin	3Pa	3Pb	3Pc	3Pd	3Pg
Score	20	20	20	20	20

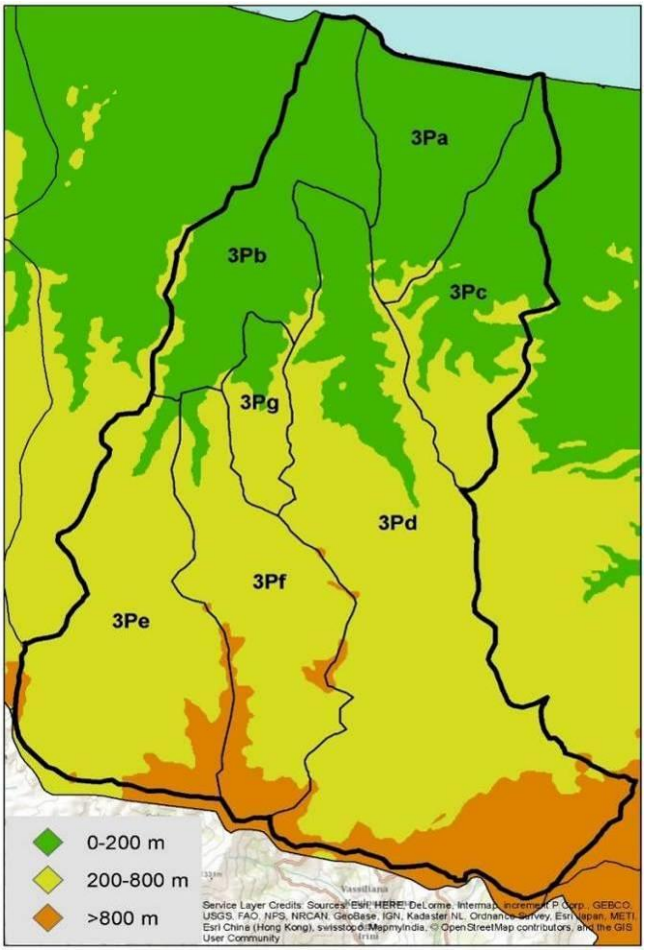


Fig. 66: Elevation zones within the river basin 3P (Tavronitis basin)

Overall scoring at Evaluation Stage II and sub-basin selection

Based on the scoring for each criterion and the weighing factors that have been defined, the following overall scoring was calculated for each sub-basin:

- Sub-basin 3Pa:

0.2*15 + 0.1*20 + 0.1*10 + 0.1*10 + 0.2*20 + 0.1*5 + 0.1*20 + 0.1*20

Overall score = 15.5

- Sub-basin 3Pb:

0.2*15 + 0.1*20 + 0.1*10 + 0.1*10 + 0.2*20 + 0.1*5 +0.1*20 + 0.1*20

Overall score = 15.5

- Sub-basin 3Pc:

0.2*15 + 0.1*20 + 0.1*10 + 0.1*10 + 0.2*5 + 0.1*5 + 0.1*5 + 0.1*20

Overall score = 11

- Sub-basin 3Pd:

0.2*15 + 0.1*20 + 0.1*10 + 0.1*10 + 0.2*20 + 0.1*5 + 0.1*5 + 0.1*20
Overall score = 14

- Sub-basin 3Pe:

Due to lack of pilot crops
Overall score = 0

- Sub-basin 3Pf:

Due to lack of pilot crops
Overall score = 0

- Sub-basin 3Pg:

0.2*15 + 0.1*20 + 0.1*10 + 0.1*10 + 0.2*5 + 0.1*5 + 0.1*5 + 0.1*20
Overall score = 11

The two sub-basins with the highest scoring were sub-basins 3Pa and 3Pb, which did not differ in their scoring for the different criteria set in the evaluation procedures. In terms of pilot crop availability, 3Pa is closer to the average ratio of olive/citrus orchards of Platanias area, while in 3Pb despite its higher surface area the citrus cultivation area is less than in 3Pa in absolute numbers. Both areas fall within the irrigated zone of area 3P, with 3Pb providing a larger acreage of non-irrigated olive orchards and higher average slope for the cultivated land. On the other hand, 3Pa has a longer coastal front, translated into more touristic activities, which provides the opportunity for better studying of issues related to antagonism among different water users. Based on the above and given the relatively small surface of these two sub-basins, the scientific team of the project decided that including both sub-basins in the pilot area that will be studied during the project will provide a more representative area that could be considered as typical for the situation in the Platanias Municipality. Therefore, the study area will include both sub-**basins 3Pa "Maleme sub-basin" and 3Pb "Voukolies sub-basin"**.

2.2.2 Sub-basins evaluation within Ag. Nikolaos Municipality (Mirabello area)

2.2.2.1 1st Stage evaluation

The area of Mirabello includes 7 basins, coded as 1M, 2M, 3M, 4M, 5M, 6M and 7M (Fig. 67). All of them where initially included in the evaluation procedure, although 6M and 7M were non-olive growing areas. The scoring procedure for each of the four evaluation criteria is presented in detail in the following paragraphs.

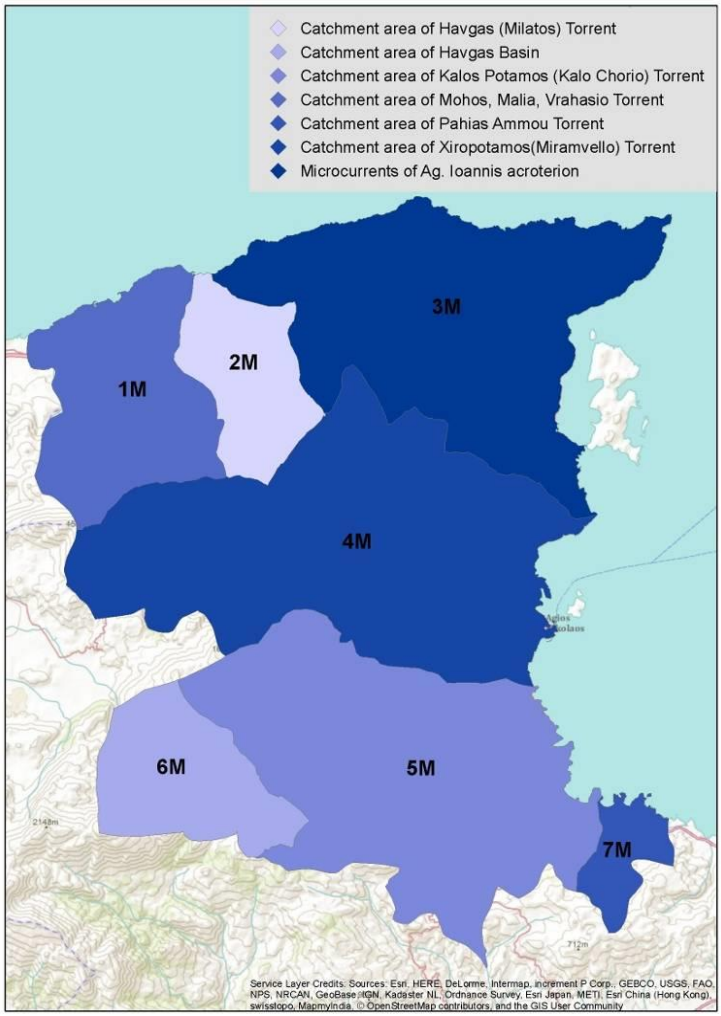


Fig. 67: Geodatabase Map extract showing the seven river basins in Mirabello

Table 74: Data on olive cultivation within the basins of Mirabello

River Basin	Parameter	Area (sq.km)	Percentage of total area (%)
1M	Total	52,78	
	Olive orchards	14,57	27,6%
2M	Total	29,2	
	Olive orchards	10,93	37,4%
3M	Total	114,09	
	Olive orchards	12,12	10,6%
4M	Total	144,54	
	Olive orchards	27,77	19,2%
5M	Total	124,47	
	Olive orchards	19,81	15,9%
6M	Total	36,11	
	Olive orchards	0	0,0%
7M	Total	11,65	
	Olive orchards	0	0,0%
Total	Total	512,84	
	Olive orchards	85,2	16,6%

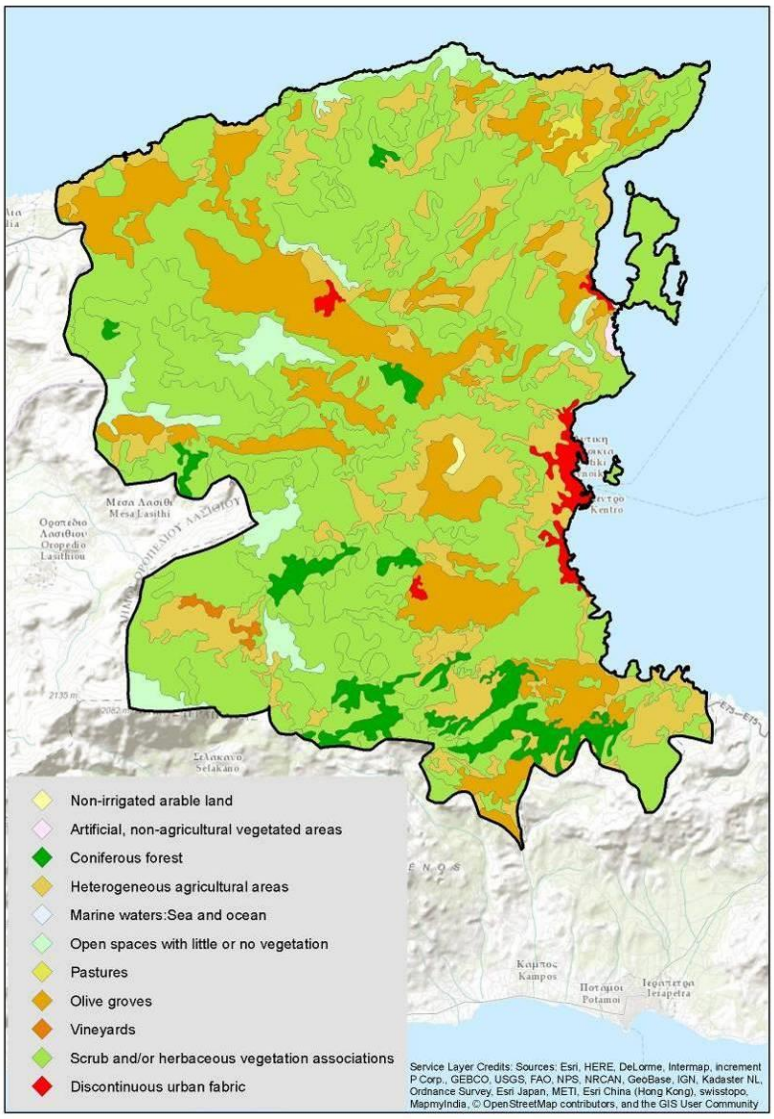


Fig. 68: Geodatabase Map extract depicting the land uses at the area of Mirabello

Available pilot crops

As presented in Fig. 68, olive tree is the dominant tree crop in the area, while significant part of the area is covered by shrubs and low vegetation and is not considered as cultivated land. Since olive tree will be the only crop studied in this area, data on olive orchard acreage within each basin are presented on Table 74. Based on these data, the scoring for the criterion of crop availability is presented on Table 75.

Table 75: Recorded score based on the criterion of pilot crop availability in Ag. Nikolaos

River Basin	1M	2M	3M	4M	5M	6M	7M
Score	15	15	15	15	15	0	0

In basins 1M-5M the percentage of the total area cultivated by olive trees was close or higher to the typical for the Mirabello area and therefore, their scoring was 15. In basins 6M and 7M there were no olive orchards and therefore they were excluded from further evaluation. Basin 2M was the one with the highest percentage of olive orchards as compared to its total surface.

Acceptance of the project by the FOR farmers

The evaluation for the criterion of farmer acceptance was based on the following two factors: a. the group of farmers that signed the form of initial intention to participate in the project upon its submission, and b. the group of farmers that responded and participated in the initial informative workshop in October 2015. Most farmers that expressed an interest to be informed about the project were located in basins 2M, 3M and 4M. Therefore, the scoring for this criterion was formulated as presented on Table 76.

Table 76: Recorded score based on the criterion of project acceptance by FOR farmers in Ag. Nikolaos

River Basin	1M	2M	3M	4M	5M
Score	5	15	15	15	5

Agricultural management systems already implemented by farmers

In general, farmers in the area were growing olives in a traditional and empirical way for a long time. In the last 10 years, the Cooperative Union of Mirabello has participated in programs for implementation of integrated management schemes that include application of agricultural practices in an environmentally friendly way. Therefore, there are several farmers belonging to the Union that have significant experience in implementing agricultural management systems following certain rules, and these farmers are spread throughout the Mirabello area. Given that the selected farms will be from the pool of farmers that followed these schemes for several years the scoring for this criterion was high as presented on Table 77.

Table 77: Recorded score based on the criterion of agricultural management system implementation in Ag. Nikolaos

River Basin	1M	2M	3M	4M	5M
Score	15	15	15	15	15

Availability of data for 2nd stage evaluation

Limitation in the availability of data is generally mostly focused on data about meteorological parameters, soil properties and water use. In general, the availability of data for these parameters is low in the area of Mirabello and this could not be a factor that could provide variable scoring among basins. Given that availability of farm specific data is essential for future Actions of the AgroClimaWater project, the number of farms for which a long recording period of data related to applied agricultural practices are existing, was also taken into account. Based on that the scoring for this criterion is presented on Table 78.

Table 78: Recorded score based on the criterion of data availability in Ag. Nikolaos

River Basin	1M	2M	3M	4M	5M
Score	10	15	10	15	5

Overall scoring at Evaluation Stage I and basin selection for Stage II

Based on the scoring for each criterion and the weighing factors that have been defined, the following overall scoring was calculated for each basin:

- **Basin 1M**: 15*0.30 + 5*0.30 + 15*0.20 + 10*0.20 → Overall score = 11

- **Basin 2M:** 15*0.30 + 15*0.30 + 15*0.20 +15*0.20 → Overall score = 15
- **Basin 3M:** 15*0.30 + 15*0.30 + 15*0.20 + 10*0.20 → Overall score = 14
- **Basin 4M:** 15*0.30 + 15*0.30 + 15*0.20 + 15*0.20 → Overall score = 15
- **Basin 5M:** 15*0.30 + 15*0.30 + 15*0.20 + 5*0.20 → Overall score = 13
- **Basin 6M:** Due to lack of olive orchards → Overall score = 0
- **Basin 7M:** Due to lack of olive orchards → Overall score = 0

Basins 2M and 4M were the ones with the highest scoring. Given that the size of basin 2M was relatively small and is not divided into sub-basins, while basin 4M, despite its larger size, the acreage of olive orchards is relatively small compared to its total size, it was decided that for the area of Mirabello it would be better to include a whole basin than divide a single basin into sub-basins that will be evaluated in Stage II. Therefore, at Stage I, basins 2M and 4M were selected to be further evaluated in Stage II.

2.2.2.2 2nd Stage evaluation

The selected basin 2M corresponds to the Havgas stream basin, while basin 4M corresponds to the basin of stream Xeropotamos. The Stage II evaluation for these basins is presented in the following paragraphs.

Available pilot crops

Data on olive tree cultivation in the two basins were already presented on Table 74 and the scoring at Stage I was similar for both basins. Basin 2M had the highest percentage of olive orchards among the basins of Mirabello. Considering the logistics of the project, this could be considered an advantage as compared to the scattered distribution of olive orchards within a larger and less accessible area, which is the situation in basin 4M. This could be the only factor that could distinguish a difference among the two basins and based on that they received a different scoring, deviating from the general protocol of evaluation. Therefore the scoring is presented on Table 79.

Table 79: Recorded score based on the criterion of crop availability in Ag. Nikolaos

River Basin	2M	4M
Score	20	10

Slope

The slope distribution in cultivated areas of the Mirabello area is presented on the map of Fig. 69. It is clear that almost all cases, from relatively flat to orchards with high slopes are included in both basins 2M and 4M. Based on these GIS data, the average slope in each basin is presented on Table 80, as compared to the average slope for the area of Mirabello. These values were quite close to the mean for the whole area and determined the scoring for the slope criterion, which is presented on Table 81.

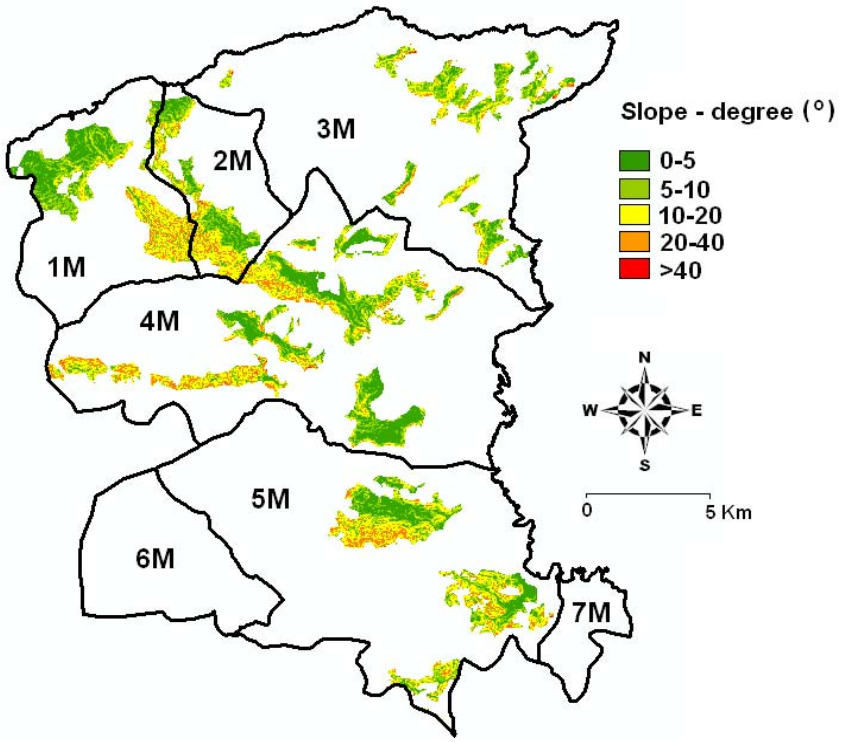


Fig. 69: Slopes in cultivated areas of Mirabello

Table 80: Average slope in cultivated land for basins 2M and 4M, as compared to mean slope for the whole Mirabello area

River Basin		2M		4M	
Mean slope		10.85		10.18	
Mean slope for Mirabello area			10.1		

Table 81: Recorded score based on the criterion slope in cultivated land at Mirabello

Basin		2M		4M	
Score		20		20	

Agricultural management systems already implemented by farmers

Both basins had been evaluated for this criterion in stage I. The scoring is presented on Table 82.

Table 82: Recorded score based on the criterion of agricultural management system implementation by farmers at Mirabello

Basin		2M		4M	
Score		15		15	

Climate conditions

The availability of meteorological data is generally limited in Mirabello. Due to proximity in both basins, the same meteorological data have to be used during the project, no matter which basin is selected. As discussed later on, both areas include cultivated land in both low and medium elevation areas, while both include inland areas with relatively higher precipitation and coastal areas with lower precipitation, meaning that they do not deviate from the typical for the area. The scoring for this criterion is presented on Table 83.

Table 83: Recorded score based on the criterion of climate conditions at Mirabello

Basin		2M		4M	
Score		10		10	

Water availability

Both areas include irrigated and non-irrigated olive orchards, although in general the majority of the orchards are rainfed and water availability is low. Therefore, they are not differentiated from the typical for the area of Mirabello. Scoring for this criterion is presented on Table 84.

Table 84: Recorded score based on the criterion of irrigation water availability at Mirabello

Basin		2M		4M	
Score		20		20	

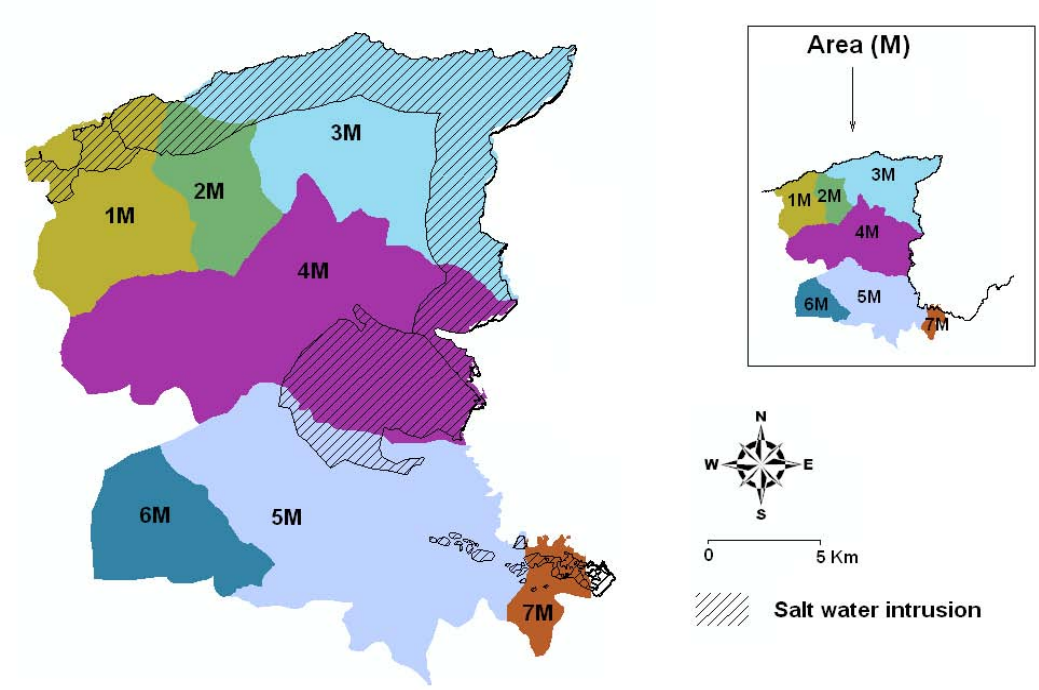


Fig. 70: Areas where salt water intrusion has been recorded at Mirabello

Water quality

As already mentioned, water availability is low in Mirabello and there are several cases where the quality of the available water is low. Fig. 70 presents the areas where sea water intrusion has been recorded in Mirabello area. It is clear that low quality water (saline) is available for irrigation along the coastal zone of both basins. The scoring for this criterion is presented on Table 85.

Table 85: Recorded score based on the criterion of irrigation water quality at Mirabello

Basin		2M		4M	
Score		20		20	

Soil data

Detailed soil maps are in general not available for the area of Mirabello. However, there are records from soil analysis that has been performed in the past in a large number of olive orchards from Mirabello Union farmers' orchards. Based on an indicative soil map from the Hellenic Soil Science Society (www.edafologiki.gr), the dominant soil type in the area is calcaric leptosols and this is extended throughout the whole Mirabello area, including both basins of interest. Therefore, the scoring for this criterion was high for both basins (Table 86).

Table 86: Recorded score based on the criterion of soil data availability at Mirabello

Basin		2M		4M	
Score		20		20	

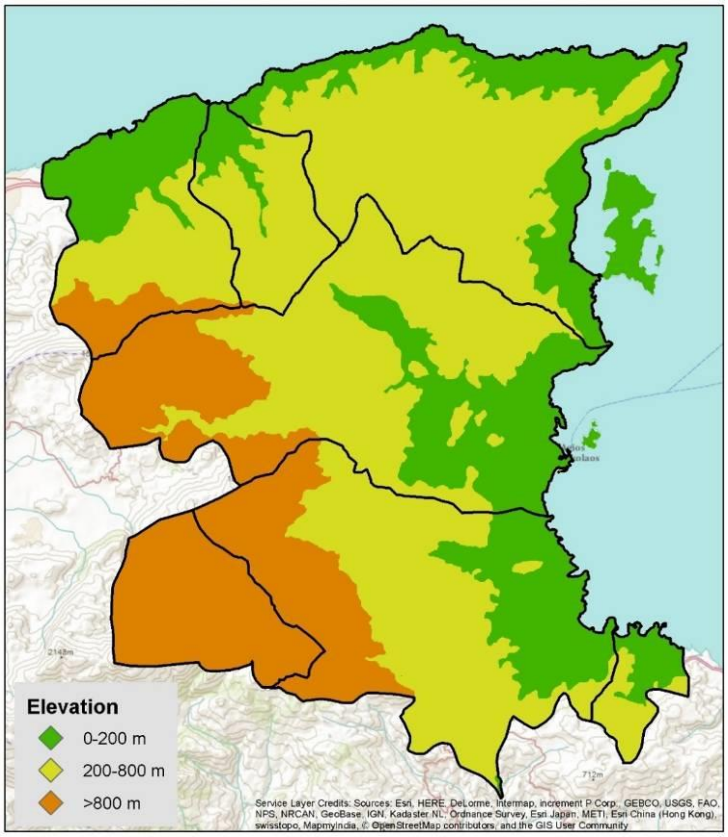


Fig. 71: Elevation zones at Mirabello

Elevation zone

The map of elevation zones included in different basins of Mirabello area is presented in Fig. 71. The two dominant elevation zones for cultivated land in the area of Mirabello are those of 0-200 m and 200-800 m. It is clear that both basins include the two dominant elevation zones for the area and therefore scoring is similar for both (Table 87).

Table 87: Recorded score based on the criterion of elevation zone at Mirabello

Basin		2M		4M	
Score		20		20	

Overall scoring at Evaluation Stage II and basin selection

Based on the scoring for each criterion and the weighing factors that have been defined, the following overall scoring was calculated for each basin:

- Basin 2M:

0.2*20 + 0.1*20 + 0.1*15 + 0.1*10 + 0.2*20 + 0.1*20 + 0.1*20 + 0.1*20

Overall score = 18.5

- Basin 4M:

0.2*10 + 0.1*20 + 0.1*15 + 0.1*10 + 0.2*20 + 0.1*20 +0.1*20 + 0.1*20

Overall score = 16.5

It is clear that both basins could be considered as typical for the area of Mirabello, since they had similar ranking in almost all criteria. Therefore, the only criterion that could differentiate them was the pilot crop availability. Since olive tree is the crop of interest for Mirabello, it is reasonable to select the area where this crop is present in higher density. Basin 2M had the highest percentage of its surface covered by olive orchards (more than 1/3 of total area). This percentage was significantly higher than in all other basins and almost double than basin 4M.

Based on the performed evaluation, basin 2M "Havgas (Milatos) sub-basin" will be the pilot basin selected for the area of Mirabello.

3. DESCRIPTION OF LIFE AGROCLIMAWATER PILOT SUB-BASINS IN CRETE

3.1 GENERAL DESCRIPTON

3.1.1 Voukolies and Maleme sub-basins

In the northern part of Tavronitis catchment area the two pilot sub-basins "Voukolies" and "Maleme" areas (Fig. 72), selected for the implementation of water management adaptation to climate change strategies, are situated.

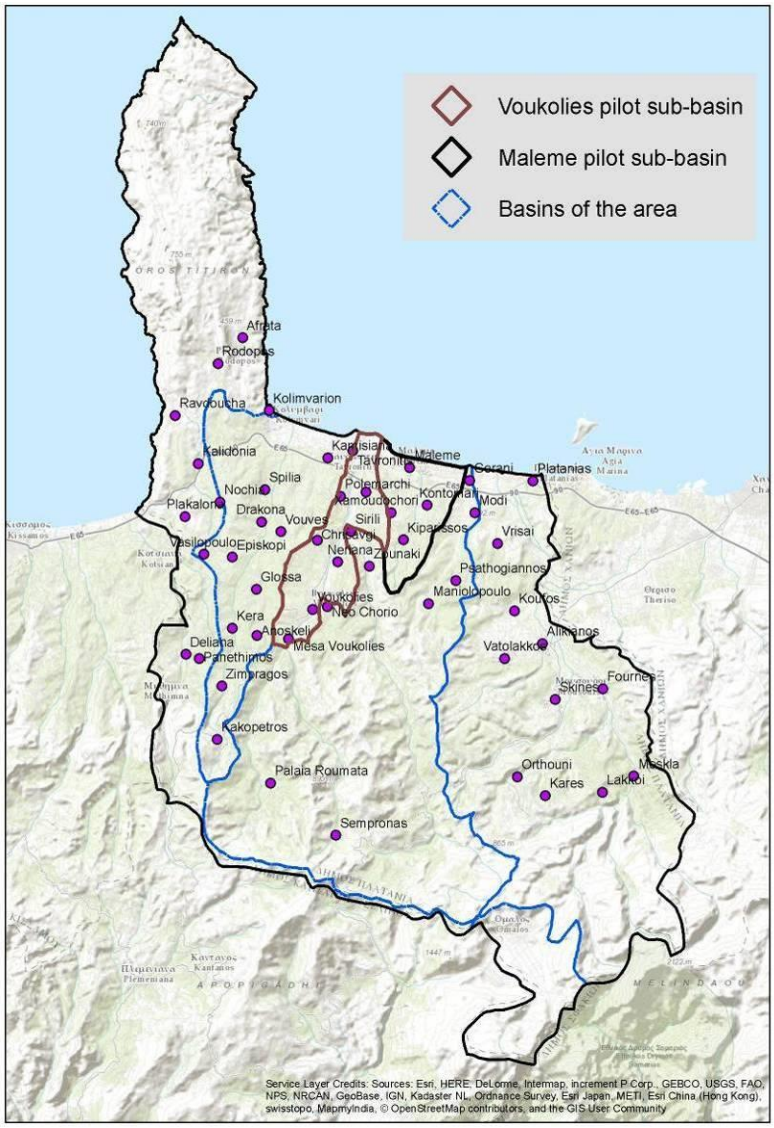


Fig. 72: Geodatabase Map Extract depicting the location of the two pilot sub-basins Voukolies and Maleme in the Municipality of Platanias

3.1.1.1 Voukolies sub-basin

Voukolies sub-basin is on the west of Maleme sub-basin. Within Voukolies sub-basin the local Communities of Tavronitis, Polomerchi, Vlacheronitissa, Chrysavgi, Neriana and Voukolies are found. It holds a great part of the Municipal Unit of Voukolies and a small

part of the Municipal Unit of Platanias (Law no 3852/2011). It covers an area of 19,42 sq.km, which is 3,95% of the total area of the Municipality of Platanias.
According to the last Population census conducted by ELSTAT in 2011, the population of the local communities that are in the sub-basin of Voukolies is shown on the following Table 88.

Table 88: Population of the Local Communities, which are within the sub-basin of Voukolies

Municipal Unit	Local Community	Population
Voukolies	Voukolies	1007
	Neriana	68
	Polemarchi	170
	Tavronitis	973
	Chrisavgi	219
Platanias	Vlacheronitissa	152

3.1.1.2 Maleme sub-basin

Maleme sub-basin is located in the Municipal Unit of Platanias. In Maleme sub-basin, the local Communities of Maleme, Xamoudochori, Kontomari and Kiparissi are situated. It has an area of 13,87 sq.km, which is 2,82% of the total area of the Municipality of Platanias. The permanent population of these local communities, according to the last population census held, is presented on Table 89, (ELSTAT, 2011).

Table 89: Population of the Local Communities, which are within the sub-basin of Maleme

Municipal Unit	Local Community	Population
Platanias	Maleme	710
	Xamoudochori	163
	Kontomari	539
	Kiparissos	171

3.1.2 Havgas - Milatos sub-basin

The catchment area of Havgas - Milatos Torrent has a northwestern-southeastern development and is located at the northern area of Ag. Nikolaos Municipality, about 17km away from Agios Nikolaos city (Fig. 73). The Havgas – Milatos pilot sub-basin covers part of the Municipal Unit of Vrachassi (settlement of Milatos) and part of the Municipal Unit of Neapoli. It covers an area of about 40 sq.km, with a ranging length of 8km and width of 5km. According to the last Population census conducted by ELSTAT in 2011, the population of the municipal and local communities that are in the sub-basin of Havgas-Milatos is as follows in Table 90:

Table 90: Population of the Municipal and Local Communities, which are within the sub-basin of Mirabello

Municipal Unit	Municipal Community	Population
Neapoli	Neapoli	2838
	Local Community	
	Latsida	249
	Voulismeni	348
Vrachassi	Vrachassi	1932
	Settlement	
	Milatos	178

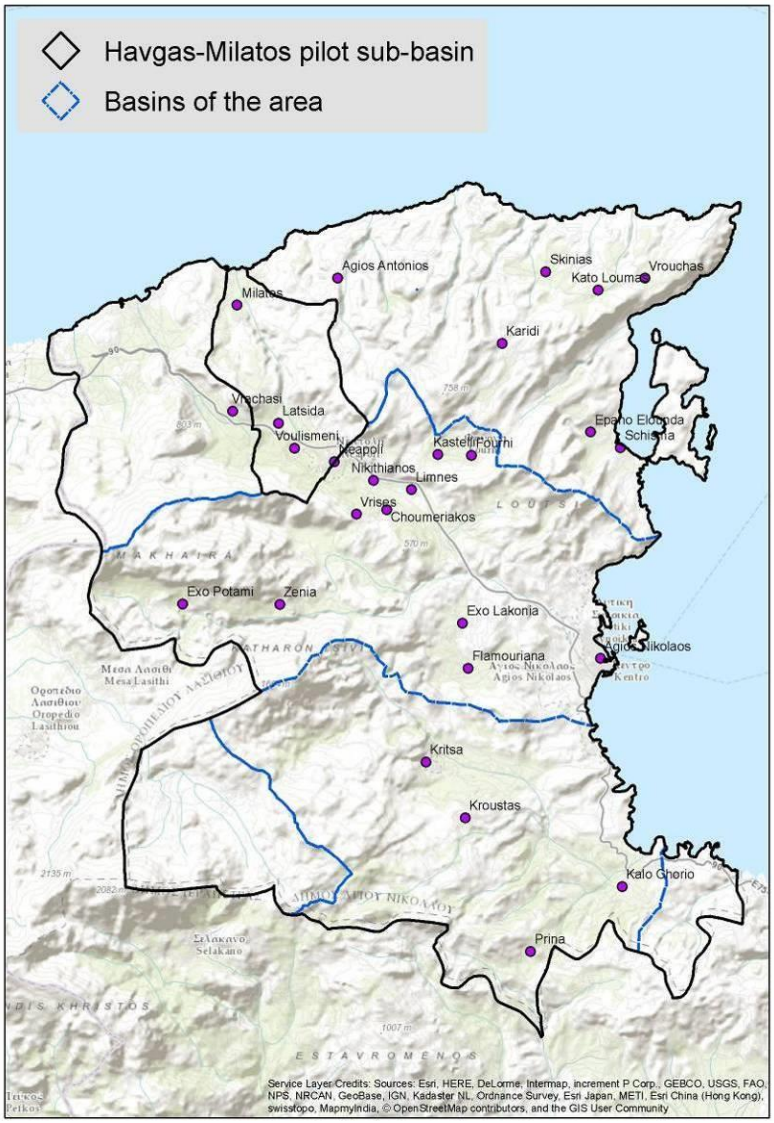


Fig. 73: Geodatabase Map Extract depicting the location of the pilot sub-basin Havgas-Milatos in the Municipality of Agios Nikolaos

3.2 GEOLOGICAL – HYDROLOGICAL CHARACTERISTICS

3.2.1 Voukolies and Maleme sub-basins

Voukolies and Maleme sub-basins are located in the Quaternary and Neogene sedimentary formations. These formations are practically alluvial deposits (al), which consist of clayey sand materials and unbounded materials of clay, sand and breccia-conglomerates in the beds and mouths of torrents, debris cones, carbonate and phyllitic colluvial deposits (H.sc,cs), Pleistocene fluvioterrestrial deposits with pebbles and breccia of varying size and lithologic composition and in places conglomerates alternating with sandstones and clays (Pt.c).

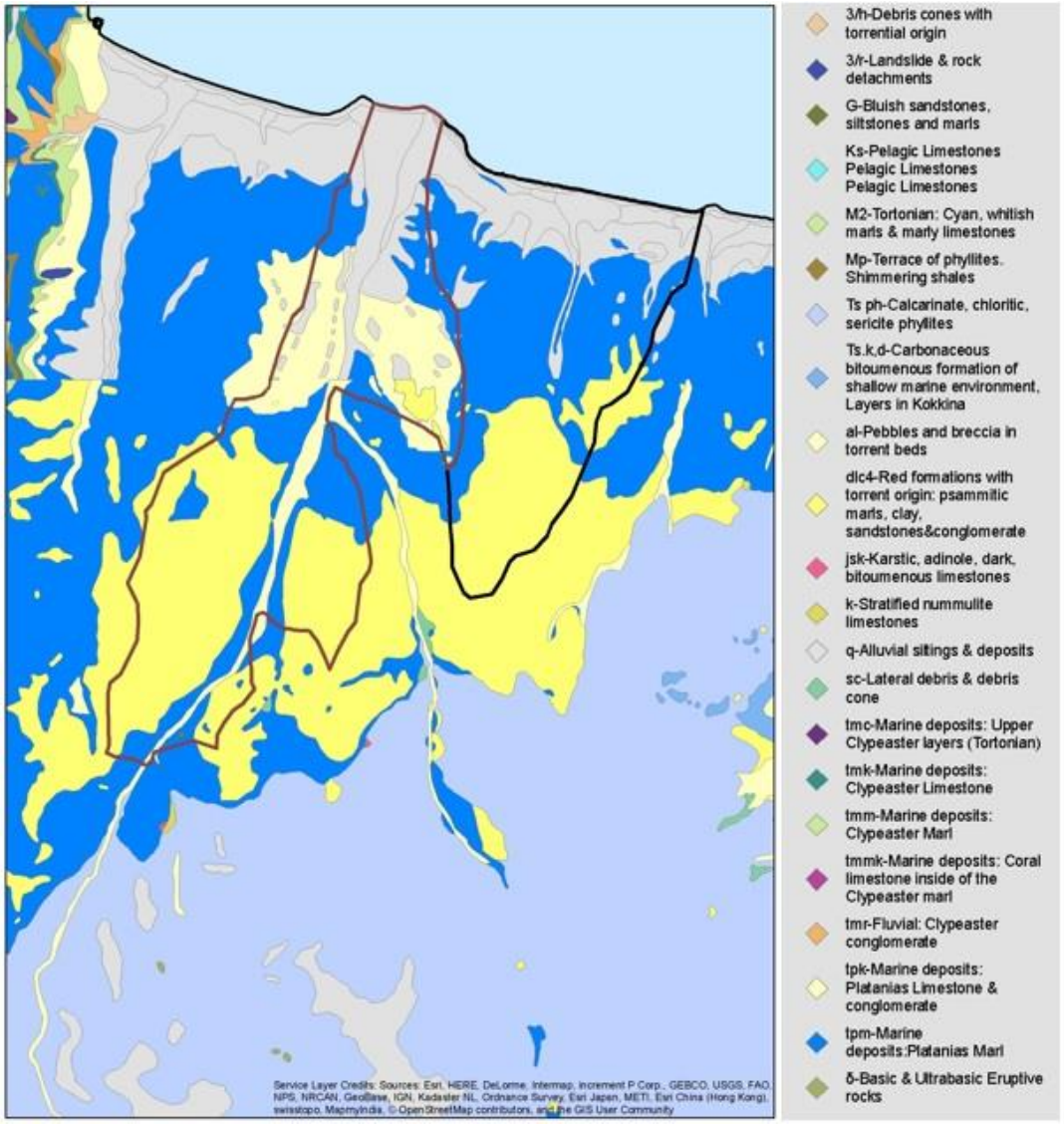


Fig. 74: Geodatabase Map Extract of Platanias pilot areas, depicting the geological formations

The Neogene deposits (Ng) are indivisible and consist of thick bedded to ungroomed, marly limestones which to the upper grow into marly clay formations.
Concerning the morphology of both pilot sub-basins (Fig. 75), they are mostly flat areas (0 − 200m), which in their northern parts are defined by the Cretan Sea, while in their

southern parts there are very small areas that are considered to be semi-mountainous (201 – 800m).

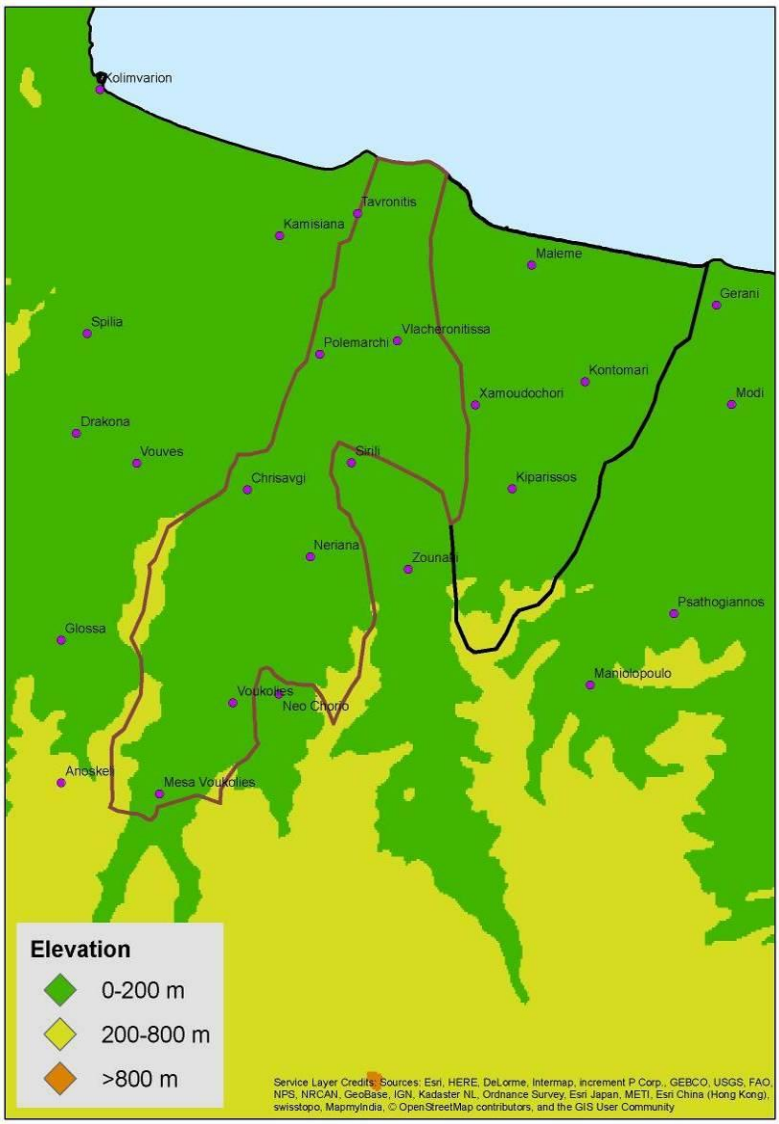


Fig. 75: Geodatabase Map Extract of Platanias pilot areas, depicting the altitude categories

Furthermore, the pilot areas are located in the Porous water System of Kampos Chania (GR 1300022), which is divided into two main aquifer systems the Neogene system in the west and the Quaternary system in the east.

The Quaternary and Neogene formations have varying permeabilities and groundwater capacities as a result of the geological composition of the rocks. The aquifer of the Neogene formations is not uniform both horizontally (superimposed aquifers) and vertically (different adjoining separated aquifers tectonically or small aquifers –locally). The granural non-alluvial deposits (pl & tpm) have low to very low permeability (P3).

In areas that are covered by conglomerates and marly limestones (dlc4) of the Neogene deposits individual aquifers of moderate to low capacity and moderate to low permeability (P2) are formed. In addition, in these Neogene deposits, layers and interpolations of gypsum (Γ) with considerable thickness are found. The aquifers formed

inside of these formations (GR1300330) are of degraded quality because of the high content of sulphites.

Last, geological formations consisting of sandstones, conglomerates and quaternary deposits, terraces as well as new alluvial formations (qf2), occupy the boundaries of the greater riverbed of Tavronitis River from the coastline up to Voukolies. These have high to moderate permeability (P1).

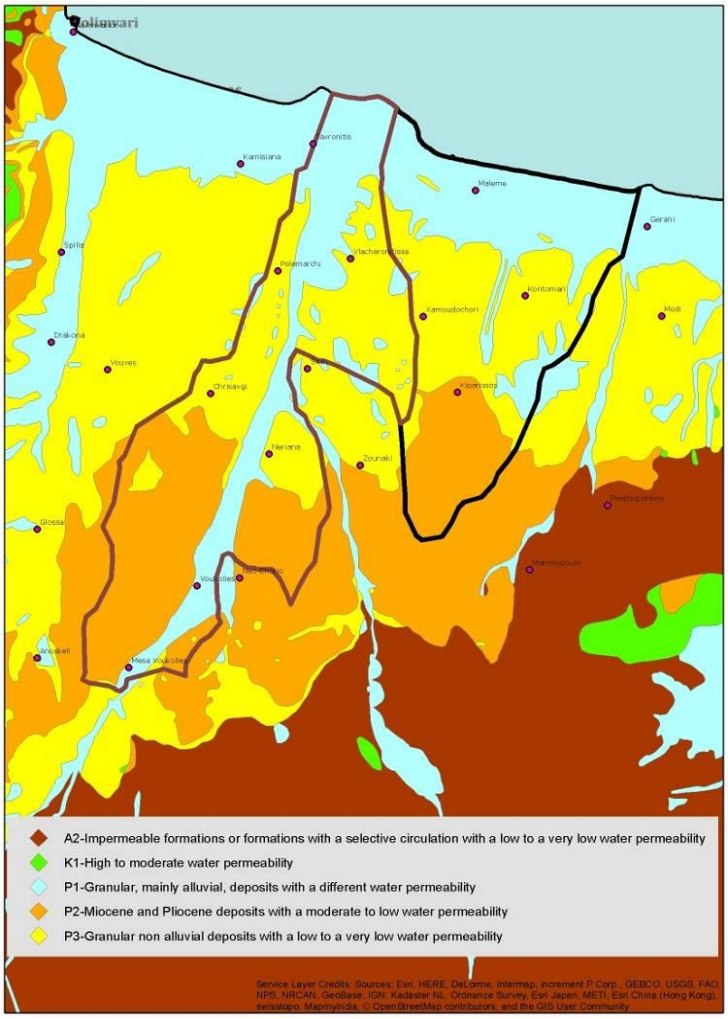


Fig. 76: Geodatabase Map Extract of Platanias pilot areas, depicting the hydrogeology

3.2.2 Havgas - Milatos sub-basin

The catchment area of Havgas - Milatos Torrent, with a northwestern-southeastern development, is a part of the northern area of Ag. Nikolaos Municipality, located about 17km away from Agios Nikolaos settlement.

It has an area of about 40 sq.km, with a ranging length of 8km and width of 5km. Its morphology is categorized by altitude (Fig. 77), as lowland (0 – 200m) defined by the Cretan Sea in the north, and hilly – semi-mountainous, with altitudes of 201 – 800m as we get closer to the southern boundary of the pilot sub-basin.

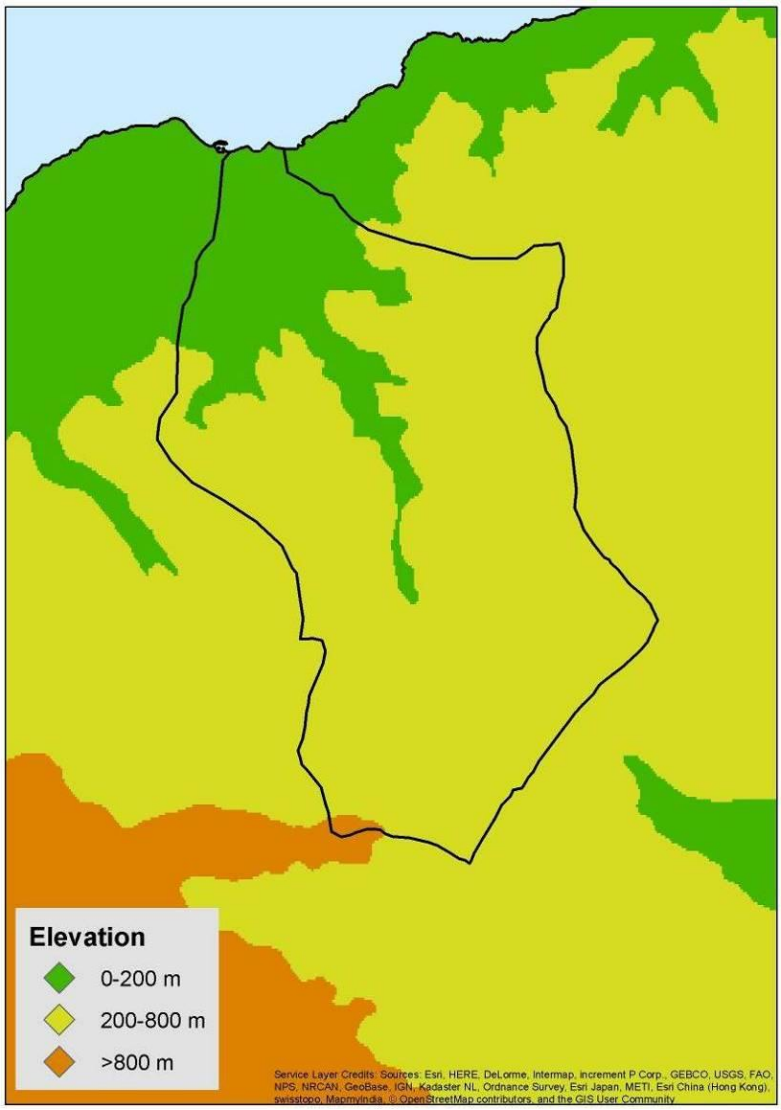


Fig. 77: Geodatabase Map Extract of Mirabello pilot area, showing the altitude categories

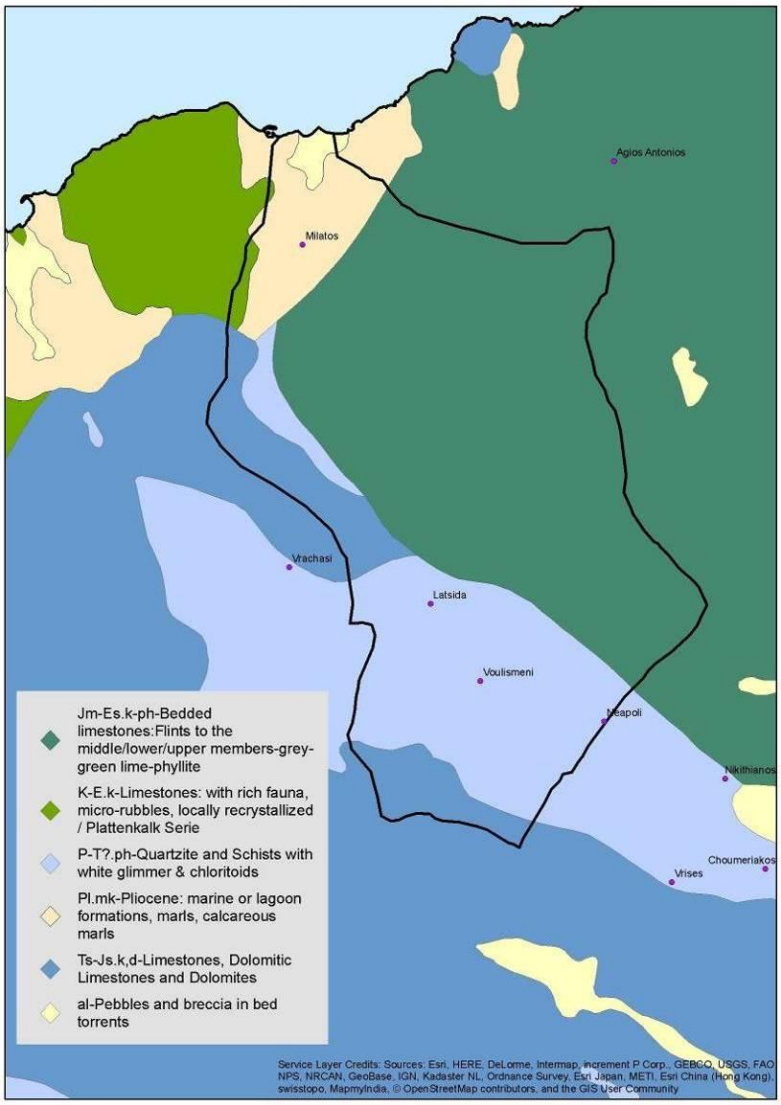


Fig. 78: Geodatabase Map Extract of Mirabello pilot area, depicting the geological formations

The central and eastern parts of the catchment area consist of an autochthonous to parautochthonous rock system, which includes the semimetamorphic Platenkalk Serie (Jm-Es.K1 & Jm-Es.K1) and the underlying limestones, dolomites with the interpolation of schists. In these formations the karstic aquifers GR1300115 and GR1300116 are formed and have moderate to low permeability (K2).

In the south-southwestern part of the pilot sub-basin, in a southeastern – northwestern elongated development, the tectonic cover of the Phyllitic-Quartzitic Series (Permian – Upper Triassic) is found. In this unit, phyllites, quartzites and shales (P-T?.ph) are found and are interpolated between bedded limestones or metaflysch and the calcareous rocks of Tripolis zone (Jm-Es.K1 & Jm-Es.K1).

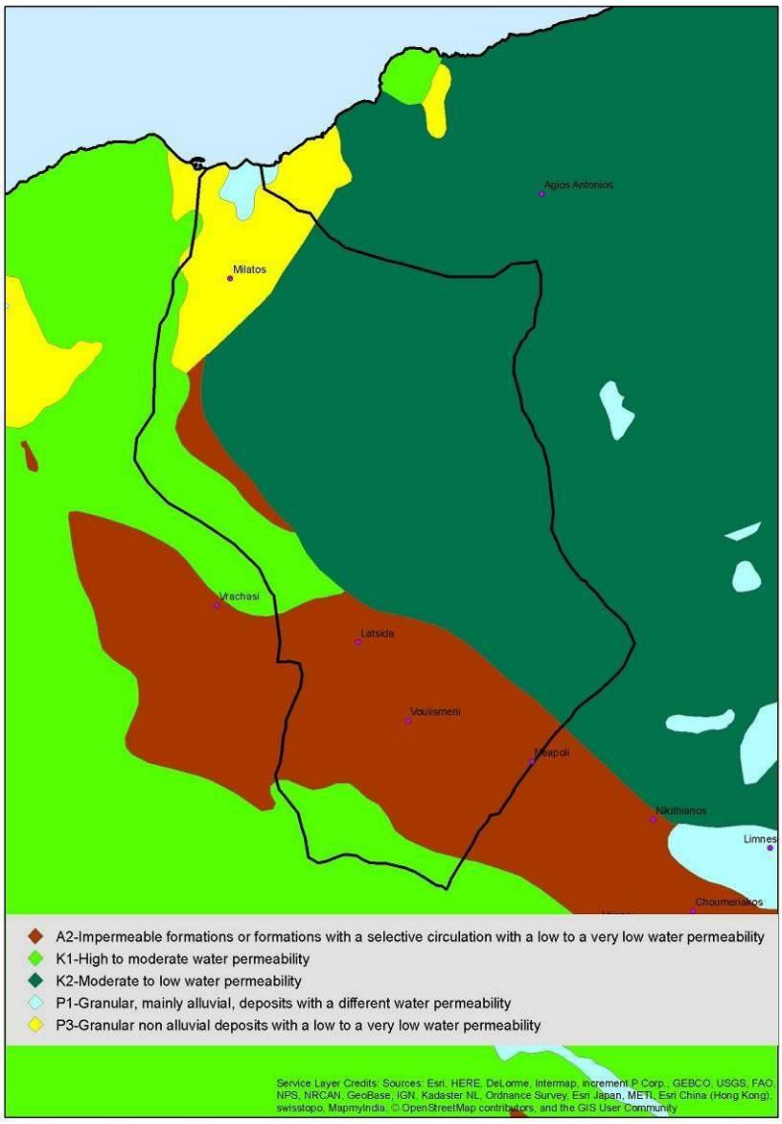


Fig. 79: Geodatabase Map Extract of Mirabello pilot area, depicting the hydrogeology

These formations are practically impermeable or with a selective water circulation and consequently have low to very low permeability (A2). In addition, they form the fractured system of Dikti (GR1300240). In some areas, low capacity aquifers can be found, which are often under overexploitation.

A small area of the western part of the basin, is built of limestones, dolomitic limestones and dolomites (Ts-Js.k,d & K-E.K) of the allochthonous carbonate system (tectonic cover of Tripoli). In the above formations the Karstic Systems of Mallia – Selena (GR1300112), North-East Mount Dikti (GR1300113) and Lakonia-Almyros – Ag. Nikolaos (GR1300114) are formed, with a total area of approximately 223 sq.km. These carbonate systems (GR1300112 & GR1300113 & GR1300114) are comprised of limestones, dolomitic limestones and dolomites (Ts-Js.k,d & K-E.K) and characterized by high to moderate permeability (K1). During summer season, underground water reserves in some areas are overexploited.

The rest of the western part of the pilot sub-basin is covered by low surface spread Pliocene deposits (Pl.mk). In essence, these deposits are marls and marly limestones with low thickness and low to very low permeability (P3).

Finally, in the lowland, south of the maritime coastline, there is a development of a small scale alluvial field, though, without any particular hydrogeological interest.

3.3 SOIL CHARACTERISTICS

As mentioned in paragraph 1.5, the 1:1.000.000 scale soil map of Greece (Katakouzinos, 1967) was used for the identification of the major soil units of the Mirabello and Platanias areas. The soil characteristics of the selected pilot sub-basins are described below.

3.3.1 Voukolies and Maleme sub-basins

The spatial distribution of soil mapping units identified in Platanias area is illustrated in Fig. 80. Soil textural classification data for Voukolies and Maleme pilot sub-basins (Platanias area) was extracted from the European Soil Database (version 2.0) (Panagos et al. 2012). Alluvial deposits mixed with eroded soils (formerly known as REGOSOLS) can be considered as a significant soil unit, as it is the dominant one of the pilot sub-basins in which calcareous Rendzina and brown Mediterranean soils are also found.

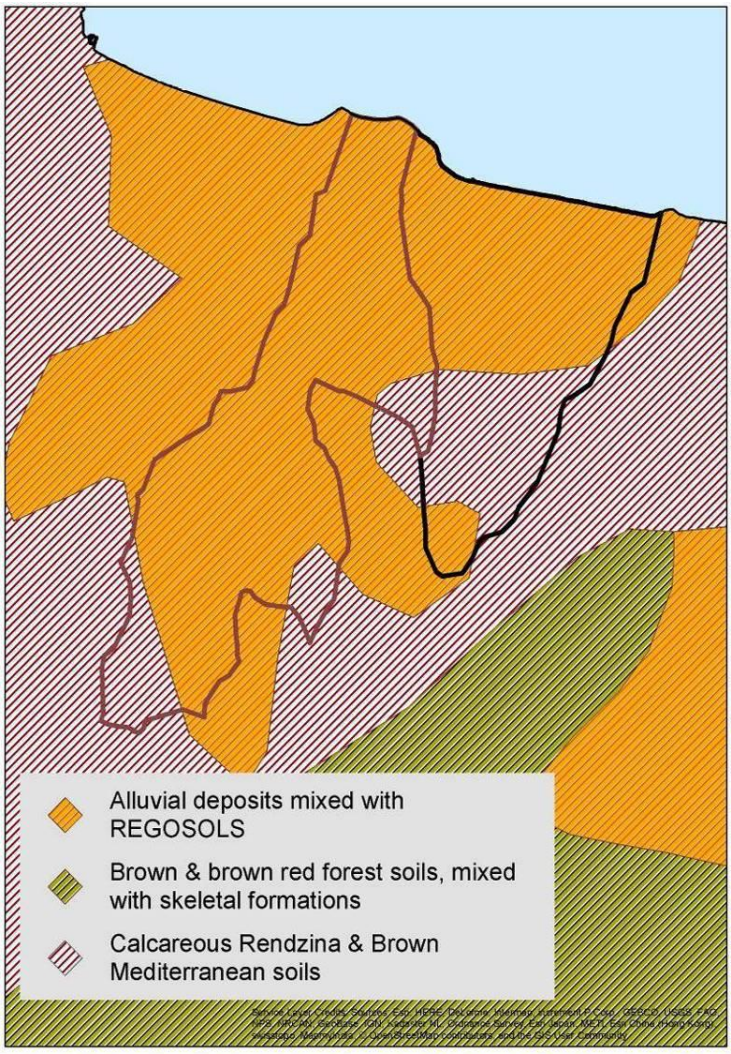


Fig. 80: Soil map of Voukolies and Maleme pilot sub-basins

The spatial distribution of the dominant textural classes at the surface (Fig. 81) and at the sub-surface (Fig. 82) of the pilot sub-basins demonstrate that their major part is dominated by soils of medium texture, for both depths, and only a small part of the sub-surface has been classified as fine.

With regard to the secondary textural class of the pilot sub-basins, despite the fact that fine soils constitute the major secondary textural class at the surface (Fig. 83), the sub-surface (Fig. 84) is characterized by higher variability in soil texture, ranging from coarse to fine soils. Considering all the above, it appears that medium to fine soils cover the major part of the pilot sub-basins.

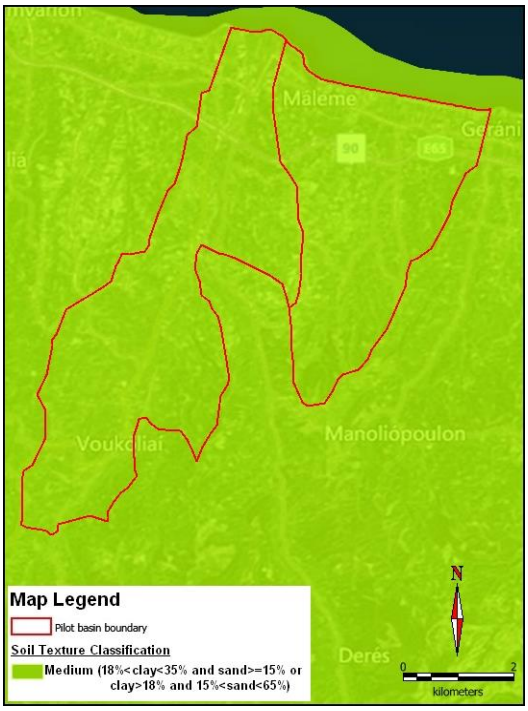


Fig. 81: Spatial distribution of the dominant textural class at the surface soil horizons for Platanias pilot areas. Bing imagery has been used as background map

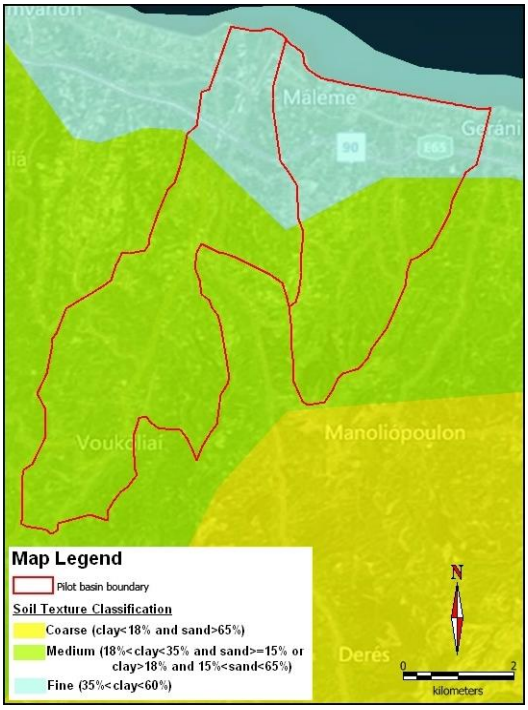


Fig. 82: Spatial distribution of dominant textural class at the sub-surface soil horizons for Platanias pilot areas. Bing imagery has been used as background map

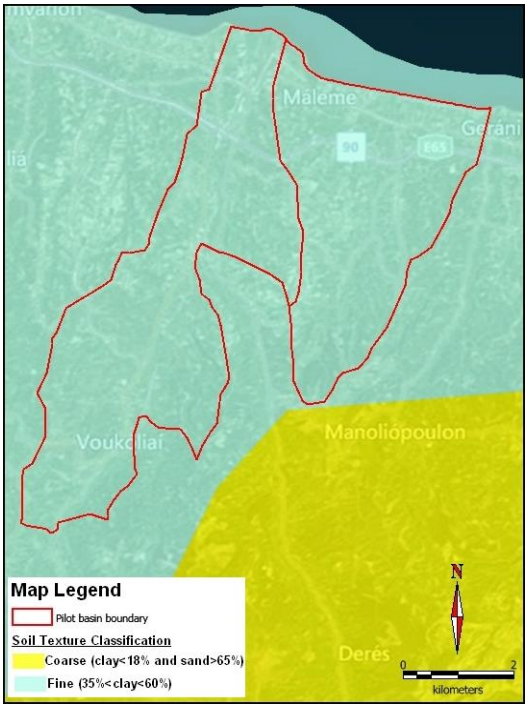


Fig. 83: Spatial distribution of secondary textural class at the surface soil horizons for Platanias pilot areas. Bing imagery has been used as background map

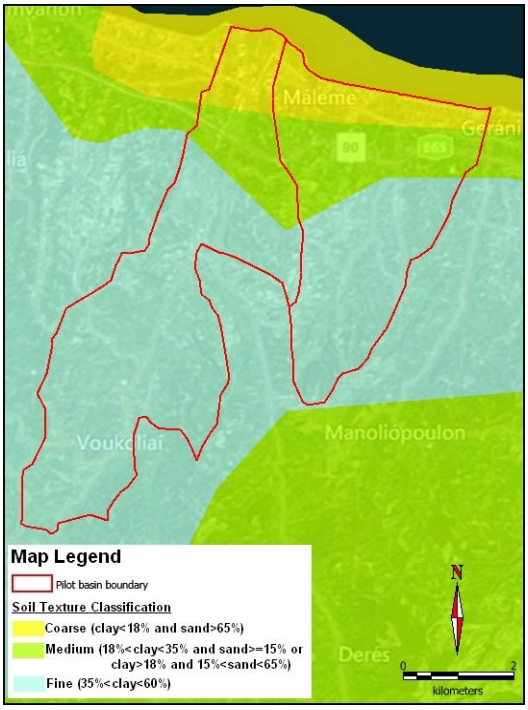


Fig. 84: Spatial distribution of secondary textural class at the sub-surface soil horizons for Platanias pilot areas. Bing imagery has been used as background map

3.3.2 Havgas - Milatos sub-basin

Three soil units are identified in the pilot sub-basin of Havgas - Milatos, namely alluvial deposits mixed with material from eroded soils at the northern part, calcareous Rendzina and brown Mediterranean soils at the central part and podzolic mixed with acidic brown forest soils at the southern part. It has to be noted that calcareous Rendzina and brown Mediterranean soils are the dominant soil class for the pilot sub-basin (Fig. 85).

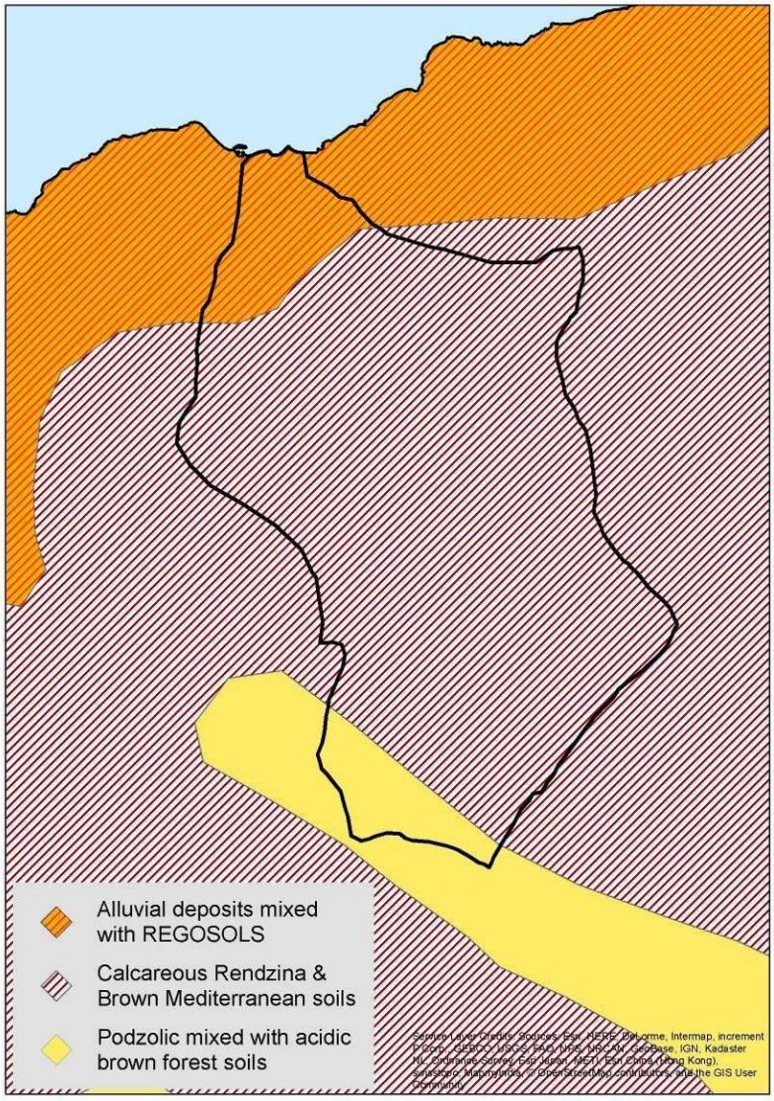


Fig. 85: Soil map of Mirabello pilot area

The textural composition of soils is one of the fundamental properties for soil characterization, as it is directly connected to the hydraulic properties of the soils. The spatial distribution of the dominant soil surface textural classes is presented in Fig. 86. The total area of the pilot sub-basin is covered by soils of medium textural class. The soil texture for the sub-surface horizon of the pilot sub-basin is defined as fine (Fig. 87). As far as the secondary textural distribution class at the surface is concerned, as presented in Fig. 88, the textural class of the pilot sub-basin is fine. At the sub-surface, the secondary textural class distribution (Fig. 89) indicates that the total area consists of medium soils. The combination of the dominant and the secondary textural classification indicates that both surface and sub-surface medium to fine soils are dominating in the pilot sub-basin.

Fig. 86: Spatial distribution of dominant particle size distribution class at the surface for Mirabello pilot area. Bing imagery has been used as background map

Fig. 87: Spatial distribution of the dominant textural classes of the sub-surface layers in Mirabello pilot area. Bing imagery has been used as background map

Fig. 88: Spatial distribution of secondary textural class at the surface soil horizons in Mirabello pilot area. Bing imagery has been used as background map

Fig. 89: Spatial distribution of secondary textural class at the sub-surface soil horizons in Mirabello pilot area. Bing imagery has been used as background map

3.4 MORPHOLOGY AND SLOPES

3.4.1 Voukolies and Maleme sub-basins

The Digital Terrain Model of the Voukolies and Maleme pilot sub-basins in Municipality of Platanias is shown in Fig. 90, while the respective geomorphologic units presented in the pilot sub-basins are depicted in Fig. 91.

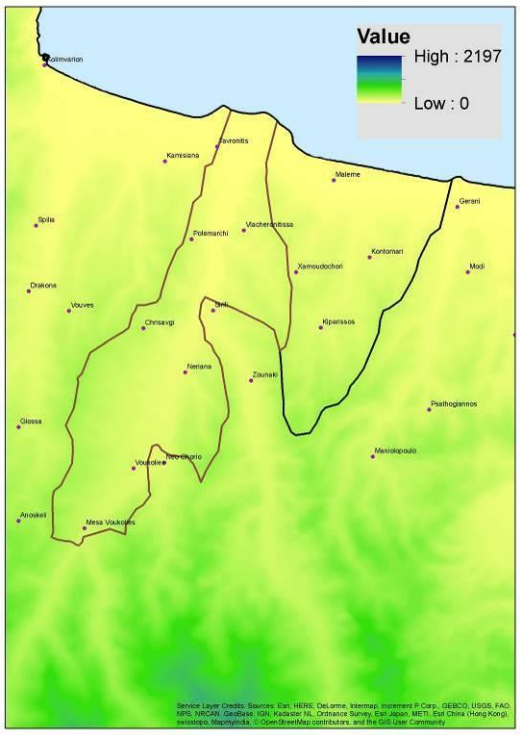


Fig. 90: Digital Terrain Model of the pilot areas of Platanias

Fig. 91: Geodatabase Map Extract depicting the altitudes of the pilot areas of Platanias

Based on the above figures, as well as the altitude histogram of both Platanias Municipality and the selected pilot sub-basins, in contrast to the wider area of interest, there are no mountainous areas in the selected sub-basins of Platanias (Fig. 91). In these pilot sub-basins, flat areas occupy the largest part covering an area of 31,39 sq.km (94,44%) and the rest 5,56 sq.km are semi-mountainous areas (5,56%).

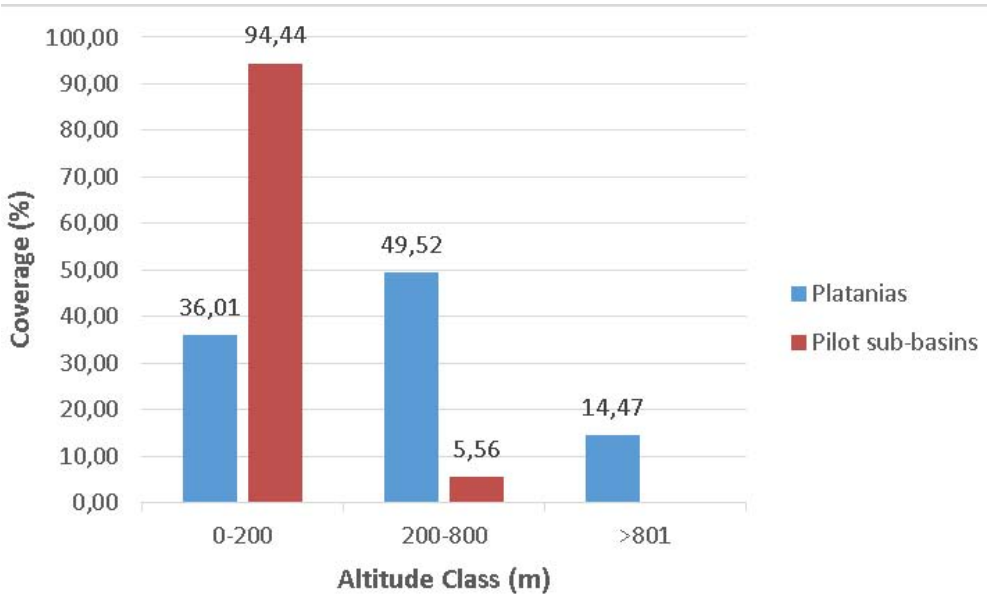


Fig. 92: Histogram showing the % coverage of three altitude classes of the Municipality of Platanias and the selected pilot sub-basins

As far as the slope classes of the pilot areas are concerned, these are presented in Fig. 93.

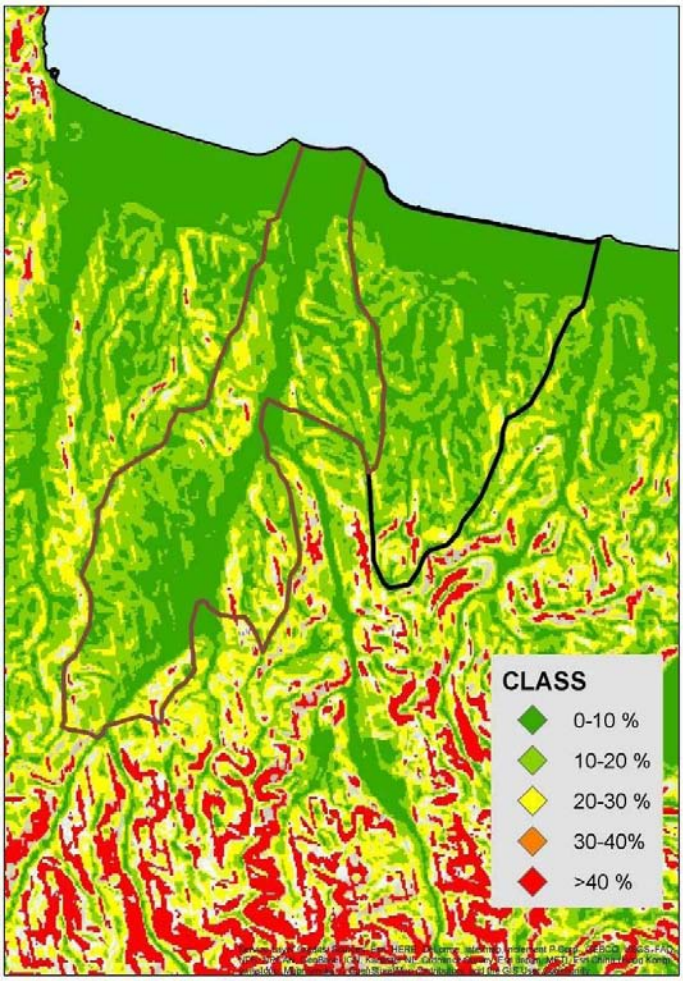


Fig. 93: Digital Slope Model of the pilot areas of Platanias

Based on the altitude histogram provided below (Fig. 94) the slope classes of 0-10% and 10-20% show the higher frequencies in the pilot sub-basins with a rate of 48,14% and 38,31%, respectively. As expected, within the pilot sub-basins the remaining slope classes (20-30%, 30-40%, >40%) follow with a downward trend. The above, however, is not true of the greater area of the Municipality, where the slope classed of 10-20% and >40% prevail, as mentioned earlier.

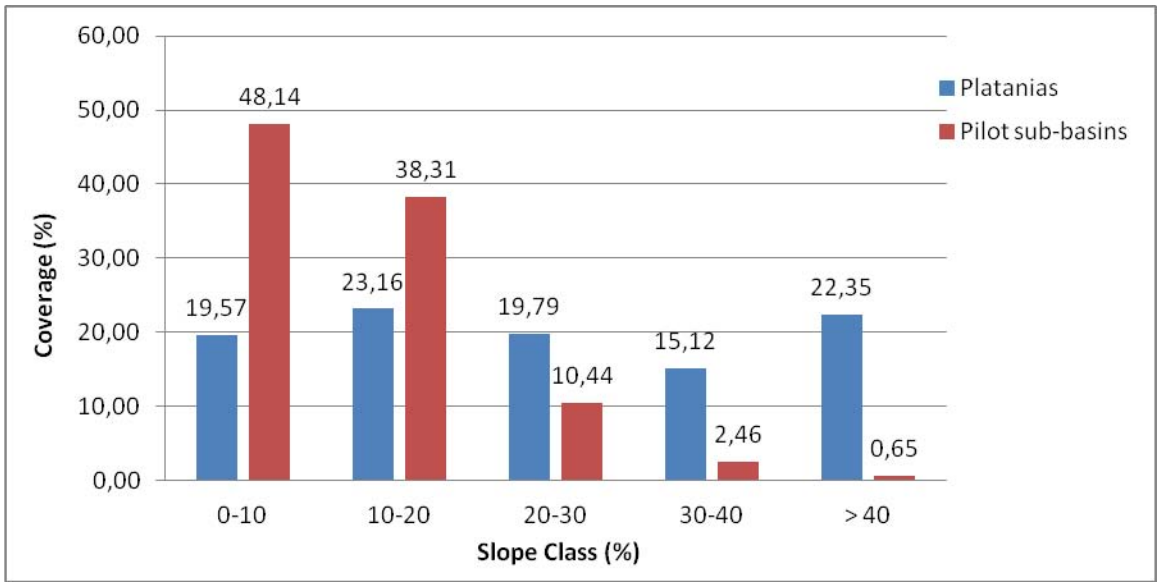


Fig. 94: Histogram depicting the slope classes of the Municipality of Platanias and the pilot areas respectively

3.4.2 Havgas – Milatos sub-basin

The Digital Terrain Model of the Havgas − Milatos pilot sub-basin in Agios Nikolaos Municipality is shown in Fig. 95, while the respective geomorphologic units present in the pilot sub-basin are depicted in Fig. 96.

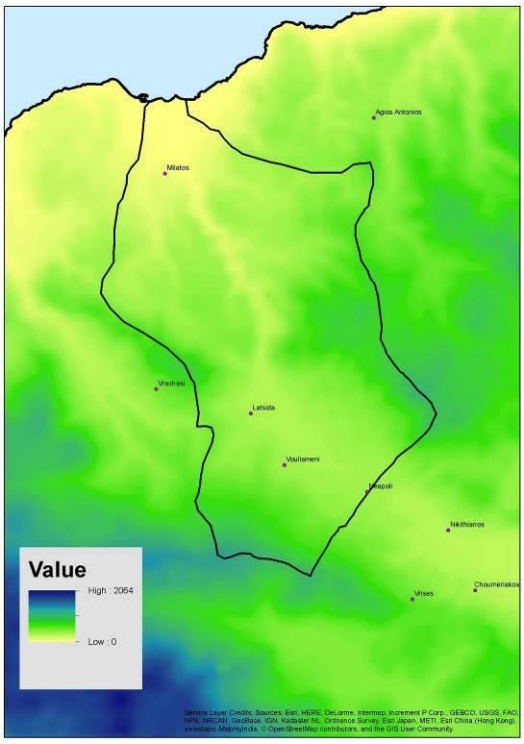


Fig. 95: Digital Terrain Model of the pilot area of Mirabello

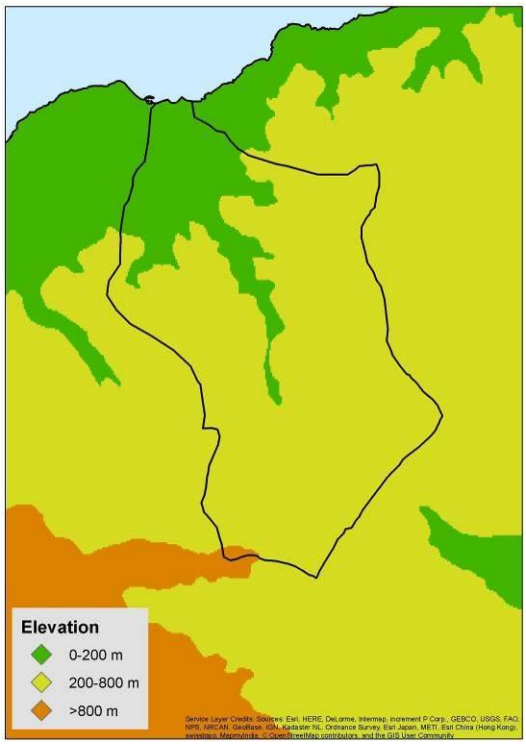


Fig. 96: Geodatabase Map Extract depicting the altitudes of the pilot area of Mirabello

Based on the above figures, as well as the altitude histogram of both Agios Nikolaos Municipality and Havgas − Milatos sub-basin (Fig. 97), similarly to Agios Nikolaos Municipality, the largest part of the pilot sub-basin are semi-mountainous areas that cover an area of 23,64 sq.km (80,94%), followed by flat areas covering 5,50 sq.km (18,66%) and mountainous areas of only 0,12 sq.km (0,40%).

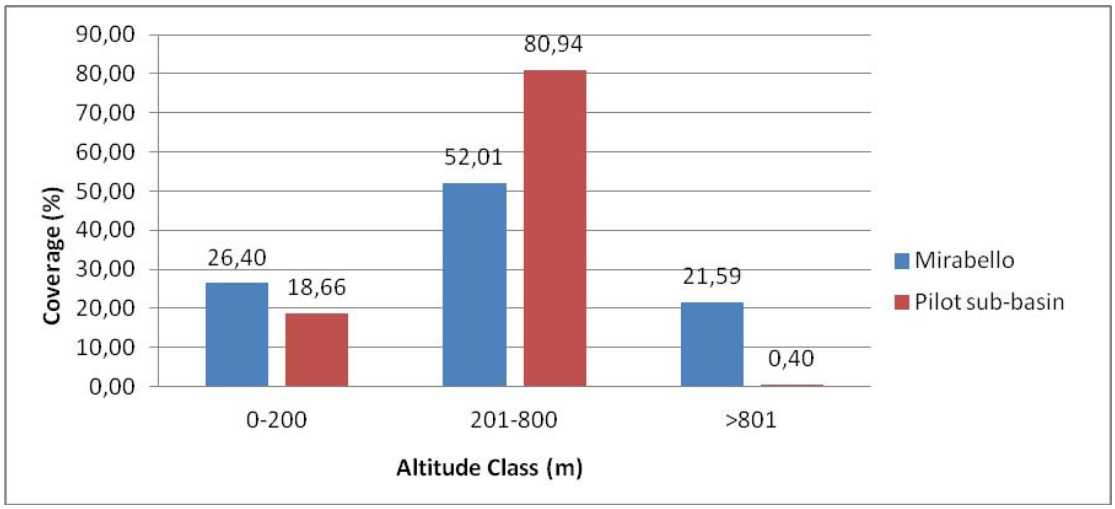


Fig. 97: Histogram showing the altitude of the Municipality of Ag. Nikolaos and the pilot area respectively

The Digital Slope Model of Havgas-Milatos pilot sub-basin is shown in Fig. 98.

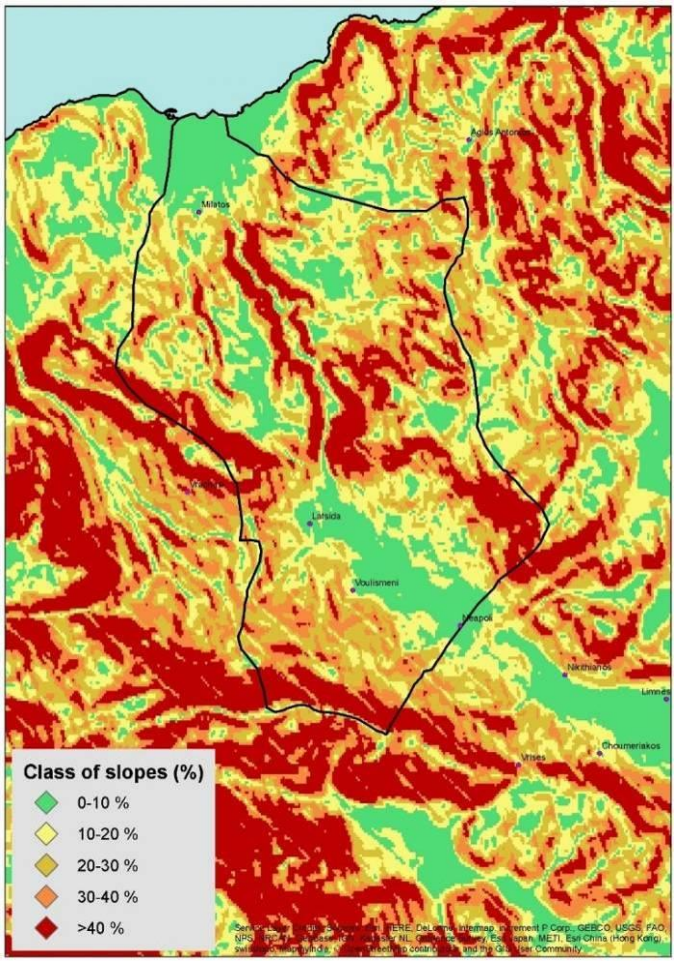


Fig. 98: Digital Slope Model of the pilot area of Mirabello

Based on the altitude histogram provided below (Fig. 99), similarly to the greater area of Agios Nikolaos, the occurrence of the five classes of slopes in the pilot sub-basin presents a uniform view. The classes of 10-20% and 20-30% present the greater frequency.

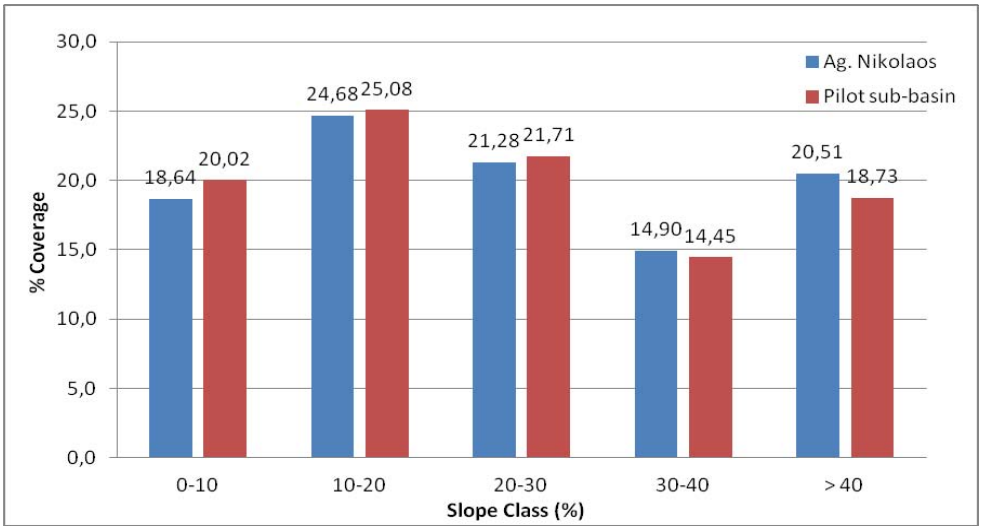


Fig. 99: Histogram depicting the slope classes of the Municipality of Ag. Nikolaos and the pilot area respectively

3.5 LAND USES

The main land uses in Voukolies and Maleme sub-basins (Fig. 100) are presented in Table 91 and further detailed below.

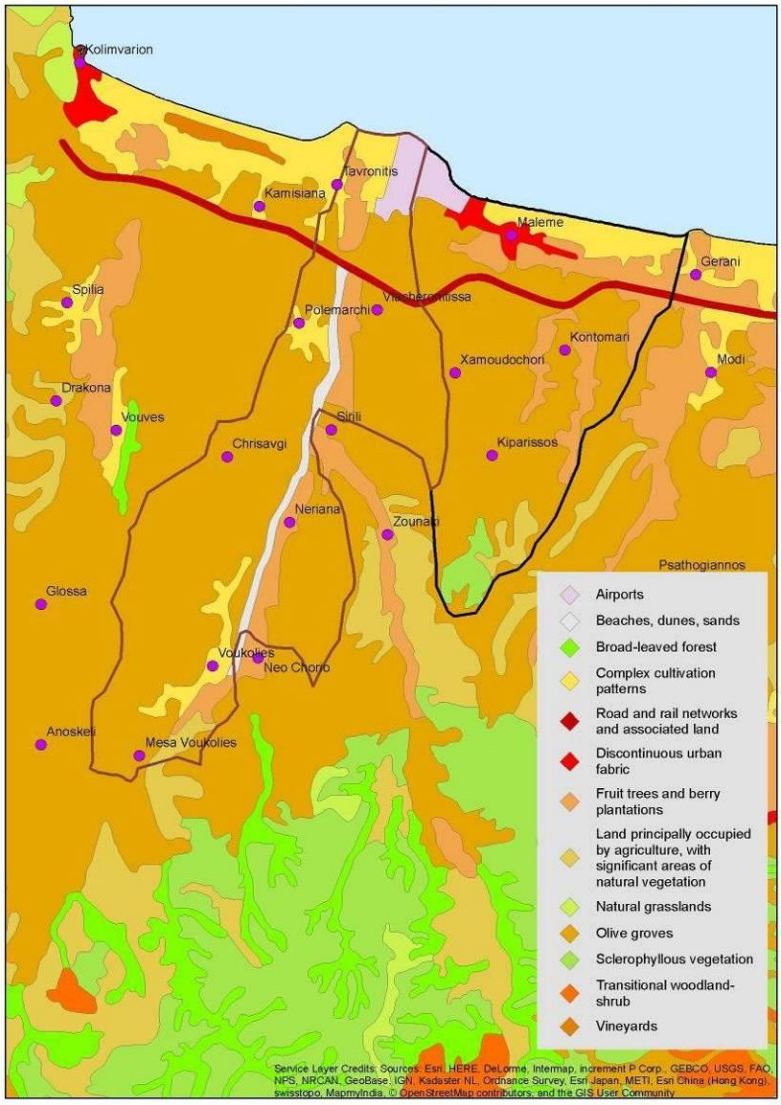


Fig. 100: Land uses of the pilot sub-basins of Platanias

3.5.1 Voukolies sub-basin

The main land use in the sub-basin of Voukolies, agricultural areas, covers an area of 18.08 sq.km, which accounts for 93.05% of the total sub-basin area. Other land uses, involve artificial surfaces and forest and semi-natural areas.

Agricultural areas are mainly covered by permanent crops, olive groves (code 2.2.3) in particular that account for 80.90% of this land use. Permanent crops also include fruit trees and berry plantations (code 2.2.2), that account for 9.56% of this land use and cover an area of 1.73 sq.km. Heterogeneous agricultural areas, account for 9.57 % and total agricultural area of the sub-basin and concern Complex cultivation patterns (code 2.4.2). Forest and semi-natural areas, in particular open spaces with little or no vegetation in the sub-basin fall into the category of beaches, dunes, sands (code 3.3.1)

and cover about 3.50% of the total area. It should be noted here, that this area accounts for Tavronitis River that transverses the sub-basin and finally falls into the Aegean Sea. Lastly, artificial areas, cover 3.45 % of the sub-basin area, that account for Industrial, Commercial and Transport units and in particular, the western part of the historic Airport of Maleme (Code 1.2.4), as well as the part of National Road 90 that transverses the area. The agglomerations included in the river sub-basin Tavronitis (part of), Polemarchi, Vlacherniotissa, Chrisavgi, Gavalomouri, Koulkouthiana, Neriana and Voukolies.
The land uses of the Voukolies pilot sub-basin are summarized on Table 91.

3.5.2 Maleme sub-basin

As in the pilot sub-basin of Voukolies, the main land use of Maleme pilot sub-basin is agricultural that covers an area of 12.15 sq.km (87.7% of the total sub-basin area). Other land uses include artificial surfaces and forest and semi-natural areas.
As shown in Fig. 100, artificial surfaces are mainly located at the upper part of the pilot sub-basin and include Industrial, Commercial and Transport units, which account for the rest of Maleme airport (2.74% of the sub-basin area) and discontinuous urban fabric (code 1.1.2) that accounts for Maleme Agglomeration (3.17% of the sub-basin area). Artificial surfaces in the sub-basin also include part of National Road 90 that transverses the area. Other agglomerations located in the sub-basin include Kontomari, Xamoudochori, Koilada and Kiparissos.
Agricultural areas included in the sub-basin, consist mainly of permanent crops, as well as heterogeneous agricultural areas. The latter fall into the categories of complex cultivation patterns (code 2.4.2) that cover an area of 1.05 sq.km (8.68%), as well as land principally occupied by agriculture (code 2.4.3), located at the southern part of the sub-basin, with an area of 0.35 sq.km (2.91%).
Permanent crops in the sub-basin include fruit trees and berry plantations (code 2.2.2) and olive groves (code 2.2.3). Fruit trees and burry plantations cover a total area of 2.27 sq.km and account for 21.1% of the permanent crops cultivated in the sub-basin. Olive groves (code 2.2.3) consist the main part of the permanent crops cultivated in the sub-basin (78.90%) and cover a total area of 8.48 sq.km.
Last, at the southern part of the sub-basin, 0.49 sq.km of Scrub and/or herbaceous vegetation associations (3.53% of the total sub-basin area) that fall into the category of sclerophyllous vegetation (code 3.2.3) can be found, generally characterized as forest and semi-natural areas.
The land uses of Maleme pilot sub-basin are summarized on Table 91.

Table 91: Land uses of Platanias pilot sub-basins (Voukolies and Maleme)

Main land use	Artificial surfaces			Agricultural Areas				Forest and seminatural areas	
Generic category	Industrial, Commercial and Transport Units		Urban fabric	Heterogeneous agricultural areas		Permanent Crops		Open spaces with little or no vegetation	Scrub and/or herbaceous vegetation associations
Specific category	Airports	Road and rail networks and associated land	Discontinuous urban fabric	Complex cultivation patterns	Land principally occupied by agriculture with significant areas of natural vegetation	Fruit trees and berry plantations	Olive groves	Beaches dunes, sands	Sclerophyllous vegetation
3Pa Platanias (Maleme)									
Area of specific category	0,38	0,4	0,44	1,05	0,35	2,27	8,48	0	0,49
Area of generic category		0,78	0,44		1,4		10,75		0,49
% of generic category	48,97%	51,03%	100,00%	74,91%	25,09%	21,10%	78,90%	-	100,00%
Area of main land use			1,22				12,15		0,49
% of main land use	31,29%	32,61%	36,11%	8,68%	2,91%	18,65%	69,76%	0,00%	100,00%
Total pilot sub-basin area	13,86								
3Pb Platanias (Voukolies)									
Area of specific category	0,49	0,18	0	1,5	0,23	1,73	14,62	0,68	0
Total of generic category		0,67	0		1,73		16,35		0,68
% of generic category	73,01%	26,99%	-	86,87%	13,13%	10,56%	89,44%	100,00%	-
Total of main land use			0,67				18,08		0,68
% of main land use	73,01%	26,99%	-	8,29%	1,25%	9,56%	80,90%	100,00%	-
Total pilot sub-basin area	19,43								

3.5.3 Havgas – Milatos sub-basin

Within the administrative boundaries of Municipality of Ag. Nikolaos, the Catchment area of Havgas - Milatos depicted in Fig. 101 has been selected as the project's pilot river sub-basin.

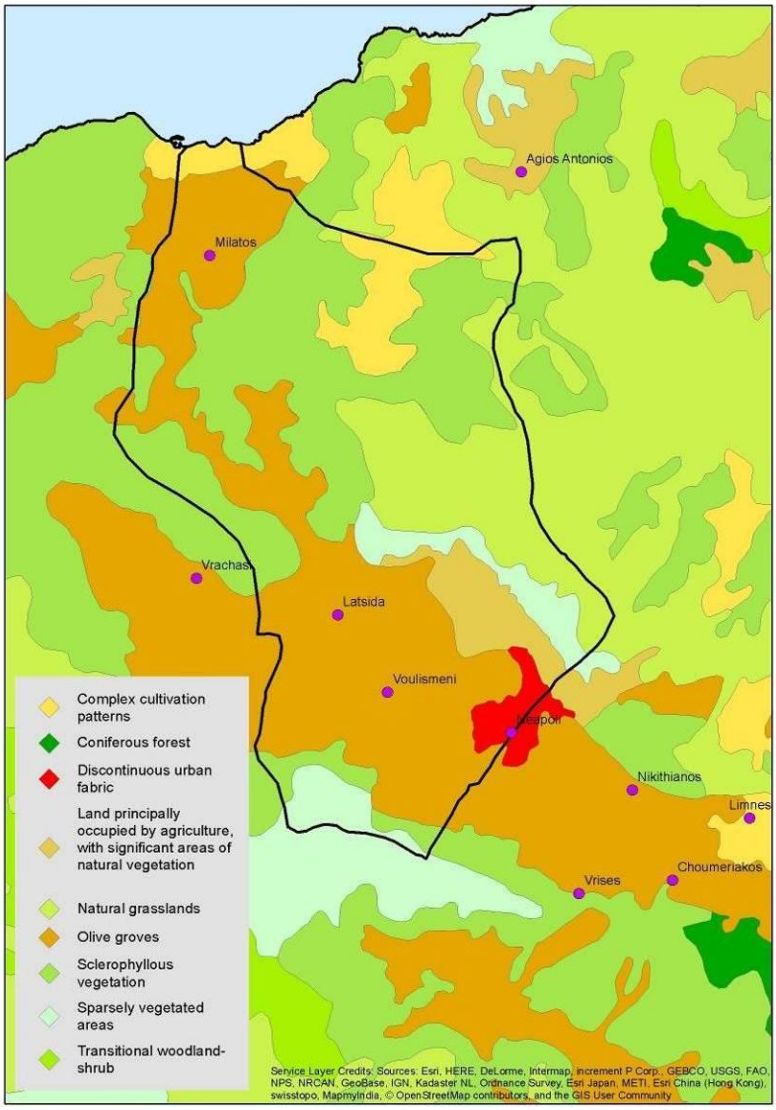


Fig. 101: Land uses of the pilot sub-basin of Ag. Nikolaos

The main land uses in the sub-basin are agricultural areas, forest and semi-natural areas. Artificial areas in the sub-basin, involve urban fabric and in particular discontinuous urban fabric of 0.48 sq.km that accounts for part of Neapolis agglomeration, situated at the SW edge of the pilot area. Other agglomerations located in the pilot sub- basin include Milatos, Latsida and Voulismeni.

Forest and semi-natural areas of the pilot sub-basin, include Scrub and/or herbaceous vegetation associations (87.73%) and open spaces with little or no vegetation (12.27%).Scrub and/or herbaceous vegetation associations cover a total area of 13.08 sq.km and consist of natural grasslands (30.73%) and sclerophyllous vegetation (69.27%). Open spaces with little or no vegetation, on the other hand, cover a total area of 1.83 sq.km and consist exclusively of sparsely vegetated areas.

Agricultural areas in the pilot sub- basin, cover an area of 13.82 sq.km and include permanent crops (79.09%), as well as heterogeneous agricultural areas. Permanent crops consist exclusively of olive groves, which cover an area of 10.93 sq.km and account for 37.42% of the sub-basins total area. Heterogeneous agricultural areas consist of 46.02% Land principally occupied by agriculture, with significant areas of natural vegetation and 53.98% complex cultivation patterns.
The land uses of the Catchment area of Havgas (Milatos) are summarized on Table 92.

Table 92: Land uses of Catchment area of Havgas (Milatos)

Main Land use	Artificial surfaces	Agricultural Areas				Forest and seminatural areas			
Generic category	Urban fabric	Heterogeneous agricultural areas		Permanent Crops		Open spaces with little or no vegetation		Scrub and/or herbaceous vegetation associations	
Specific Category	Discontinuous urban fabric	Complex cultivation patterns	Land principally occupied by agriculture with significant areas of natural vegetation	Fruit trees and berry plantations	Olive groves	Beaches dunes, sands	Sparsely vegetated areas	Sclerophyllous vegetation	Natural grasslands
Area of specific category	0,48	1,56	1,33	0	10,93	0	1,83	9,06	4,02
Area of generic category	0,48		2,89		10,93		1,83		13,08
% of generic category	100%	53,98 %	46,02%	0,00 %	100%	0,00%	100%	69,27%	30,73%
Area of main land use	0,48				13,82				14,91
% of main land use	100%	11,29 %	9,62%	0,00 %	79,09 %	0,00 %	12,27 %	60,76%	26,96%

3.6 HIGH CONSERVATION VALUE AREAS

3.6.1 Nationally designated areas

Nationally designated areas of Platanias and Agios Nikolaos Municipalities have been presented in Chapter 1.7.1. As shown, in Fig. 37 & Fig. 39 of the particular chapter there are no Wildlife Refugees, neither Protected Forests located in the pilot sub-basins of Platanias.
However, as shown in Fig. 102 there are two Wildlife Refuges located in the pilot sub-basin of Mirabello, namely Latsidiani Kefala Dimou Neapolis (K876) and part of Anavlocho (Vrachasiou) (K557). The characteristics of the above Wildlife Refugees are presented on Table 93.

Table 93: The Wildlife Refuges of the pilot area of Mirabello

Code	Name	Area in the pilot sub-basin (sq.km)[1]	% of Total Area	Government Gazette No
K876	Latsidiani Kefala Dimou Neapolis	4,89	99.9%	Designation: 787/B/22-06-01
K557	Anavlocho (Vrachasiou)	2,61	54.9%	Designation: 708/B/27-9-82

[1]Source: Own processing

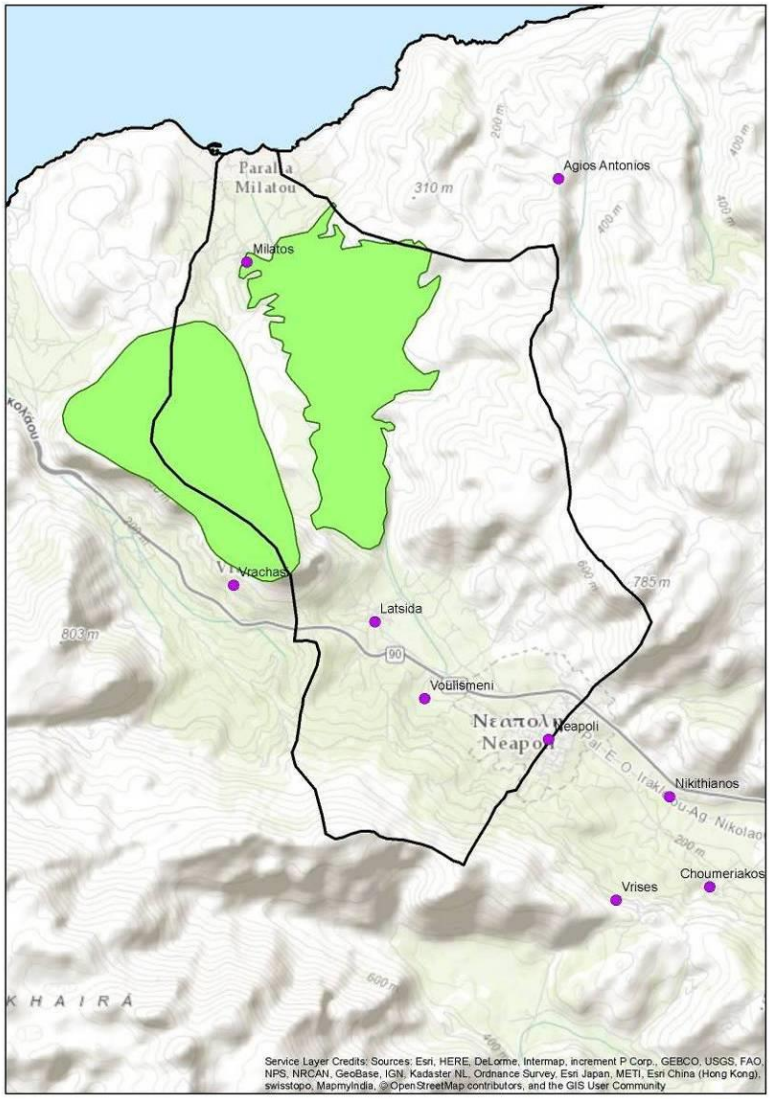


Fig. 102: Geodatabase Map Extract of the Wildlife Refuges situated in the pilot sub-basin of Mirabello

3.6.2 Small island wetlands

Small Island Wetlands, protected under Law 3937/2011 (60/A/31-03-11) and the Presidential Decree on the "Adoption of the Small Island Wetlands Inventory and definition of terms and restrictions for the protection of these small coastal wetlands" (229/ΑΑΠ/19-06-12) were presented in Chapter 1.7.2.

The small island wetlands of Municipality of Platanias, located within the pilot sub-basins are shown in Fig. 103. These include Tavronitis Estuary and marsh and Sfakoryako Estuary, depicted in Fig. 104 and Fig. 105, respectively.

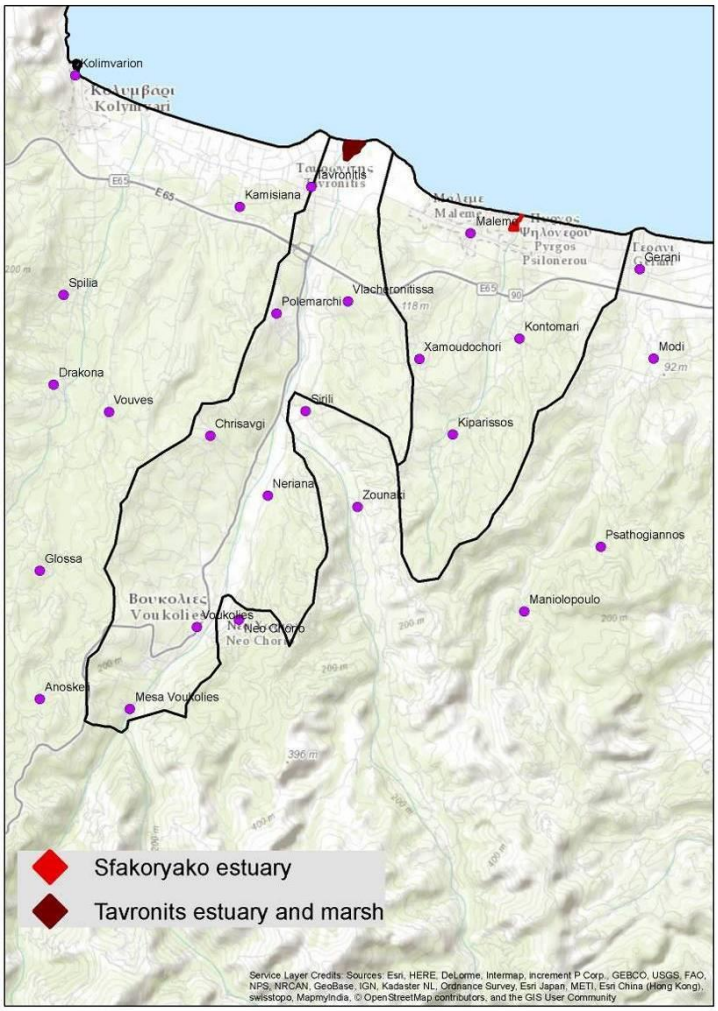


Fig. 103: Geodatabase Map Extract of the small island Wetlands located in the pilot sub-basins of Platanias

Fig. 104: Tavronitis estuary and marsh

Fig. 105: Sfakoryako estuary

Relevant information is summarized on Table 94.

Table 94: The small island Wetlands of the pilot areas of Platanias

Name	Code	Area	Interrelated Systems		
			Surface waters (inland, transitional and coastal waters)	Groundwater bodies	Natura 2000 sites
Tavronits estuary and marsh	Y434KRI203	56	GR3901R000301006N GR133901T0001N	-	GR4340003
Sfakoryako estuary	Y434KRI202	13	GR1339C0002N	-	GR4340003

As far as Mirabello area is concerned, there are no small island wetlands located within the boundaries of the selected pilot sub-basin.

3.6.3 Recreational (Bathing) waters

Recreational (bathing) waters, in conformance with the requirements of the Bathing Waters Directive (2006/7/EC), located within the boundaries of the pilot sub-basins selected in Platanias area involve Maleme beach. Bathing waters of Maleme beach are of excellent quality based on the assessment of the previous 4 years. Maleme beach, situated at the coast of the Maleme, has a length of 4km and an average width of 35 m. The exact location, as well as the area included in the bathing waters inventory is shown in Fig. 106. In the western and eastern ends of the beach are the mouths of 3 intermittent streams, while right in the middle, the Sfakoryako estuary is located. The main land uses of the area are urban, including hotels, permanent and summer houses and agricultural, mainly olive groves and vineyards.

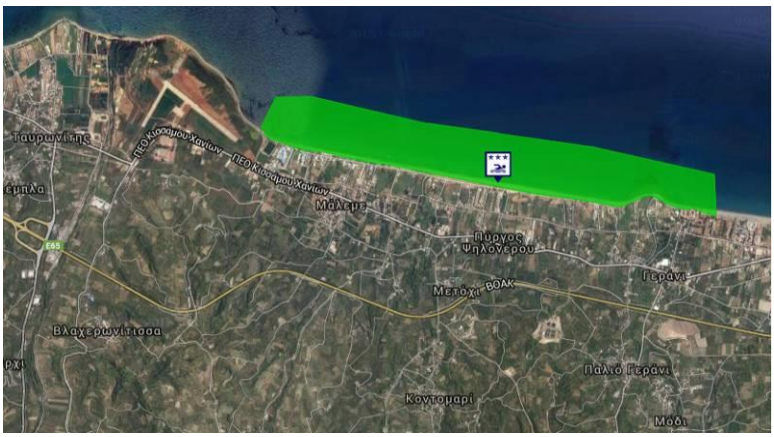


Fig. 106: Bathing waters of Maleme beach in Platanias

Table 95: The bathing waters of the pilot areas of Platanias

Name	Code	Interrelated coastal systems
Maleme	GRBW139323085	GR1339C0002N

Within the boundaries of the selected sub-basin in Mirabello area, on the other hand, Milatos beach is located (Fig. 107) which is also included in the national bathing waters inventory. Milatos Beach, about 2 km northern of Milatos, is the coastal front of a 190 m gulf and has an average width of 15 m. The main land uses of the area are urban, with dispersed settlements and little vegetation.

Fig. 107: Bathing waters of Milatos Beach in Mirabello

Table 96: The bathing waters of the pilot area of Mirabello

Name	Code	Interrelated coastal systems
Milatos	GRBW139310032	GR1341C0009N

3.6.4 Water bodies for the abstraction of drinking water

3.6.4.1 Voukolies and Maleme sub-basins

As shown in Fig. 108, the selected pilot sub-basins in the area of Platanias are situated in the area of the Porous of Kampos Chanion aquifer. Thus, there are no groundwater bodies intended for the abstraction of water for human consumption located in the pilot sub-basins of Platanias.

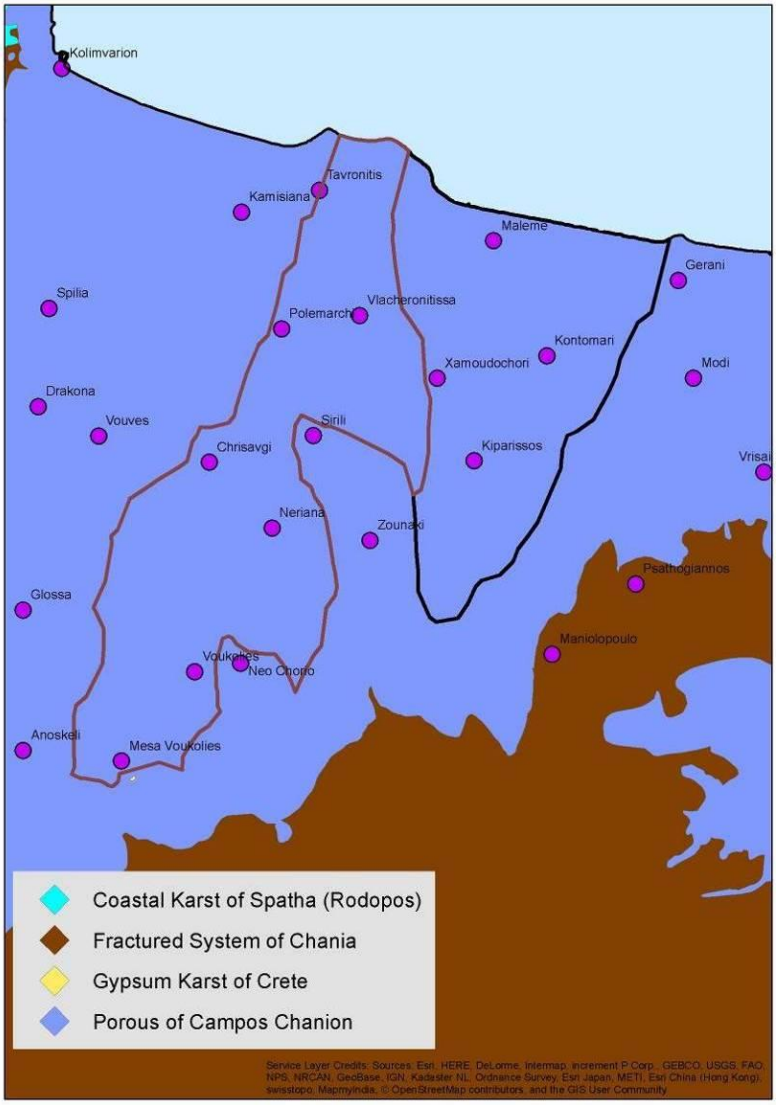


Fig. 108: Geodatabase Map Extract of the aquifers the pilot sub-basins of Platanias are situated

3.6.4.2 Havgas – Milatos sub-basin

Small parts of 5 groundwater bodies are found within the boundaries of the selected pilot sub-basin (Fig. 109), four of which are intended for the abstraction of water for human consumption. Groundwater bodies utilized for drinking, Coastal karst of Sisi-Milatos-Elounda, Karst of Fourni − Elounda, Fractured system of Dikti, karst of Malia Selena, karst of NE Dikti, are summarized on Table 97.

Table 97: Groundwater bodies used for human consumption in Havgas - Milatos sub-basin

Code	Name	Aquifer Type	Area (sq.km)
GR1300116	Coastal karst of Sisi-Milatos-Elounda	karstic	90.18
GR1300115	Karst of Fourni - Elounda	karstic	80.98
GR1300113	Karst of NE Mount Dikti	karstic	86.75
GR1300112	Karst of Malia - Selena	karstic	92.51

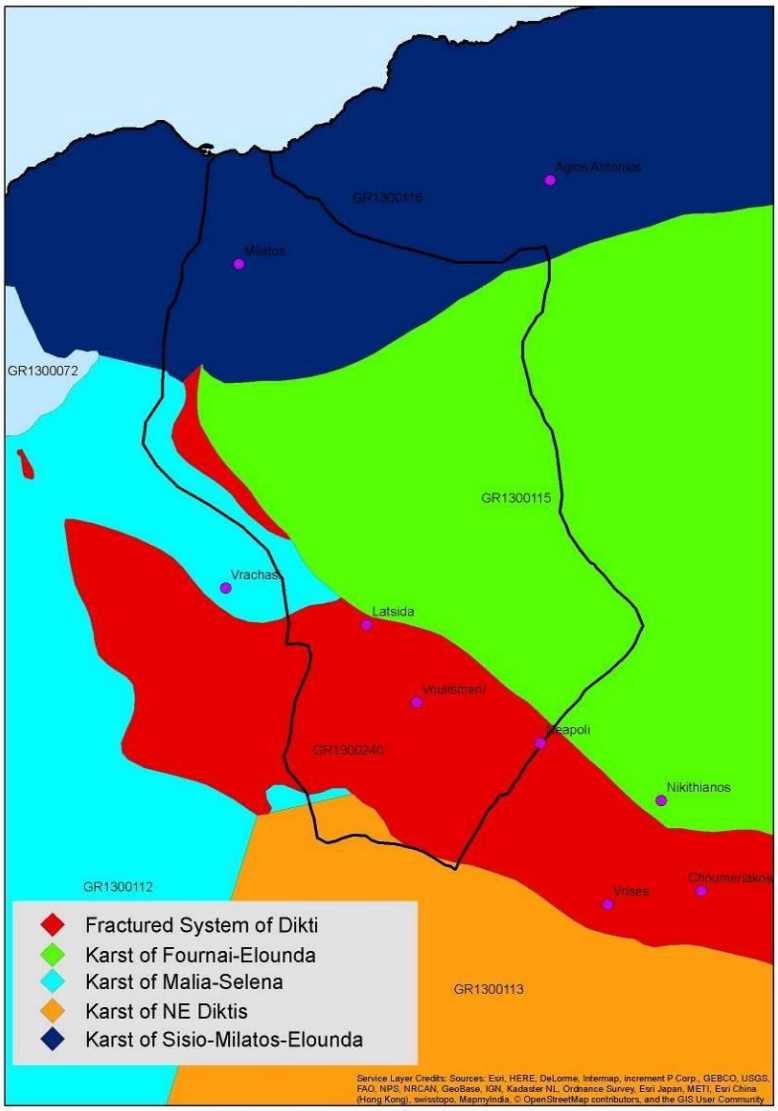


Fig. 109: Geodatabase Map Extract of the aquifers the pilot sub-basin of Mirabello is situated

3.7 RESPONSIBLE BODIES ON WATER SERVICES

The bodies responsible for supplying water for drinking, irrigation and other uses have been presented in chapter 1.10.

In particular, the bodies responsible for supplying water for irrigation use in the pilot areas of Platanias are (Fig. 110):

- OAK S.A., and
- TOEB Agia Kolymvari

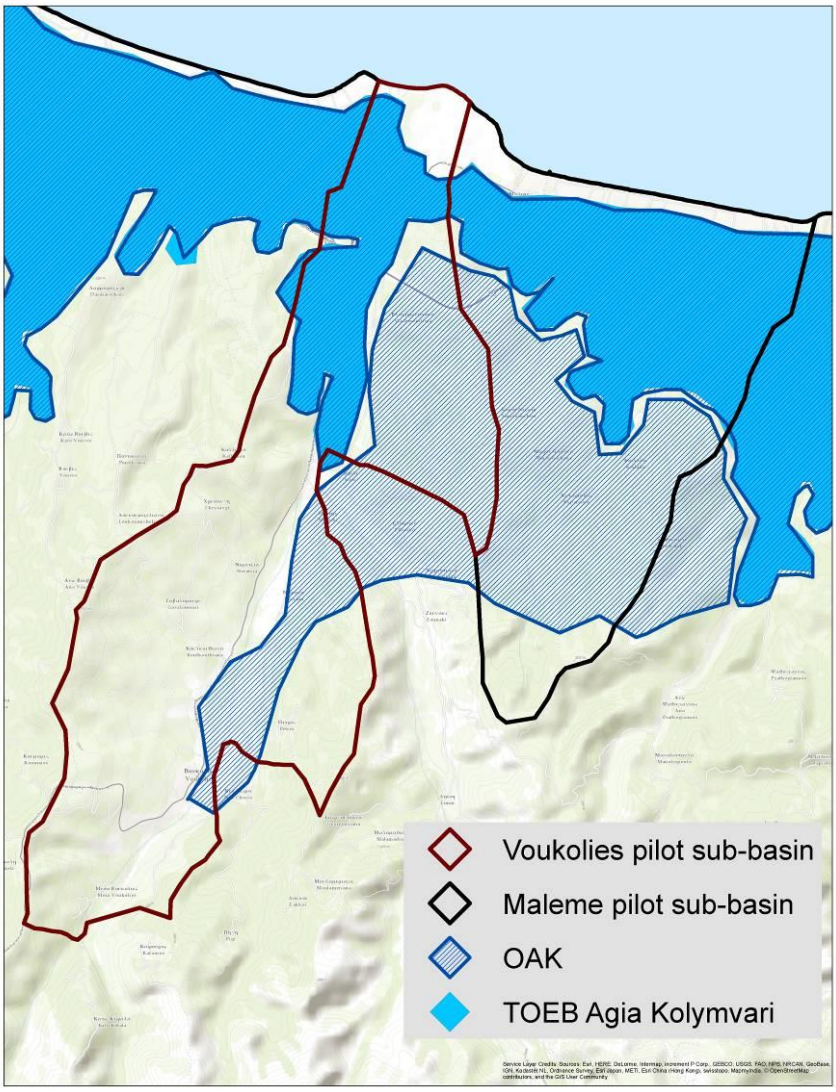


Fig. 110 Geodatabase Map Extract of Platanias, depicting the responsibility area of water supplier bodies in **Platanias' pilot areas**

Regarding the pilot area of Mirabello, there are no irrigation networks managed by responsible bodies.

3.8 WATER CONSUMPTION

3.8.1 Voukolies and Maleme sub-basins

Based on the data provided in chapter 3.1.1, the settlements within the boundaries of the pilot river sub-basin of Voukolies are Tavronitis (part of), Polemarchi, Vlacherniotissa, Chrisavgi, Gavalomouri, Koulkouthiana, Neriana and Voukolies. Moreover, the following settlements are located within the pilot sub-basin of Maleme: Maleme, Kontomari, Xamoudochori, Koilada and Kiparissos.

The annual drinking water consumption in the above settlements for the years 2011-2014 are presented on Table 98.

Table 98: Annual drinking Water Consumption (m^3/year) of Voukolies and Maleme sub-basins

Settlement	YEAR				Average
	2011	2012	2013	2014	
Vlacherniotissa	14.302	14.544	13.355	12.642	13.711
Voukolies	66.170	78.290	83.935	89.794	79.547
Tavronitis	81.410	81.096	75.708	78.763	79.244
Polemarchi	12.449	19.306	18.621	21.442	17.955
Chrisavgi	26.153	33.813	31.520	38.592	32.520
Neriana	8.692	8.720	8.765	9.214	8.848
Gavalomouri, Koulkouthiana	19.084	22.113	21.123	23.098	21.355
Kontomari	23.470	22.080	18.813	25.526	22.472
Koilada	4.128	5.656	2.437	2.824	3.761
Maleme	98.379	92.239	101.223	111.683	100.881
Kiparissos	11.725	11.514	10.899	9.876	11.004
Xamoudochori	29.286	20.047	18.572	19.893	21.950

Data regarding the irrigation water consumed from the municipal network for the same time period is provided on Table 99.

Table 99: Annual Irrigation water consumption m^3/year of Voukolies and Maleme sub-basins

Settlement	2011	2012	2013	2014	Average
Vlacherniotissa					
Voukolies					
Tavronitis					
Polemarchi	21.444	39.866	28.456	23.712	28.370
Chrisavgi	67.079	133.799	92.463	126.730	105.018
Neriana	38.130	49.266	36.979	42.454	41.707
Gavalomouri, Koulkouthiana	12.081	25.983	14.193	23.072	18.832
Kontomari					
Koilada					
Maleme					
Kiparissos					
Xamoudochori					

For the irrigation of the areas cultivated in the Voukolies and Maleme pilot sub-basins private wells are mostly utilized, located mainly alongside of Tavronitis River. In particular, there are 65 wells, 17 of which group managed, allowing for a maximum annual water abstraction quantity of 282.907,5 m^3/yr. It is estimated that water abstracted from the above wells is utilized for the irrigation of about 53.3 ha of olive groves, 35 ha of citrus trees, 4.5 ha of avocado trees, 4.2 ha of vegetables and 3.8 ha of vineyards.

As far as water boreholes are concerned, there is only one group owned used for irrigation purposes, allowing for a maximum annual abstraction quantity of 8.790 m^3/yr. There is also one water borehole owned by OAK, with a maximum annual water abstraction quantity of 180.000 m^3/yr utilized for the irrigation of 2500 ha of olive groves, citrus trees, vineyards and vegetables via the irrigation network of Voukolies. The latter, is also supplied from a water borehole located at Kefala, Local Community of

Voukolies with a maximum annual water abstraction quantity of 150.000 m^3/yr. The abstraction points used for irrigation purposes in the pilot sub-basins of Platanias Municipality are depicted in Fig. 111.

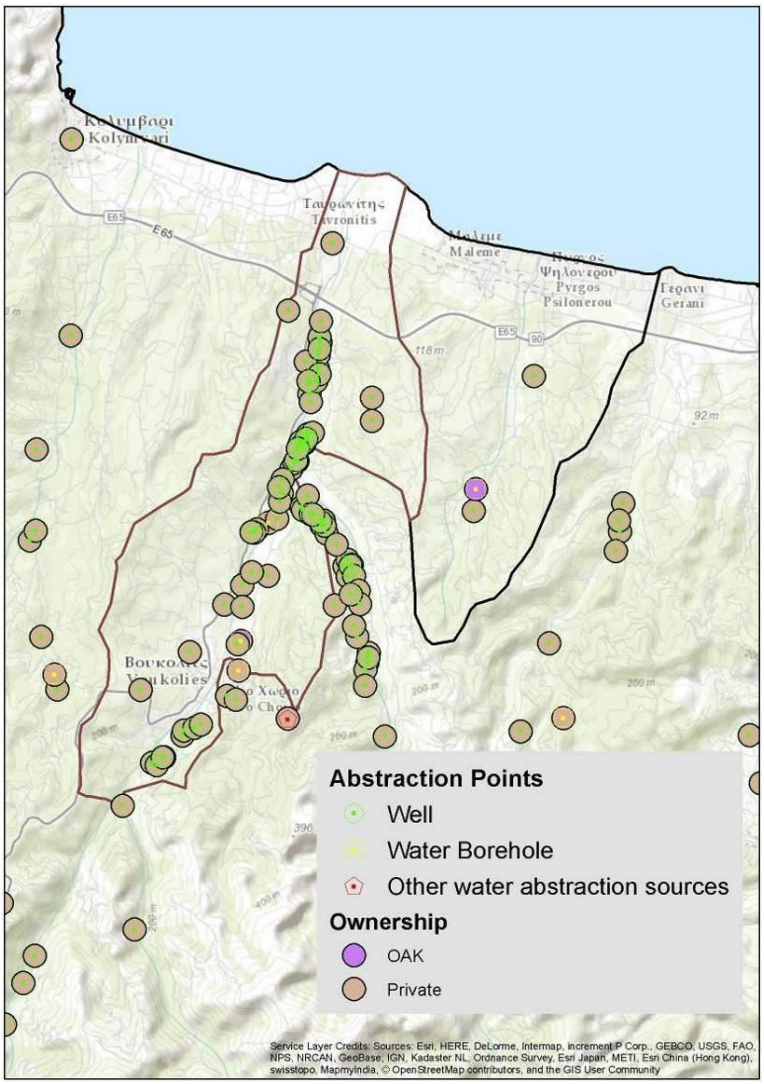


Fig. 111: Abstraction points used for irrigation purposes within Platanias area sub-basins

3.8.2 Havgas - Milatos sub-basin

Based on the data provided in chapter 3.1.2, the settlements within the boundaries of the selected river sub-basin in Municipality of Agios Nikolaos are Neapoli (part of), Voulismeni, Latsida and Milatos

The annual drinking water consumption for the year 2013 is presented on Table 100.

Table 100: Water Consumption for the year 2013 of Havgas – Milatos sub-basin

Agglomeration	Water Consumption (m^3)
Neapoli	163.450
Voulismeni	19.695
Latsida	19.880

Vraxasi - Milatos - Sisi	418.543
Total	621.559

The cultivations in the selected sub-basin, are mostly rainfed, thus the area is not covered by TOEB's nor the municipal's irrigation network. For the irrigation of the few irrigated olive groves of the area, water is abstracted from private or group owned boreholes.

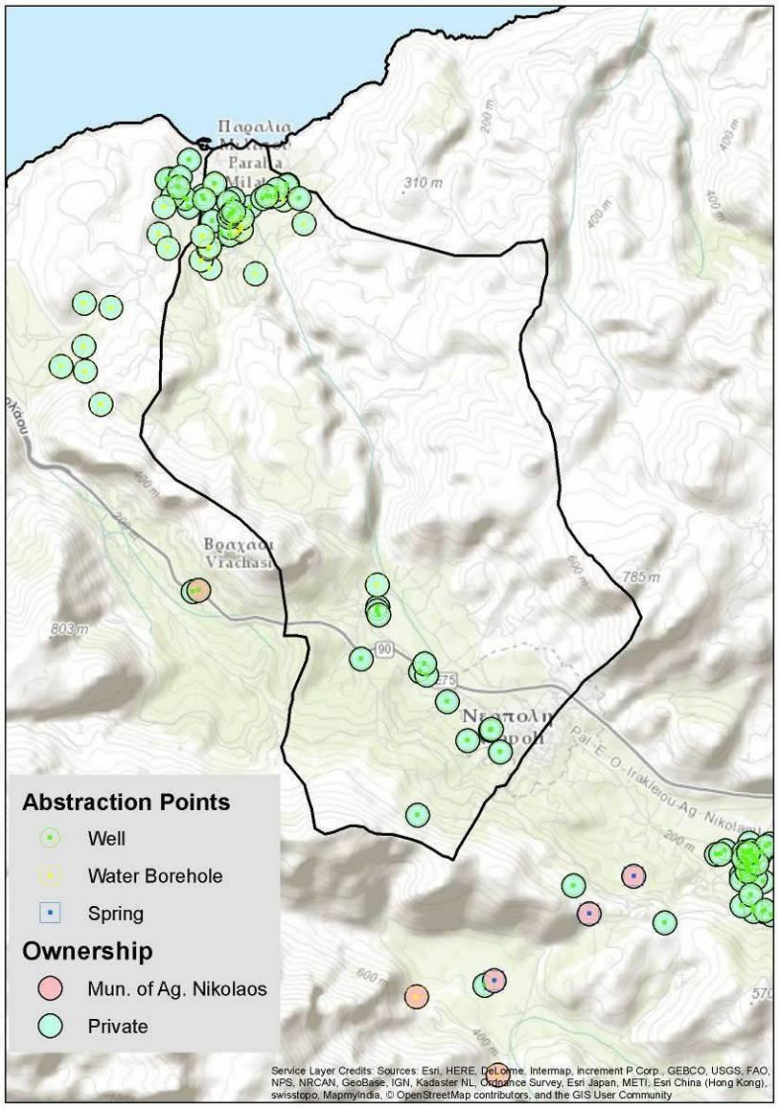


Fig. 112: Abstraction points used for irrigation purposes within Mirabello area sub-basin

There are 10 boreholes, 7 of which private and 3 group owned, with a total annual maximum abstraction quantity of 54.565 m^3/yr. There are also 27 wells used for irrigation purposes in the selected sub-basin with a total annual maximum abstraction quantity of 86.848 m^3/yr. It is estimated that the abstracted water is utilized for the irrigation of about 43.8 ha of olive groves, 1.7 ha of vegetables and 0.4 ha of citrus trees. As shown in the map extract below (Fig. 112), most abstraction points are located at the northern part of the Havgas - Milatos sub-basin, Northern of Milatos settlement and abstract water from the karstic aquifer of Sissio- Milatos- Elounda.

PART B – DESCRIPTION OF TARGETED AREAS AND PILOT RIVER SUB-BASIN IN METAPONTINO AREA IN BASILICATA REGION, ITALY

1. DESCRIPTION OF THE TARGETED AREAS IN METAPONTINO AREA, ITALY

1.1 GENERAL DESCRIPTION

1.1.1 Basilicata Region, Italy

Originally called Lucania, Basilicata is part of the Mezzogiorno, the meta-region encompassing the southern part of the Italian mainland (Abruzzo, Molise, Basilicata, Campania, Puglia, Calabria) and the two major islands of Sicily and Sardinia. Basilicata borders with Campania, Calabria and Puglia, as well as with Ionian and Tyrrhenian Sea (Fig. 113). It is the third-smallest region in Italy, after Valle d'Aosta and Molise. It covers a 3.3% of the national territory and hosts almost 1% of the total population (578,391 inhabitants in December 31st 2013). Hilly-mountainous areas make up over 90% of its territory, rendering it one of the least accessible regions of Italy and also one of the most sparsely populated, with about 58 inhabitants per sq.km, against a national average of 202. This peculiarity is reflected in its administrative structure. Basilicata has two provinces (Potenza and Matera), both of which are predominantly rural. Together, they encompass a large number of small municipalities (131) (Venanzi et al., 2013).

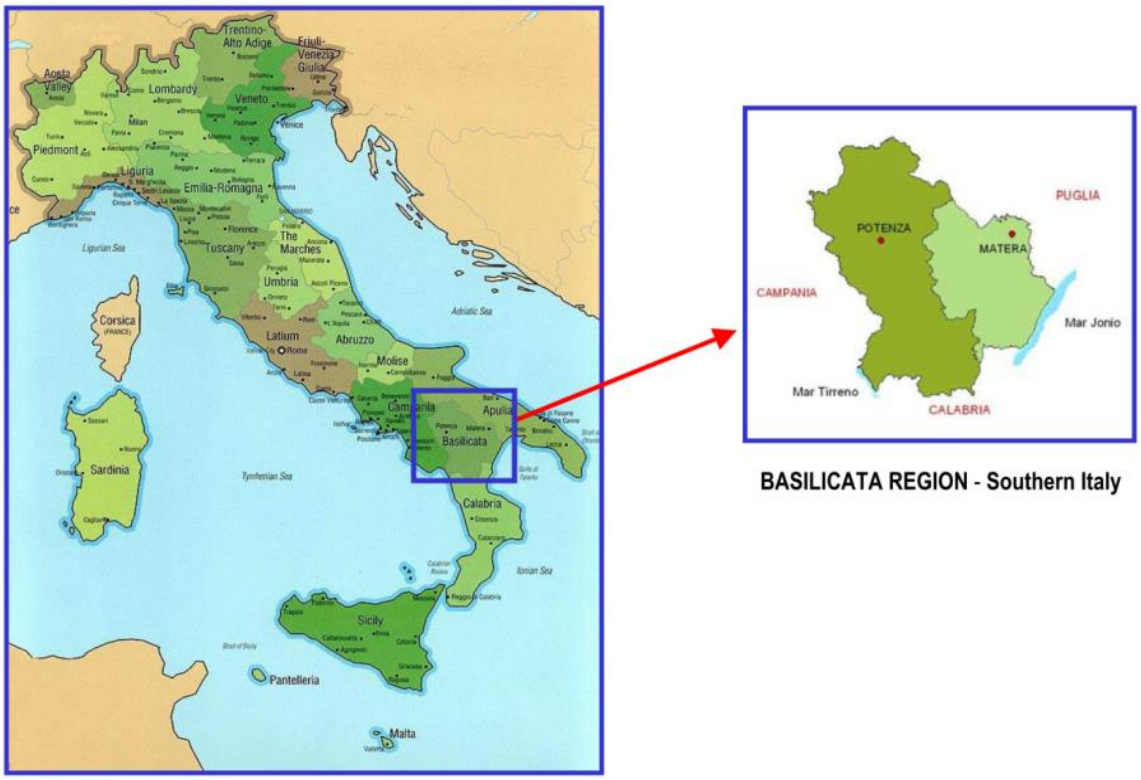


Fig. 113: Geographical framework (Basilicata is highlighted) (source: Interregional River Basin Authority of Basilicata)

Despite the fact that the GDP per capita is still slightly above the average of the South, which in 2013 was 14,769 euro, this indicator was decreased by 15.2% in real terms, between 2007 and 2013. Even before the global economic crisis, Basilicata showed a growth trend tending to stagnate. From 2008 and onwards, GDP has decreased, a total of 13.1 points, compared to the national 10.6 points. So even during the crisis the

regional economic system highlights a particular weakness (Programma operativo FESR Basilicata 2014/2020).

1.1.2 Metapontino Area

Metapontino (Fig. 114), which overlooks the Ionian Sea, covers about 800 sq.km of the Matera province in Basilicata region and beyond, including the entire plain of Metaponto and the surrounding hills.

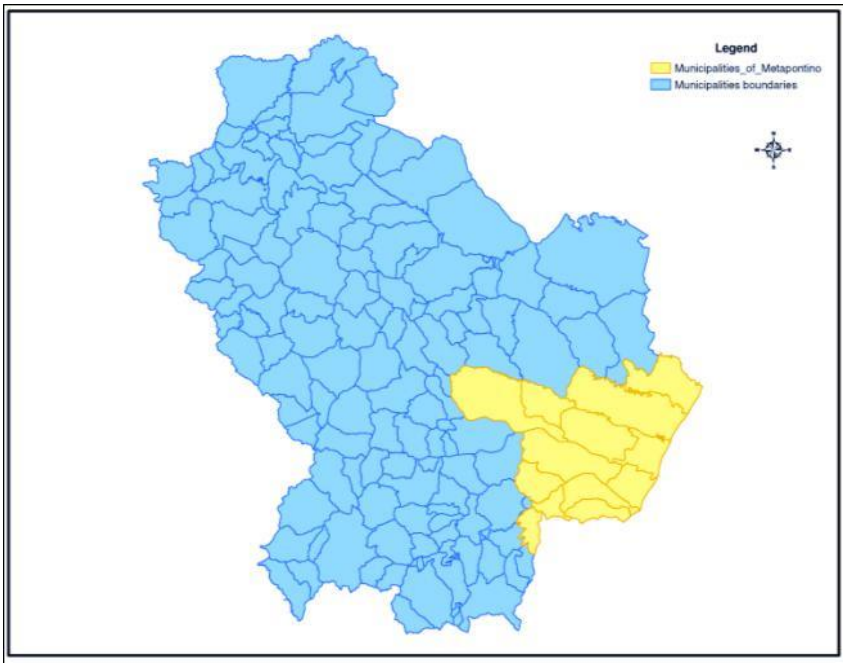


Fig. 114: Geographical framework (Metapontino area is highlighted)

It has a population of 82,320 inhabitants (Table 101).

Table 101: Metapontino area population

Municipality	Population		
	Male	Female	Sum
Bernalda	5,904	5,986	11,890
Colobraro	619	658	1,277
Craco	386	371	757
Montalbano Jonico	3,495	3,595	7,090
Nova Siri	3,095	3,207	6,302
Pisticci	8,564	8,753	17,317
Policoro	7,656	8,014	15,670
Rotondella	1,264	1,335	2,599
San Giorgio Lucano	651	634	1,285
Scanzano Jonico	3,792	3,598	7,390
Stigliano	2,033	2,304	4,337
Tursi	2,413	2,465	4,878
Valsinni	730	798	1,528
Sum	40,602	41,718	82,320

The municipalities that fall within the territory of Metaponto are Bernalda, Pisticci, Scanzano Jonico Montalbano Jonico Policoro Tursi, Nova Siri, Rotondella, Valsinni, Colobraro, San Giorgio Lucano, Stigliano and Craco (Fig. 115).

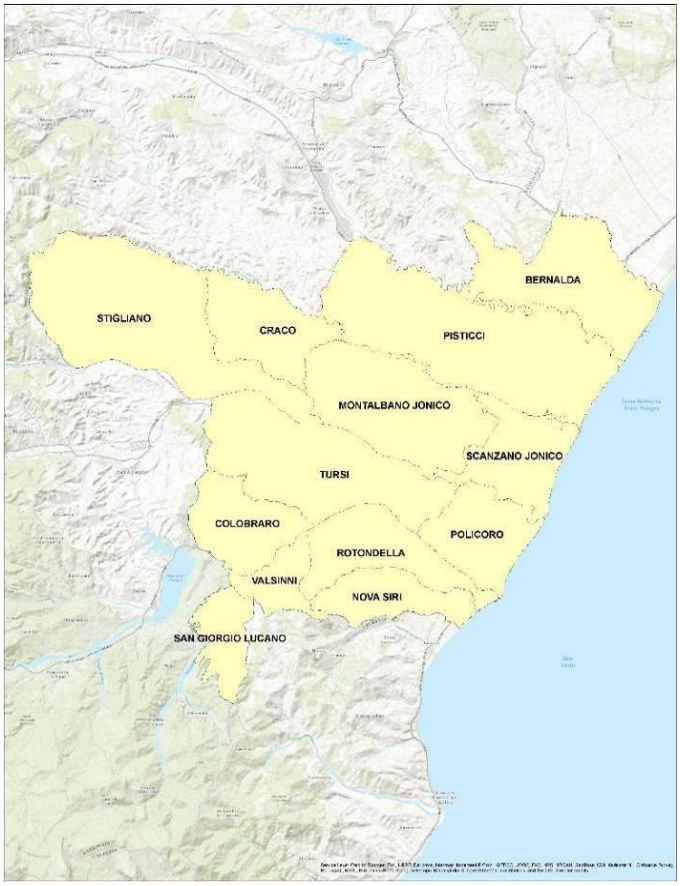


Fig. 115: Municipalities of Metapontino area

The plain of Metaponto is named after the ancient Greek city of Metaponto. Moreover, the term Metapontino indicates the historical region in which a thriving civilization of Ancient Greece was developed. The area has plenty of archaeological sites, including the ancient city of Metapontum, Heraclea and Siris as well as the archaeological site of "dell'Incoronata" in Pisticci. Finally, in the entire area numerous town's historic centers, castles and shrines in the hills are found.

Rivers Bradano, Basento, Cavone, Agri and Sinni flow through Metaponto area, overlooking the Ionian coast of Lucania (Basilicata). The large pine forest behind the beach, especially the Bosco Pantano, WWF oasis, is very important for Metaponto area. Metapontino is the richest area of the region and the most densely populated. The GDP per municipality of Metapontino is presented on Table 102 and Fig. 116.

Table 102: GDP per Municipality in Metapontino area

Municipality	GDP **2012 (€)**
Bernalda	12,770
Colobraro	11,705
Craco	10,345
Montalbano Jonico	13,382
Nova Siri	13,378
Pisticci	14,084

Policoro	14,460
Rotondella	11,218
San Giorgio Lucano	12,266
Scanzano Jonico	10,564
Stigliano	13,765
Tursi	11,584
Valsinni	12,757
Mean	12,483

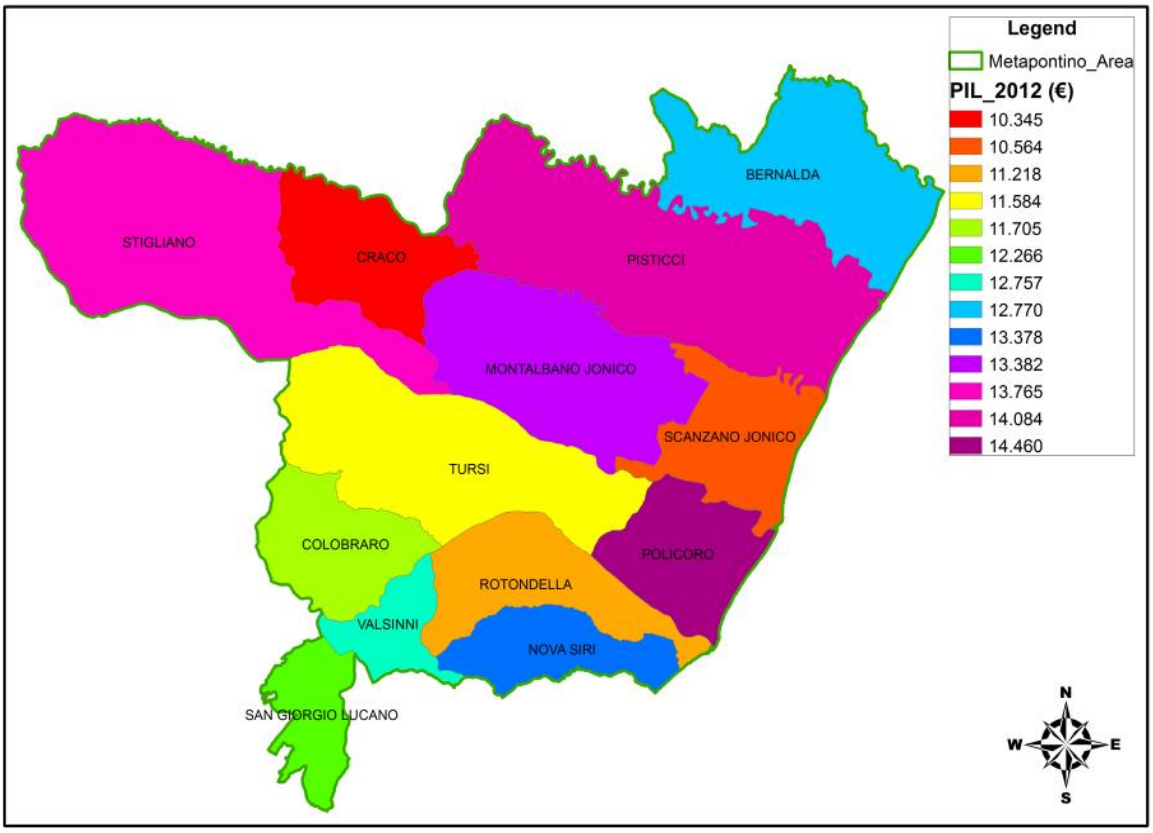


Fig. 116: GDP distribution in Metapontino area municipalities

Metapontino is called the "California of Italy" for its intensive cultivation of fruit and several kinds of vegetables, which are almost totally exported. In particular, Metapontino area is famous for strawberries. The type of farms per Municipality of Metapontino is presented on Table 103.

Table 103: Type of farms per Municipality in Metapontino area

Municipality	Farms Management		
	With employees	Without employees	Other
BERNALDA	19	994	-
COLOBRARO	5	245	1
CRACO	5	201	-
MONTALBANO JONICO	39	894	-
NOVA SIRI	8	474	-
PISTICCI	36	2104	1
POLICORO	23	906	-

ROTONDELLA	7	534	-
SAN GIORGIO LUCANO	34	156	1
SCANZANO JONICO	25	841	1
STIGLIANO	15	710	1
TURSI	33	857	-
VALSINNI	2	142	2
Sum	*251*	*9058*	*7*
Total	*9316*		

The area also includes the industrial areas of Val Basento and Policoro.
Tourism is very intensive during summer, where it is estimated that the number of visitors is around 500,000, within the entire Ionian coast (about 40 km). During the 60′s and 70′s, there was a consistent phenomenon of immigration from mountainous areas and interior of Basilicata to Metapontino.

1.2 METEOROLOGICAL DATA

Many meteorological stations are found in Basilicata Region (Fig. 117). Weather data collected for the period 2010-2015 for the purposes of Agroclimawater project are presented in the following paragraphs. Basilicata weather stations are managed by Agenzia Lucana di Sviluppo e di Innovazione in Agricoltura (ALSIA).

Fig. 117: Basilicata weather stations (source: www.ssabasilicata.it/)

As shown in Fig. 113, there are 12 weather stations located in Metapontino Area, further detailed on Fig. 119.

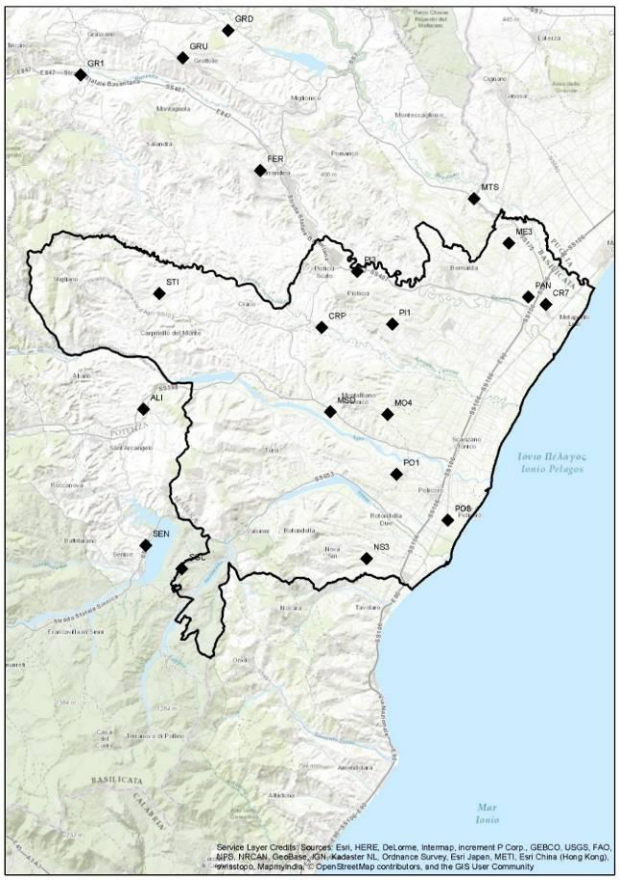


Fig. 118: Metapontino weather stations (source: http://www.ssabasilicata.it/)

W.S. code	n.	Location	Municipality	y_lat	x_long	Elevation (m a.s.l.)
ME3	6	C.da Pezzagrande	Bernalda	40.439667	16.76255	49
MO4	10	Cozzo del Fico	Montalbano J.	40.281331	16.61442	151
CRP	13	C.da Pozzitello	Pisticci	40.361773	16.53423	50
SGL	14	Piano delle Rose	S. Giorgio L.	40.138178	16.36368	455
NS3	16	Agriturismo La Collinetta	Nova Siri	40.147606	16.58917	136
PI1	17	Castelluccio	Pisticci	40.364615	16.62036	189
PI3	19	Pisticci Sc.	Pisticci	40.413445	16.57765	49
PO1	20	C.da Troyli	Policoro	40.225833	16.62556	115
PO3	22	Pantano Sottano	Policoro	40.183333	16.68806	4
STI	25	C.da Torre	Stigliano	40.392938	16.33595	285
PAN	39	AASD Pantanello	Metaponto	40.389966	16.78633	9
MSD	43	S. Donato	Tursi	40.283692	16.54469	58

Fig. 119: Information about the weather stations in the greater area of Metapontino

Data from these weather stations was evaluated with the aim of getting an overview of the area's climatic conditions. Mean annual weather data acquired from these stations is presented in Fig. 120, Fig. 121 and Fig. 122.

	T_{mean}	T_{min}	T_{max}	RH_{mean}	RH_{min}	RH_{max}
Municipality	(°C)			(%)		
Bernalda	16.77	11.67	23.20	58.18	34.85	76.86
Montalbano J.	15.49	10.73	21.45	52.62	32.52	70.05
Pisticci	16.78	10.34	24.17	55.66	28.14	78.37
S. Giorgio L.	14.76	9.89	21.17	72.42	41.76	93.27
Nova Siri	17.53	13.83	22.60	47.98	30.23	65.70
Pisticci	16.15	11.53	21.74	53.96	34.28	71.35
Pisticci	17.00	10.97	23.89	61.88	45.57	76.71
Policoro	16.95	12.56	22.37	62.92	39.02	82.71
Policoro	16.99	11.02	23.12	72.74	50.14	91.56
Stigliano	16.22	11.60	21.91	57.56	39.95	72.89
Metaponto	17.07	11.58	22.94	68.73	43.75	88.52
Tursi	16.47	10.52	23.18	51.29	27.88	71.82
Mean	**16.52**	**11.35**	**22.64**	**59.66**	**37.34**	**78.32**

Fig. 120: Metapontino Municipalities weather data (mean annual temperatures and relative humidity)

As shown in Fig. 120, the mean annual temperature is 16.52°C, while minimum and maximum temperatures are 11.35°C and 22.64°C, respectively. The mean annual relative humidity is 59.66%.

	Rain	ET_0	Direct Radiation	$Wind\ Speed_{Mean}$
Municipality	(mm)	(mm)	($MJ\ m^{-2}$)	($km\ d^{-1}$)
Bernalda	601.83	3.31	61.55	162.84
Montalbano J.	593.82	3.61	67.31	128.15
Pisticci	540.30	4.06	0.00	150.58
S. Giorgio L.	753.70	3.25	12.21	84.11
Nova Siri	686.70	3.74	67.64	151.25
Pisticci	660.37	3.80	78.70	137.67
Pisticci	670.83	3.55	10.62	120.12
Policoro	659.83	3.66	89.38	156.40
Policoro	520.20	3.32	64.65	97.74
Stigliano	618.03	3.74	12.62	120.91
Metaponto	628.67	3.65	16.31	192.76
Tursi	671.37	4.18	0.04	125.39
Mean	**633.80**	**3.66**	**40.09**	**135.66**

Fig. 121: Metapontino Municipalities' weather data (mean annual rainfalls, ET_0, Direct radiation and wind speed)

As shown above, mean annual rainfall is 633.80 mm; poorly distributed rainfall, concentrated and sometimes torrential noticeable summer dryness. The daily average annual evaporation is 3.66 mm.

	T_{min}	T_{max}	RH_{min}	RH_{max}
Municipality	(°C)		(%)	
Bernalda	-3.9	43.4	11	96.5
Montalbano J.	-4.6	41.1	9	99.7
Pisticci	-4.8	43.9	10.1	99.8
S. Giorgio L.	-5.6	39.6	10.1	100
Nova Siri	-1.9	43.2	9	99.9
Pisticci	-4.4	41.9	11	99.8
Pisticci	-4.2	44.7	12	100
Policoro	-2.9	41.6	8	100
Policoro	-5	40.4	17	100
Stigliano	-4.4	41.6	10.4	97.2
Metaponto	-3.5	41.3	10.3	100
Tursi	-4.5	41.6	10.8	100
Mean	**-5.6**	**44.7**	**8**	**100**

Fig. 122: Metapontino Municipalities weather data (mean minimum temperatures, mean maximum temperatures and relative humidity ever from 2010-2015)

The absolute maximum temperature experienced in years 2010-2015 is 44.7°C, while the absolute min temperature was -5.6°C.
The climate of the area is a typical of Mediterranean climate; mild and rainy winters, relatively warm and dry summers. As in most Mediterranean areas, Metapontino area is affected by the increase in temperature induced by climate change.
Overall analysis of data shows a relatively mild climate. However, unpredictable cold spells that usually occur during the first months of each year affect negatively the crops' productivity in the area. The presence of the rains in autumn - winter and the drought in spring-summer affects both agriculture and the production techniques. This emphasizes the need of a functional irrigation system (Quinto G. R. et al. 2010).

1.3 GEOLOGICAL – HYDROGEOLOGICAL CHARACTERISTICS

The study area falls within the Ionian coastal plain (Southern Italy), bounded on the West by Sinni River and on the East by Bradano River. It covers 40 km along the coast and 6 km inland. Data analysis of 1130 boreholes has given information about the geological and hydrogeological features and the physicochemical groundwater features of the study area. The bottom of each aquifer differs concerning the geological origin of their soils. The most interesting aquifer is the coastal plain aquifer because of its practical utilisation. Groundwater flow is mainly unconfined inland, where the aquifer is constituted by terraced deposits and confined in the alluvial coastal plain. An upper clayey layer overlies the sandy coastal aquifer characterised by a mean hydraulic conductivity value equal to 2.3 10^{-4} m/s. Due to the fact that the direct natural recharge is extremely low, the recharge of this coastal aquifer is mainly guaranteed by the discharge from upward aquifers and from river leakage. The bottom of the aquifer is a silty-clayey bed which lies under the sea level and permits seawater intrusion. This phenomenon involves the studied coastal plain for a width of 1-1.5 km on average and it is less evident moving inwards where the altitude of the clayey bottom of the aquifer heads progressively higher than the sea level. Physicochemical data analysis,

concerning the quality of waters, showed that the pollution of groundwater is considered to be a serious environmental problem in the study area, (Polemio M. et al.2002).

1.3.1 Geological Description

The study area is located in the southern part of the Apennine foredeep, known as "Fossa Bradanica". The geological and structural characteristics of the area show a tabular structure typically represented on the surface by extensive plains on which areas of terracing sea, gradually sloping towards the Ionian Sea are identified, interrupted by large incisions of the rivers Bradano Basento and Cavone, characterized by steep slopes and valley floor flat. From the point of view of the substrate stratigraphic entire area it consists of pelitic deposits belonging to the cycle of suprapliocenico-infrapleistocenico of "Fossa Bradanica" related to the formation of clays subappennine. They rest unconformably on these deposits marine terraces, which are the hills and alluvial deposits that cover the river valleys and the coastal plain of Metaponto. (Polemio M. et al. 1991)

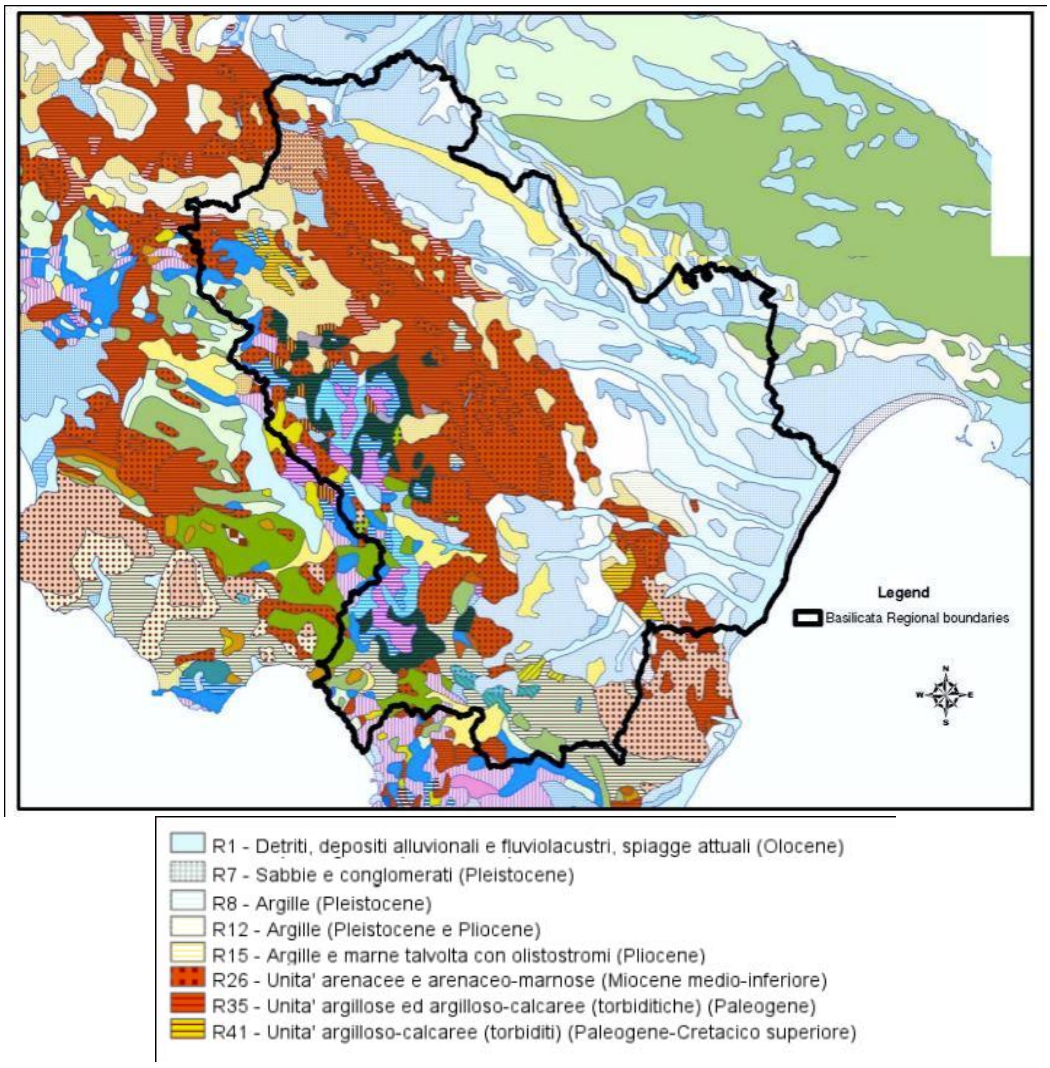


Fig. 123: Basilicata geological map

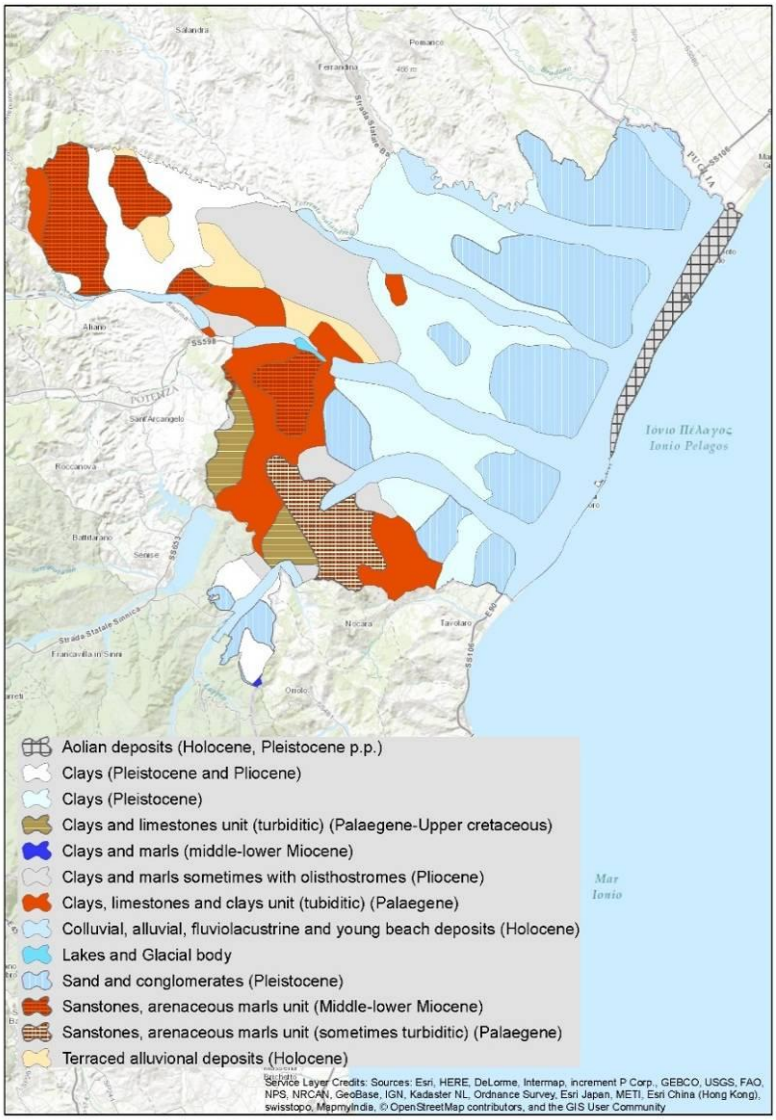


Fig. 124: Metapontino geological map

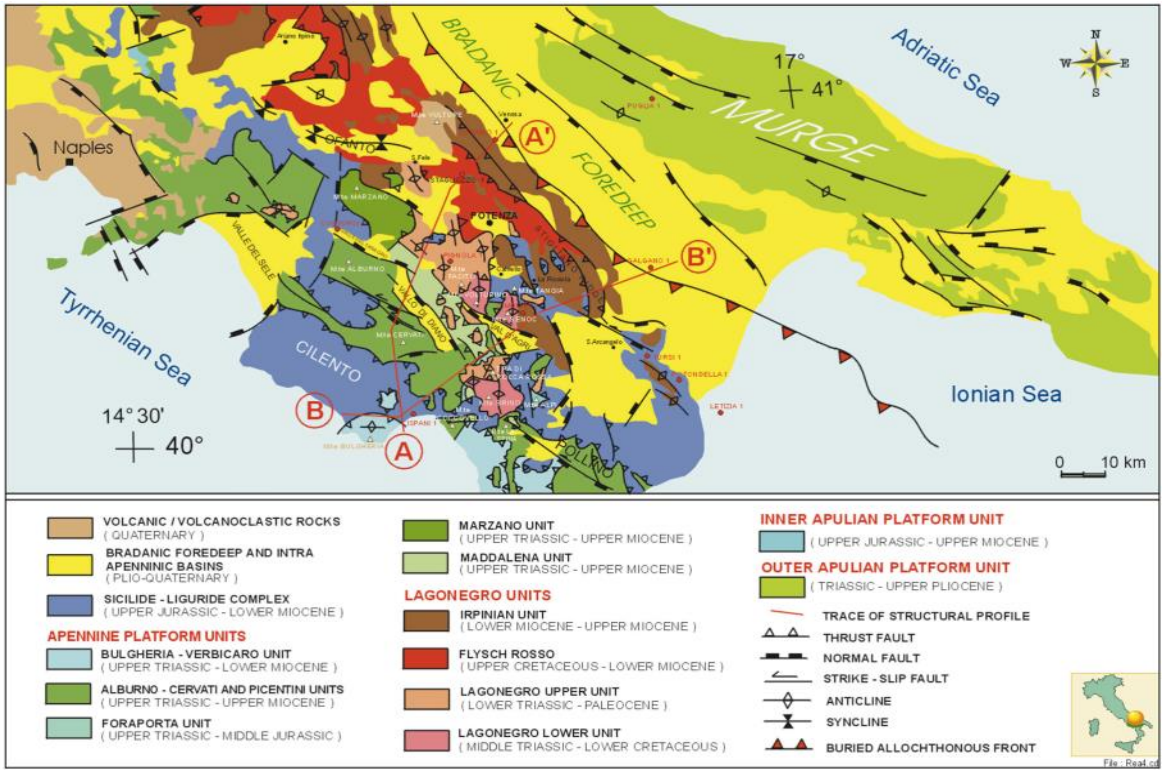


Fig. 125: Southern Apennine geological scheme (source: Menardi Noguera A. et al., 2000)

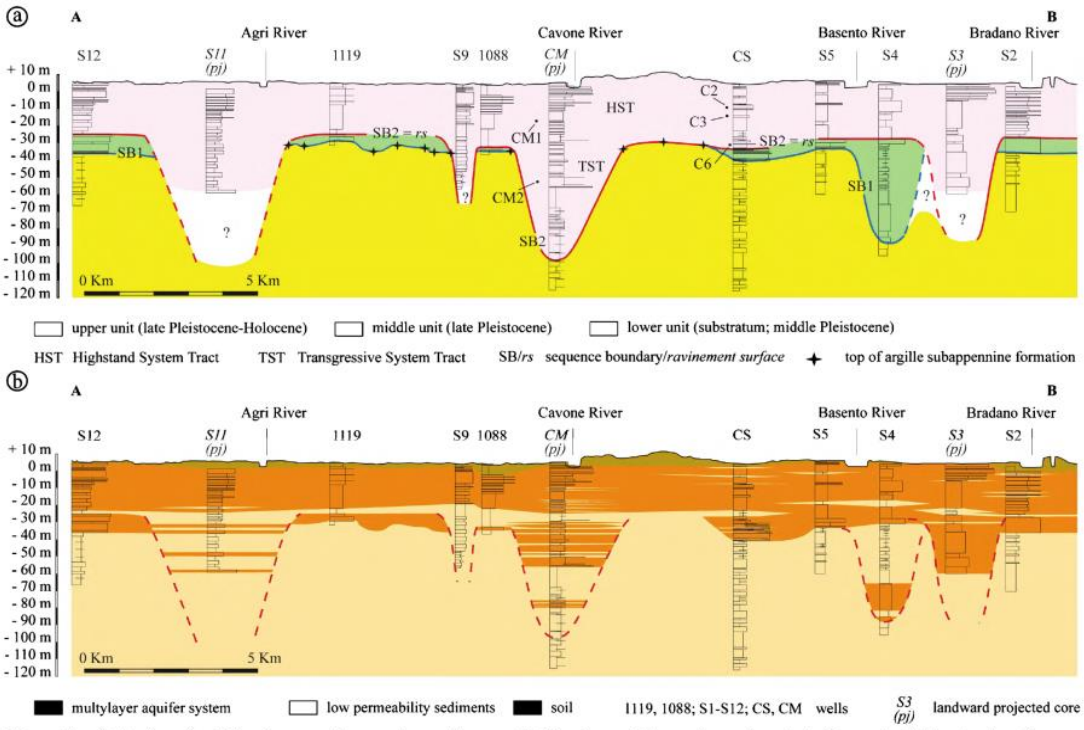


Figura 2 - a) stratigrafia della piana costiera metapontina, per l'ubicazione della sezione si veda la figura 1; b) idrostratigrafia preliminare (modello stratigrafico 2D). Da Cilumbriello et al. (2010).

Fig. 126: a) Stratigraphy of the coastal plain of Metaponto; b) Hydrostratigraphy 2D Model (source: Tropeano M. et al., 2011)

1.3.2 Hydrogeological Description

Five rivers flow through the Metaponto plain, located along 40 km of Ionian coast. Marine terraced deposits, mainly sands, conglomerates and silts are found in the upper part of the Metaponto plain, while alluvial, transitional, marine and coastal deposits are found in the coastal plain and along the rivers (Polemio et al., 2003). Two main types of porous aquifers can be distinguished in the Metaponto plain (Fig. 127). The first one encloses the aquifers of the marine terraces and the alluvial river valley deposits. The marine terrace aquifers display medium to high hydraulic conductivity; the river valleys regularly break their spatial extent. The aquifers of the river valleys display low to medium hydraulic conductivity and they do not generally permit an accumulation of significant groundwater resources. The second type of aquifer includes one of the coastal plain deposits and has medium hydraulic conductivity. This aquifer is the most exploited for practical purposes due to its extent (about 40 km wide), thickness and continuity across the plain. Moreover, because of its outcropping surface the aquifer is more affected by economic growth and increasing water demand. The groundwater of the coastal plain aquifer flows in a multi-layered aquifer; it is mainly phreatic, otherwise it is confined due to an upper, almost impervious and outcropping stratum (Polemio M. et al.,2008).

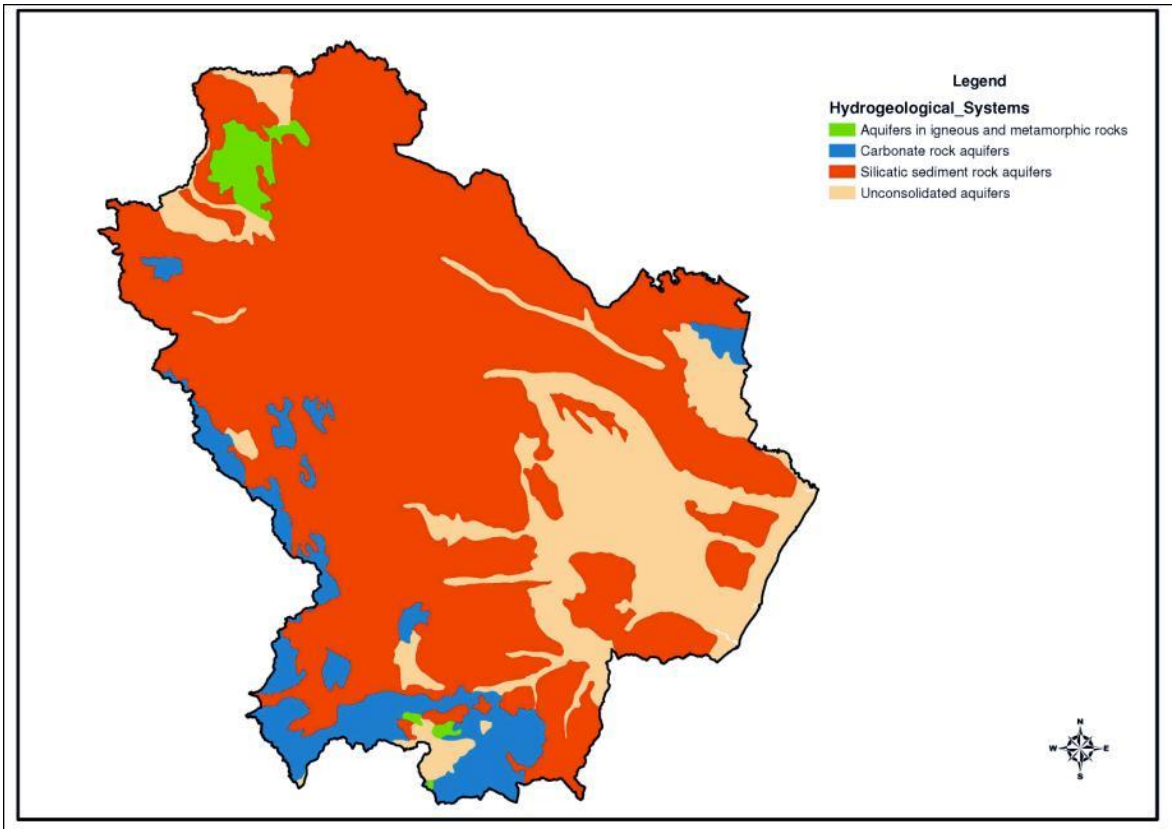


Fig. 127: Basilicata hydrogeological systems

The main hydrogeological systems (more than 50% of the territory) of Metapontino area are silicatic sediment rock aquifers and unconsolidated aquifers (Fig. 128).

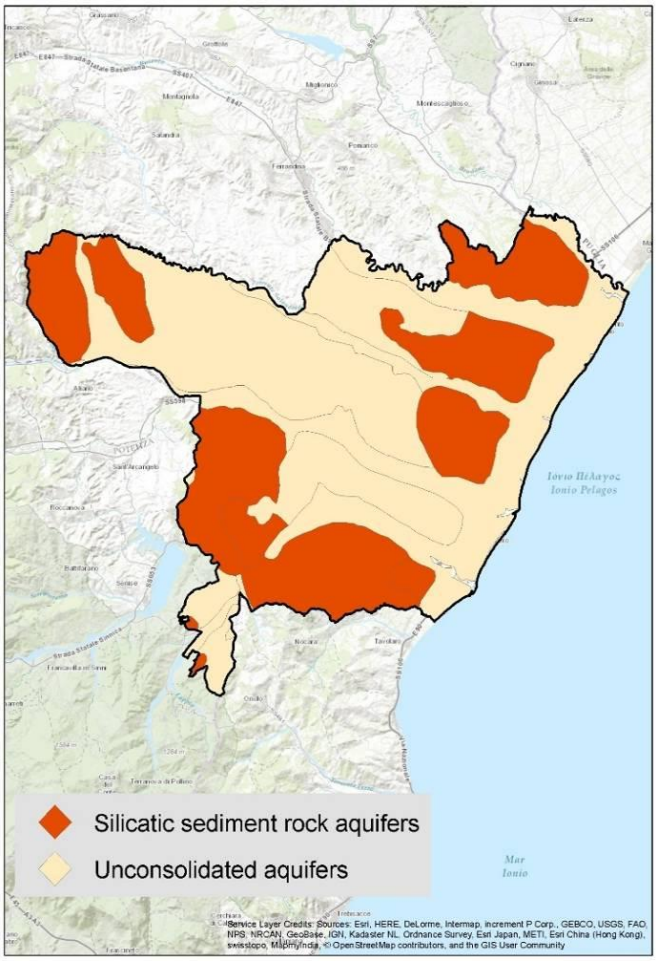


Fig. 128: Metapontino area hydrogeological systems

1.4 MORPHOLOGY AND SLOPES

Basilicata is a region of strong contrasts relating to mountains, especially with regard to their position and form. The region covers an area of 9,992.24 sq.km, 46.8% of which is mountainous, 45.2% is hilly and only 8% is characterized as flat area. In Basilicata, south of the volcanic mountain Monte Vulture the Apennines begin and are divided into five distinct groups. The first is the backbone of the Mountains of Wall, Beautiful and Avigliano, which starts south of the smaller group of Mountains, Monti Li Foi in Picerno. The western mountain range of Maddalena (Monti della Maddalena) only marginally affects the territory Lucano (of Basilicata). The valleys of Melandro (Valle del Melandro) and Agri (Alta Val d'Agri) separate Maddalena Mountains from the mountain complex of Vulturino. Further south, the Apennine ridge rises to form the mountains of Lagonegro with the two peaks of the Monti del Papa and Madonna del Sirino, on the border with Calabria.

The eastern side is occupied by hills that due to the composition of the soil that continuously erodes, has areas with less or no vegetation.

Flat areas are identified mainly in the plain of Metaponto, which formed by the continuous accumulation of eroded material carried downstream by the numerous Basilicata Rivers.

The complex topography of the region has generated a rich hydrographic network. Basilicata rivers Agri, Basento, Bradano, Cavone and Sinni river flow through the

regional territory and drain into the Ionian Sea, while others, such as Noce, Ofanto and some tributaries of Sele, flow through only a part of the territory and then drain either into the Tyrrhenian Sea or the Adriatic (http://www.regione.basilicata.it/).

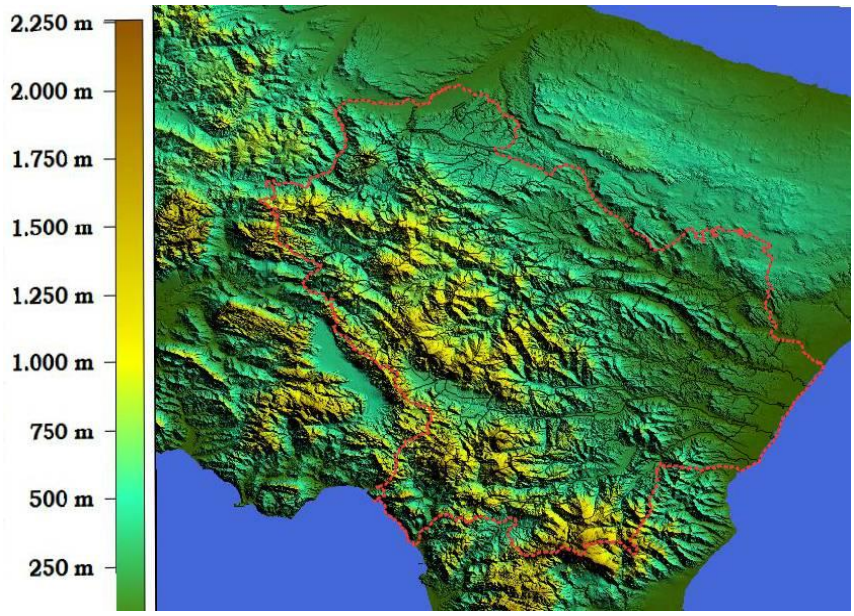


Fig. 129: Basilicata Digital Terrain Model (source: http://rsdi.regione.basilicata.it/)

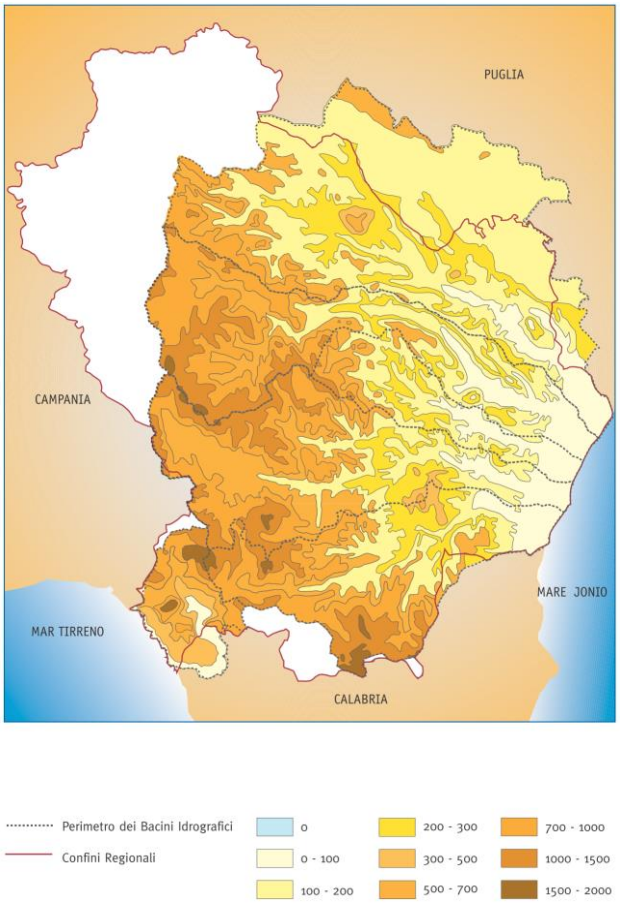


Fig. 130: Basilicata altimetry map (source: Interregional River Basin Authority of Basilicata)

According to the European standard classification, Low land (0-200 m), semi-mountainous areas (200-800 m) and mountainous areas (>800 m) are found in Metapontino area (Fig. 131).

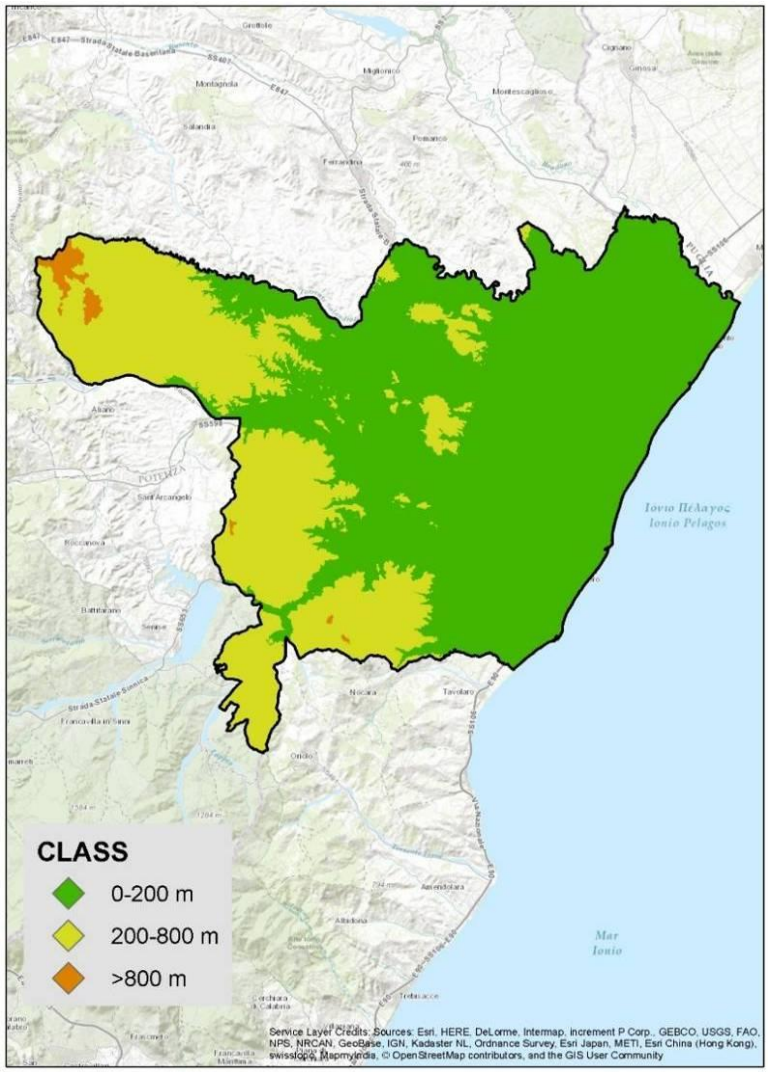


Fig. 131: Metapontino altimetry map

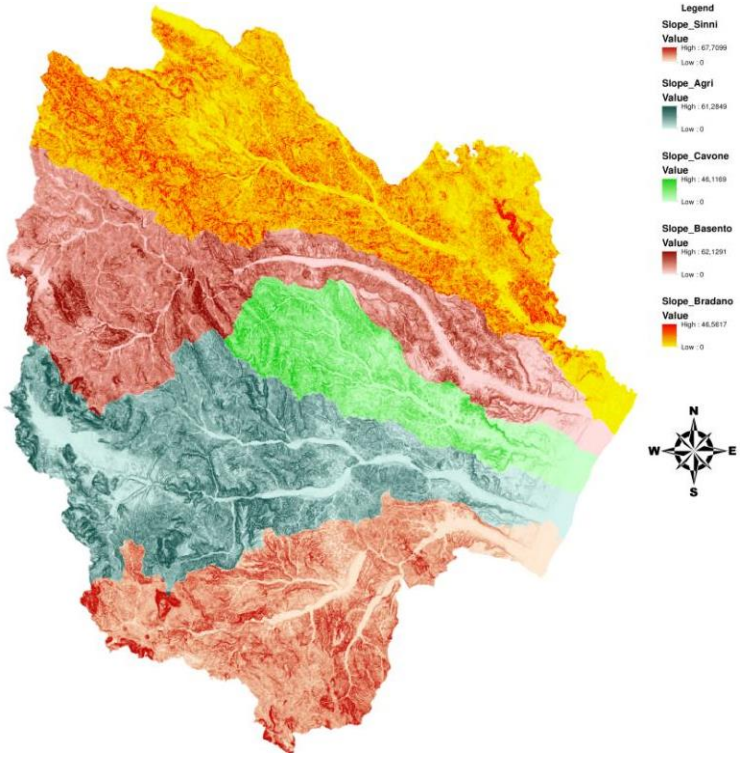


Fig. 132: Basilicata slopes map

As shown in Fig. 133 the morphology of Metapontino area shows a range from 0 to over 40%.

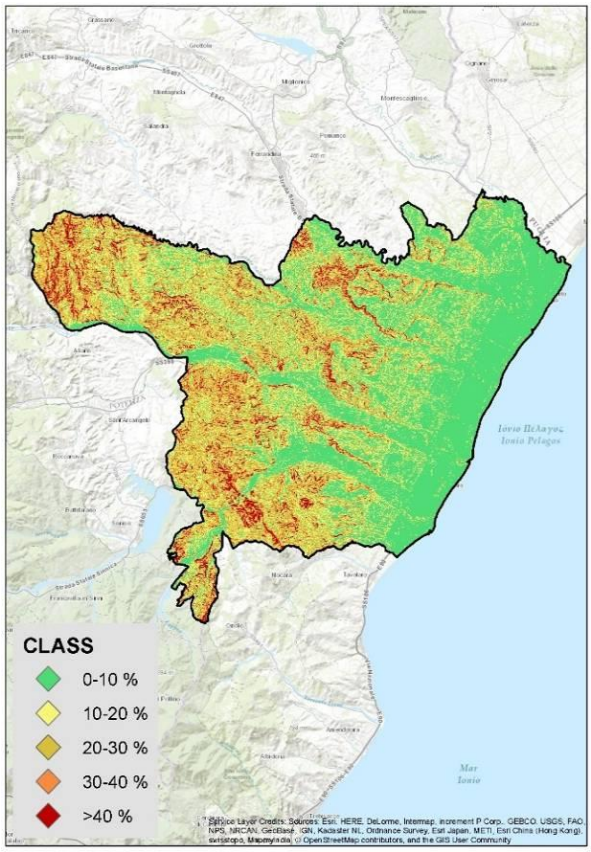


Fig. 133: Metapontino slopes map

1.5 SOIL CHARACTERISTICS

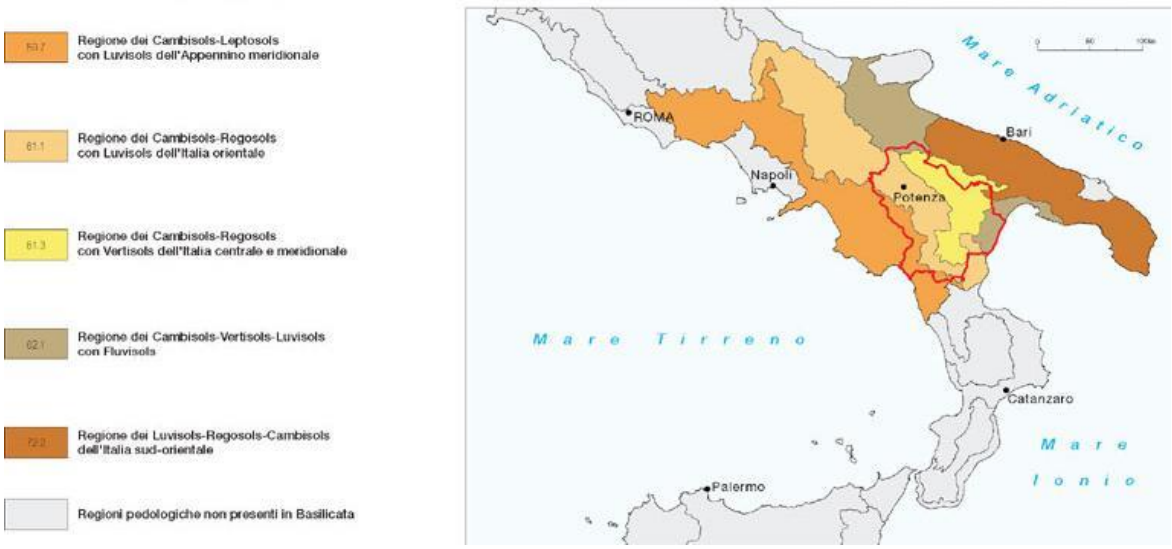


Fig. 134: Basi**licata's Pedological Regions (source:** http://www.basilicatanet.it/)

Metapontino area, as shown in Fig. 135, has the following pedological areas:

- Geological Province 14: Soils of the plains, on alluvial deposits, lake with variable grain size, from clay to pebble
- Pedological area 61.1: Apennines and antiappenninici with tertiary sedimentary rocks (sandstone flysch marl and clay of central and southern
- Pedological area 61.3: Surfaces of the pit with Bradanica pilocenici deposits (deposits marine, estuarine and river).
- Pedological area 62.1: Surfaces of the pit Bradanica and Ofanto basin with Pleistocene deposits (deposits, marine estuary and river).

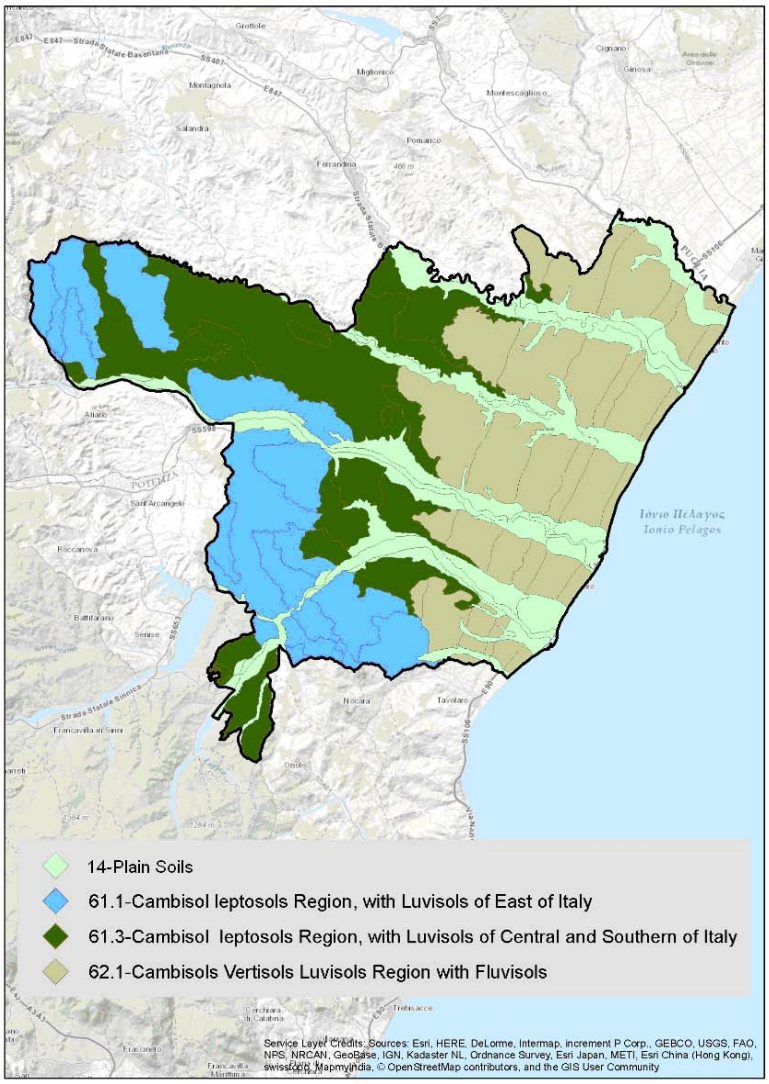


Fig. 135: Metapontino Pedological areas

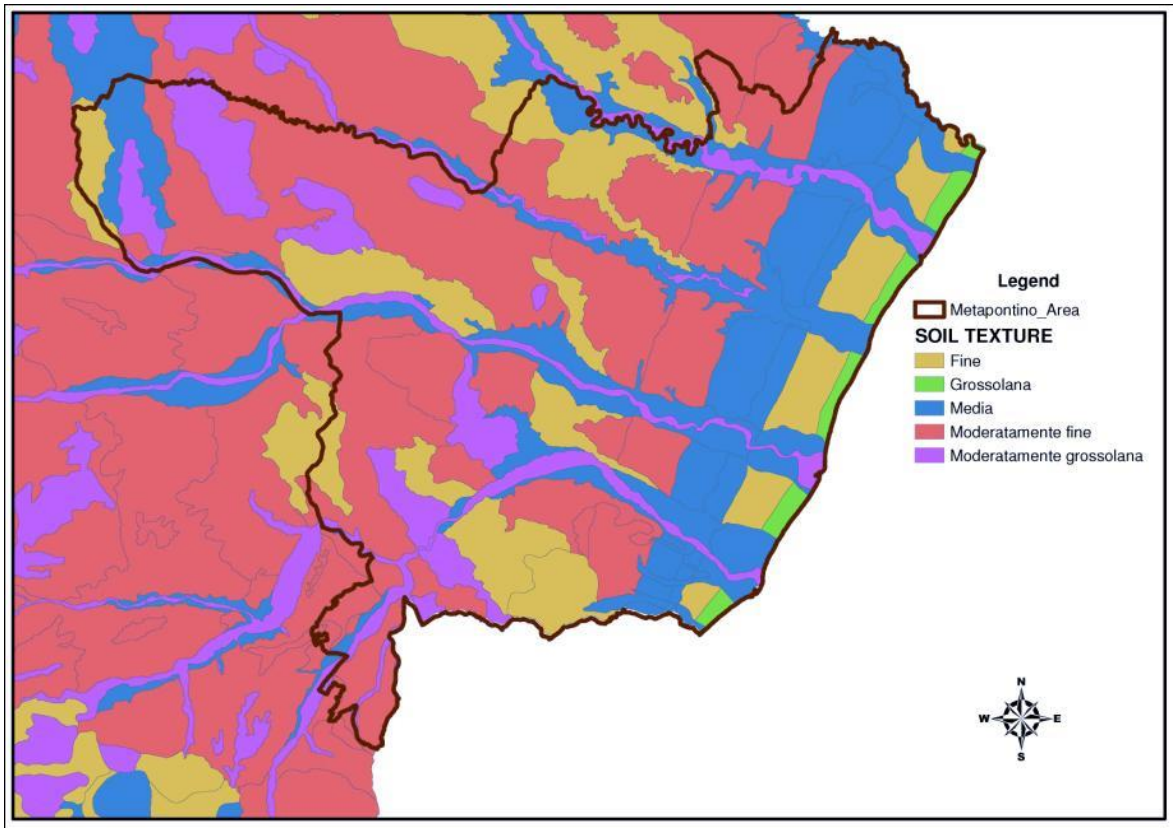


Fig. 136: Metapontino area soil texture map

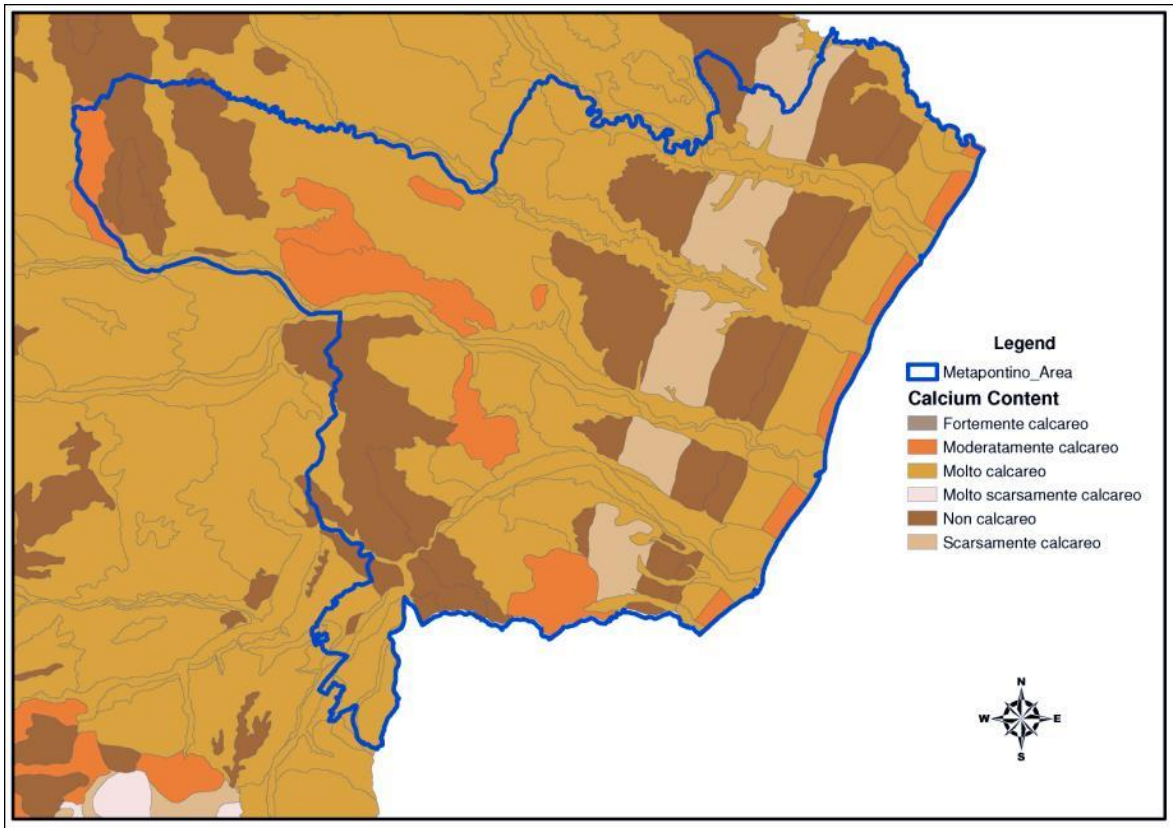


Fig. 137: Metapontino area calcium content map

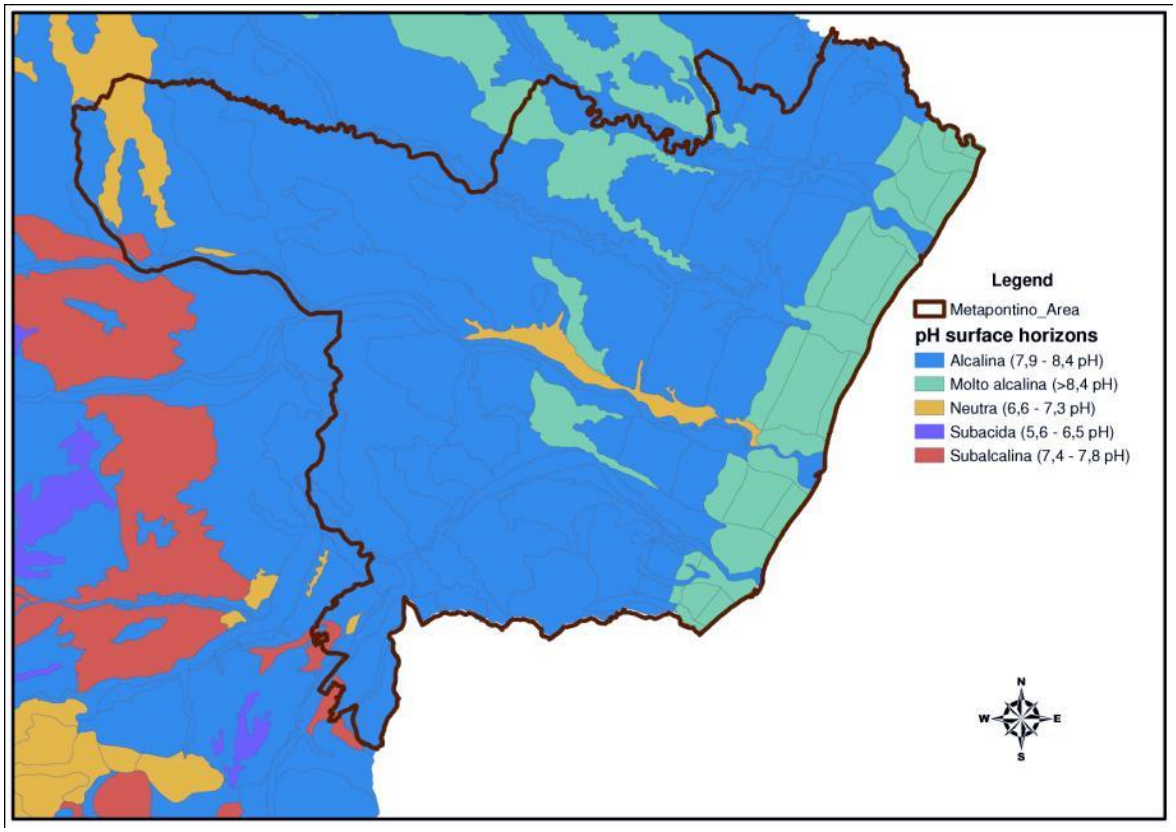


Fig. 138: Metapontino area pH surface horizons

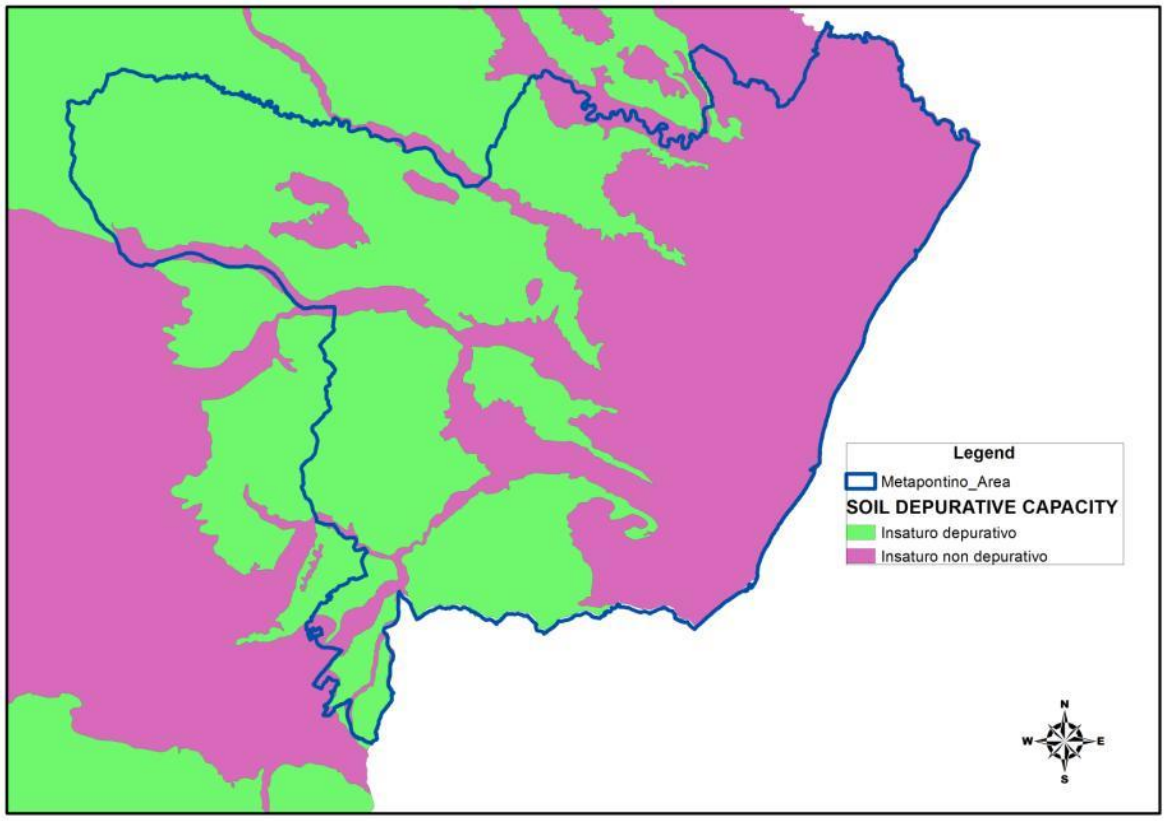


Fig. 139: Metapontino area soil depurative capacity

1.6 LAND USES

Basilicata covers an agricultural area of 702,000 ha and a Utilized Agricultural Area (UAA) of 553,886 Ha. Agricultural Land is the largest land use of the whole territory (58%), followed by Forests (29%), Natural Areas (12%) and artificial areas (1.4%). During the period 1990-2000, there has been a reduction of approximately 2000 Ha in UAA and a reduction of approximately 600 Ha of forestry areas. Mountainous areas are more prone to this reduction of land because of a 20% decrease of UAA (Utilised Agricultural Area). The number of regional farms is about 74,510. Labour productivity in agriculture, which is expressed in Gross Value Added (GVA) per annual work unit (AWU), is € 19.600 and is quite similar to the national average (€ 21.600). The main features concerning human capital in Basilicata, expressed as the ratio between percentages of farmers less than 35 years old and percentage of farmers of 55 years old or more, is 5.12%, similar to the national average, 6.03% (Rural Development Programme 2007-2013 for Basilicata).
Basilicata agricultural land has 45,713.78 Ha of tree crops (olive, orchards and citrus). As shown in Table 104, agricultural land is composed mainly by generic orchards (56%), olive trees (39%) and citrus (5%). Apricots and peaches are the main crops of Metapontino area and are included into generic category of orchards.

Table 104: Basilicata crops

Basilicata Basins	Olive (Ha)	Orchards (Ha)	Citrus (Ha)	Sum (Ha)
Bradano	6,129.90	4,018.98	232.95	10,381.82
Basento	3,006.84	5,880.51	138.93	9,026.28
Cavone	1,565.32	4,283.34	241.03	6,089.69
Agri	3,482.01	7,443.61	985.75	11,911.37
Sinni	3,596.30	3,821.47	886.85	8,304.62
Sum (Ha)	17,780.37	25,447.91	2,485.51	45,713.78

The main land use in Metapontino area is agricultural areas, followed by forest and semi natural areas (Fig. 135). Naturally, the most important sectors are the fruit and vegetable sector with an area of about 28,000 hectares. Fruit and vegetable sector represents the 50% of farm Gross Production Value (GPV). The Agribusiness sector (Distretto agroalimentare), covering an area of 21,117 ha, contributes about 85% of the regional fruit and vegetable production. In addition, in Metapontino area there are located 5000 farms, 9 Vegetables Producer Organisations and 9 marketing systems. Crops cultivated include peach, apricot, plum, strawberry, orange, clementines, kiwi, grapes, cauliflower, fennel, lettuce, asparagus, eggplant, tomato, bell pepper, etc. The production of high quality wine and olive oil is also of great value for the area (www.regione.basilicata.it/).

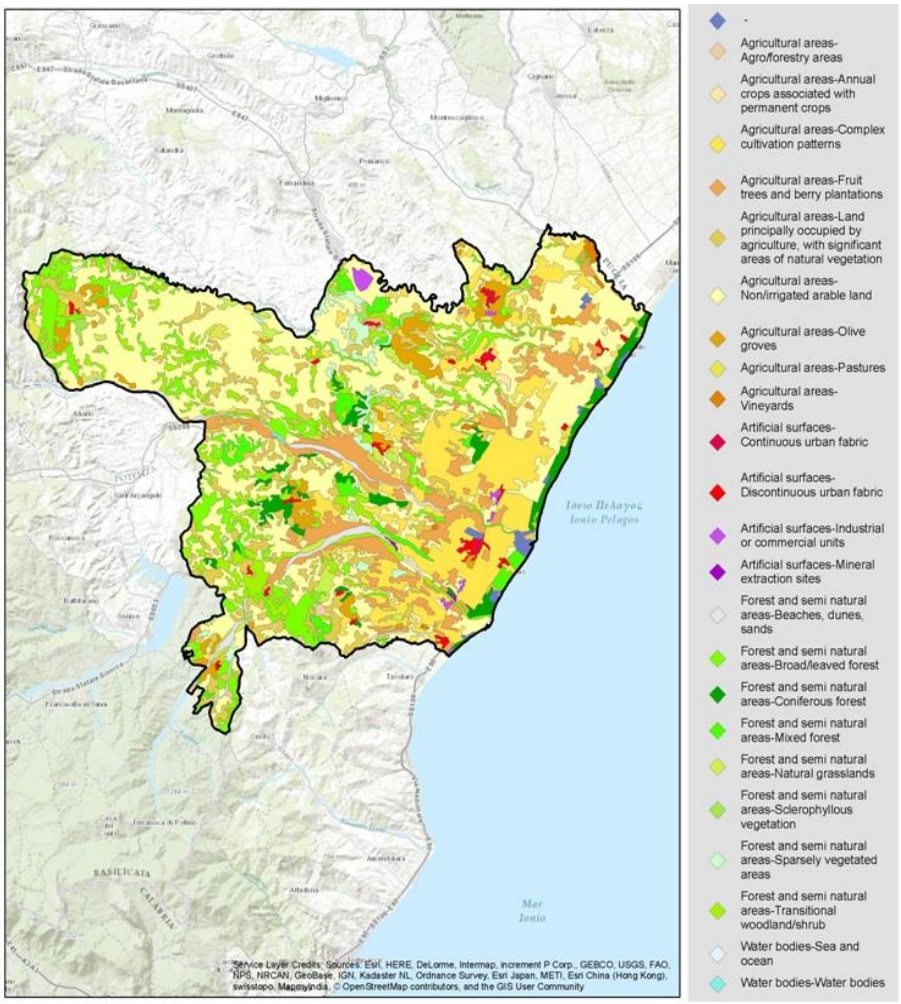


Fig. 140: Metapontino area land use map

The key crops of Metapontino area are presented on Fig. 141, while further information is provided on Table 105.

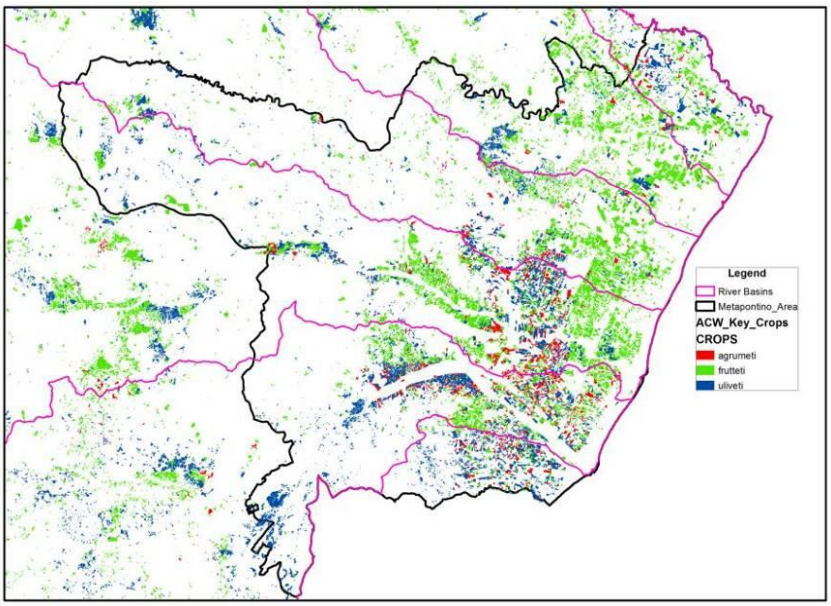


Fig. 141: Metapontino area key crops map

Table 105: Metapontino area key crops

Metapontino Area	Olive (Ha)	Orchards (Ha)	Citrus (Ha)	Sum (Ha)
Bradano	565.72	951.81	111.11	1,628.63
Basento	616.06	2,605.42	83.84	3,305.32
Cavone	951.48	3,103.01	204.30	4,258.79
Agri	2,094.36	3,976.74	845.92	6,917.02
Sinni	2,204.06	2,004.68	798.73	5,007.46
Sum (Ha)	6,431.67	12,641.65	2,043.90	21,117.22

1.7 HIGH CONSERVATION VALUE (HCV) AREAS

The high conservation value areas located in Basilicata are presented in Fig. 142 , while Metapontino area Sites of Community Importance (SCI), Special Protection Areas (SPA) and Important Bird Areas (IBA) are depicted in Fig. 143, Fig. 144 and Fig. 145, respectively.

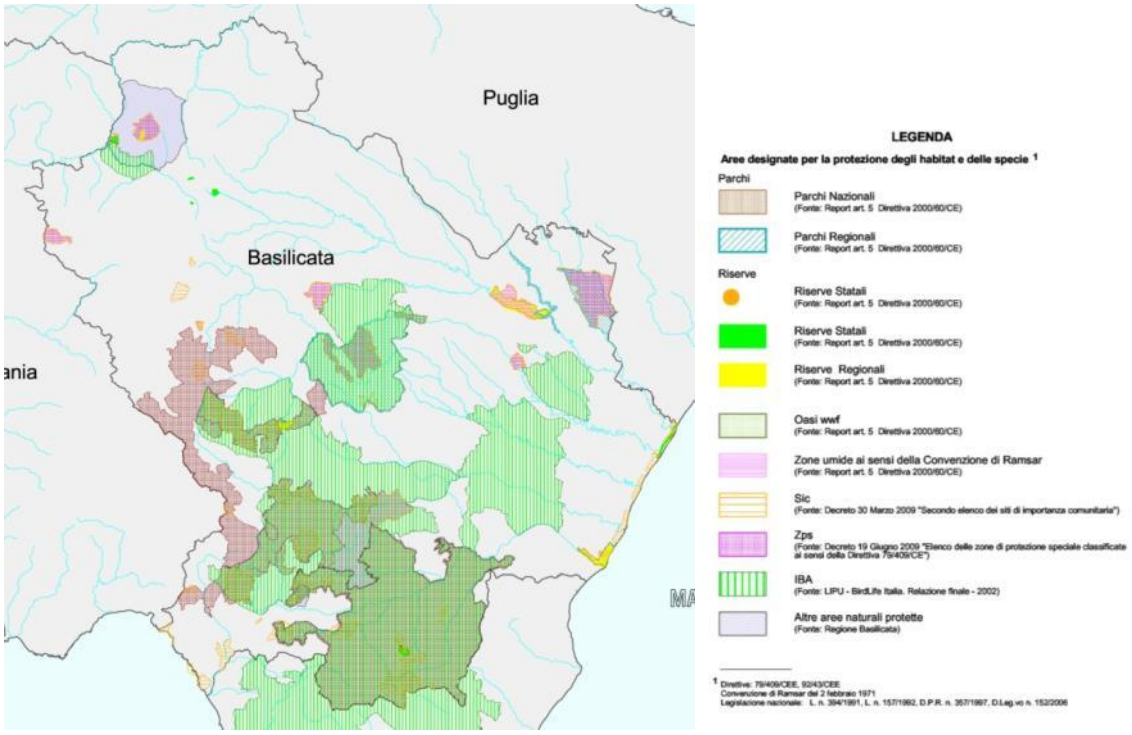


Fig. 142: Basilicata high conservation value areas (source: Distretto **idrografico dell'Appennino Meridionale)**

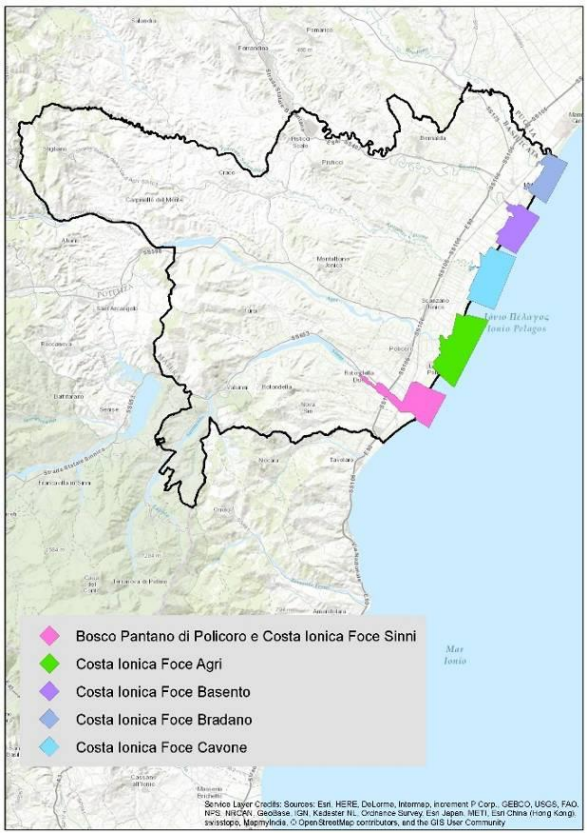


Fig. 143: Metapontino area Sites of Community Importance (SCI)

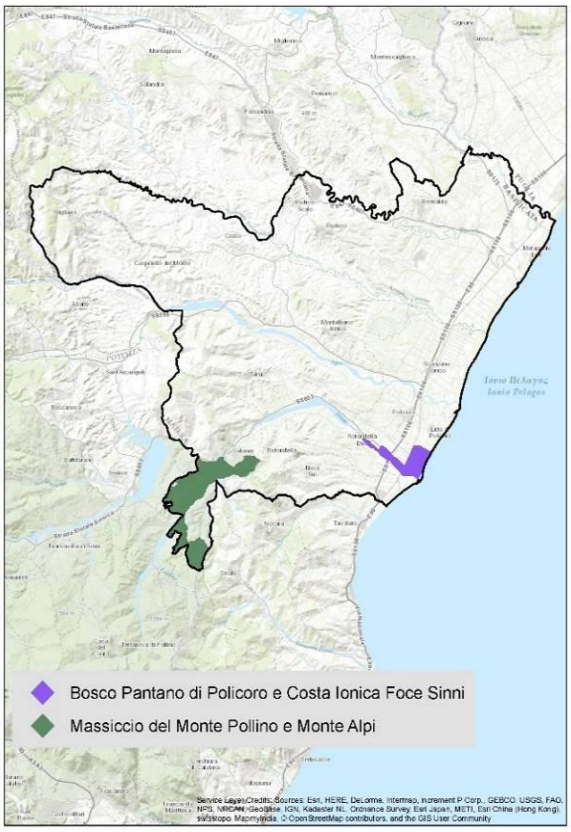


Fig. 144: Metapontino area Special Protection Areas (SPA)

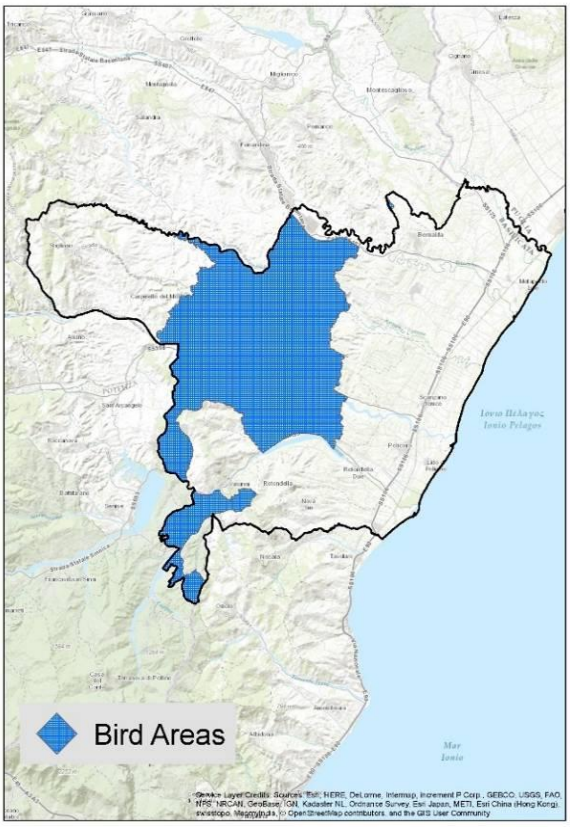


Fig. 145: Metapontino area Important Bird Areas (IBA)

1.7.1 ARCHEOLOGICAL SITES

Metaponto was a rich and flourishing outpost of Magna Grecia. It was founded in the 7th century BC and it is the town where Pitagora, the Greek Mathematician spent the last years of his life. There are important archaeological findings dating back to the Magna Grecia and are located on the Italian Ionian coast. Tourists can enjoy the beautiful "Tavole Palatine", which are the remaining columns from a Greek temple and date back to the 6th century BC; the temple was dedicated to the Goddess Hera. The Doric ruins of Apollo Licio's temple stand in the middle of the old town and tourists can see its huge monolithic columns. Moreover, they can visit the ruins of a theater from the 6th century BC, which stand close to the aforementioned temple. Both of these last two archeological sites are important evidence of a complex flourishing era.

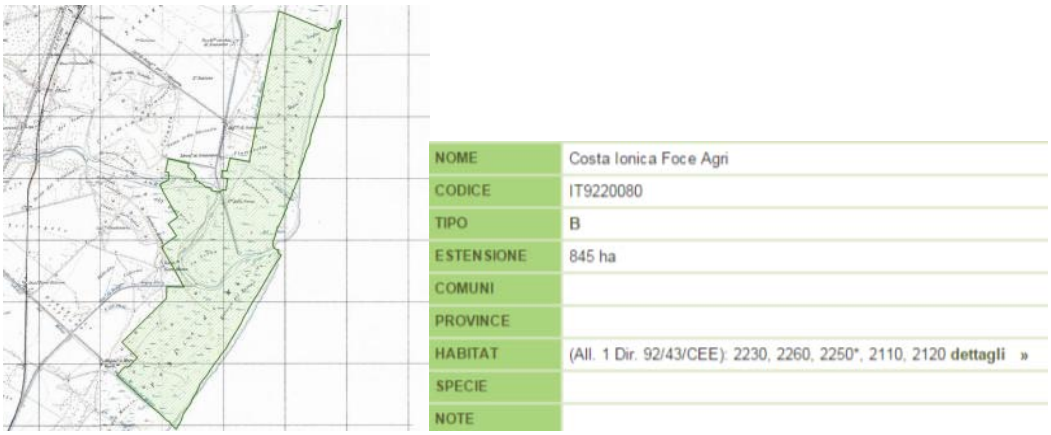
Many archaeological findings of great interest have been unearthed during the archaeological excavations that have recently been carried out in Metaponto, which was one of the most important sites of Magna Grecia. (www.italia.it/en/discover-italy/basilicata/poi/archaeological-area-of-metaponto.html)

Fig. 146: The Metaponto archaeological park (source: www.italythisway.com)

1.7.2 SITE COMMUNITY IMPORTANCE (SIC)

The five most important Sites Community Importance (SIC) based in Basilicata Region are located in Metapontino area and are listed below:

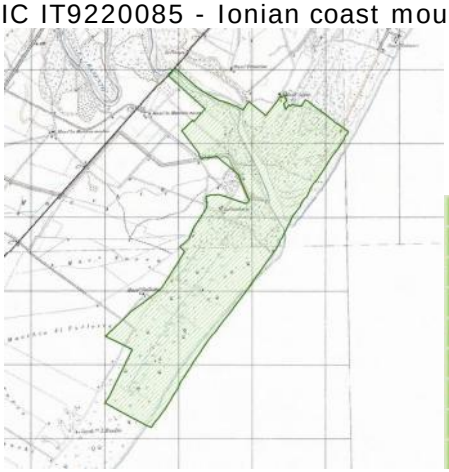
- SIC IT9220080 - Ionian coast mouth river Agri



NOME	Costa Ionica Foce Agri
CODICE	IT9220080
TIPO	B
ESTENSIONE	845 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2230, 2260, 2250*, 2110, 2120 **dettagli** »
SPECIE	
NOTE	

Fig. 147: Ionian coast mouth river Agri - SIC IT9220080 (source: http://natura2000basilicata.it)

- SIC IT9220085 - Ionian coast mouth river Basento



NOME	Costa Ionica Foce Basento
CODICE	IT9220085
TIPO	B
ESTENSIONE	548,38 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2230, 2260, 2250*, 2110, 2120 **dettagli** »
SPECIE	
NOTE	

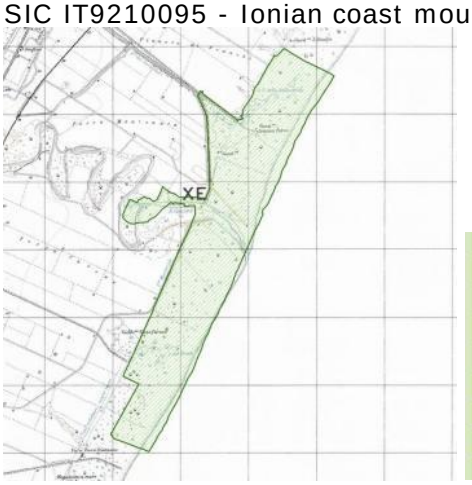
Fig. 148: Ionian coast mouth river Basento - SIC IT9220085 (source: http://natura2000basilicata.it)

- SIC IT9220090 - Ionian coast mouth river Bradano

NOME	Costa Ionica Foce Bradano
CODICE	IT9220090
TIPO	C
ESTENSIONE	495,14 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2240, 2230, 2260, 2250*, 2110 **dettagli** »
SPECIE	
NOTE	

Fig. 149: Ionian coast mouth river Bradano - SIC IT9220090 (source: http://natura2000basilicata.it)

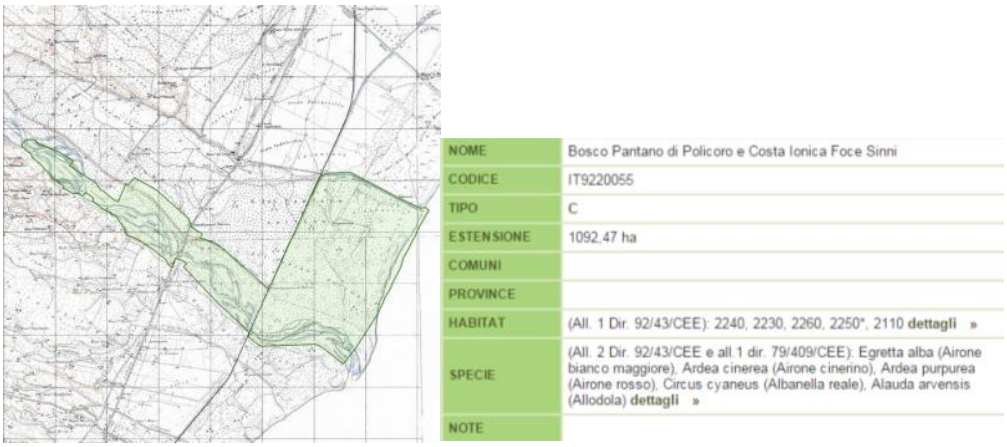
- SIC IT9210095 - Ionian coast mouth river Cavone



NOME	Costa Ionica Foce Cavone
CODICE	IT9220095
TIPO	B
ESTENSIONE	590,06 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2240, 2230, 2260, 2250*, 2110 **dettagli** »
SPECIE	
NOTE	

Fig. 150: Ionian coast mouth river Cavone - SIC IT9210095 (source: http://natura2000basilicata.it)

- SIC IT9220055 - Pantano woodland of Policoro and Ionian coast mouth river Sinni



NOME	Bosco Pantano di Policoro e Costa Ionica Foce Sinni
CODICE	IT9220055
TIPO	C
ESTENSIONE	1092,47 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2240, 2230, 2260, 2250*, 2110 **dettagli** »
SPECIE	(All. 2 Dir. 92/43/CEE e all.1 dir. 79/409/CEE): Egretta alba (Airone bianco maggiore), Ardea cinerea (Airone cinerino), Ardea purpurea (Airone rosso), Circus cyaneus (Albanella reale), Alauda arvensis (Allodola) **dettagli** »
NOTE	

Fig. 151: Pantano woodland of Policoro & Ionian coast mouth river Sinni - SIC IT9220055 (source: http://natura2000basilicata.it)

1.8 RIVER BASINS WITHIN THE GREATER AREA OF METAPONTINO

Metapontino area is characterized by a wide and complex hydrographic network. Some of the main water bodies, such as Bradano river, Basento river, Cavone, Agri and Sinni rivers flow into the Ionian Sea, after having streamed with a NW − SE direction through almost the entire region in a parallel way (Fig. 152).

Fig. 152: Basilicata river basins (source: Interregional River Basin Authority of Basilicata)

AGRI RIVER BASIN

The Agri river starts not far from the source of the Basento River, it flows in Western Basilicata, from the Apennines to the Ionian coast, crossing the most fertile valley, in which many settlements also exist. It is 136 km long and has a catchment area of about

1730 sq.km (out of which 15 sq.km are in the Campania region). The mountainous part of the basin is located between the provinces of Potenza and Matera, and is oriented from northwest to southeast, bordering the river basins of the Basento River and Cavone River at the north, Sele River at the west, Sinni River and Noce River at the south.

CAVONE RIVER BASIN
Cavone River springs in the central-southern region of Basilicata. It has a length of 49 km and a catchment area of 675 sq.km. Its hydrographic network is developed entirely within the province of Matera and is characterized by outflows markedly torrential.

BASENTO RIVER BASIN
The Basento River, with a length of about 149 km, springs from the northern Apennines, from Monte Arioso and runs from northwest to southeast in the provinces of Potenza and Matera. Also, it flows into the Gulf of Taranto, near Metaponto. Its basin covers Basilicata for about 1537 sq.km.

BRADANO RIVER BASIN
The Bradano River springs near the village of Lagopesole. It flows into the Ionian Sea, in Metaponto, in the Gulf of Taranto and affects the entire central and western areas of Basilicata in the province of Potenza and Matera. It borders the river basins of Ofanto and Basento. Bradano River is 120 km long and its basin covers an area of 2765 sq.km, out of which 2010 sq.km belong to Basilicata and 755 sq.km to Puglia.

SINNI RIVER BASIN
The Sinni River, springs at 1380 meters altitude, from Serra della Giumenta, on the eastern slopes of Mount Sirino-Papa, in the municipality of Lauria (PZ). It runs from west to east the biggest southern part of Basilicata. Sinni is 94 km long and covers a total area of 1292 sq.km. It borders the basins of the rivers Agri in the North, Noce in the West, Lao and Coscile - Crati in the South. Lastly, it flows into the Ionian Sea, at Policoro.

1.8.1 WATER QUALITY

Information on the quality of Metapontino surface waters is presented in Fig. 153.

1.8.2 GROUNDWATER

The territory of the Basin Authority of Basilicata is an area rich in underground water resources of good quality (Fig. 154). Most of these groundwater resources are based on the powerful and extensive hydrogeological carbonate karst and fissured, and in some significant porous aquifers, in detrital - alluvial valleys of the rivers found in Basilicata (for example Alta Val d'Agri) or in the coastal plain of Metaponto.

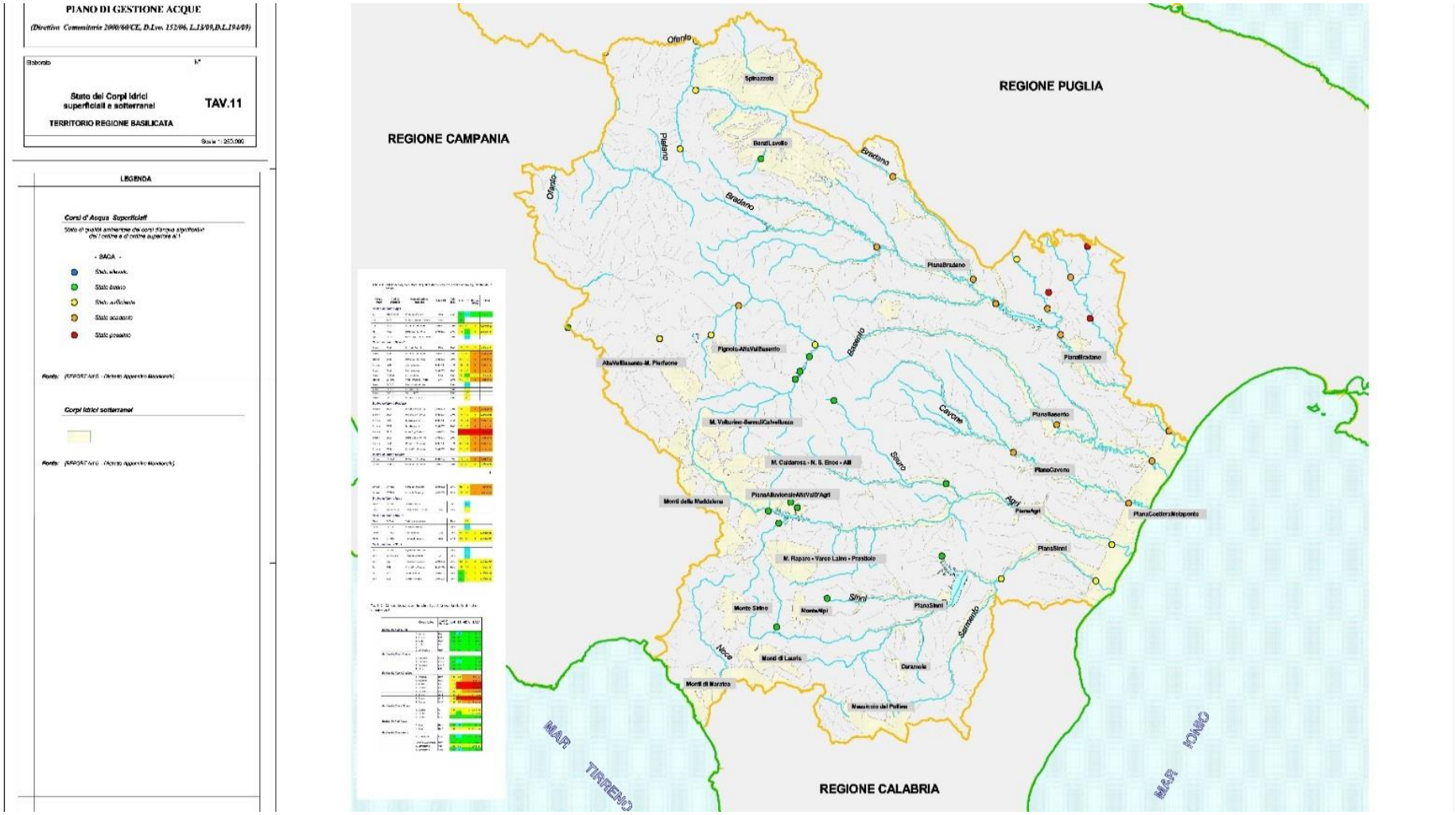


Fig. 153**: Water quality of Metapontino (source: Distretto idrografico dell'Appennino Meridionale)**

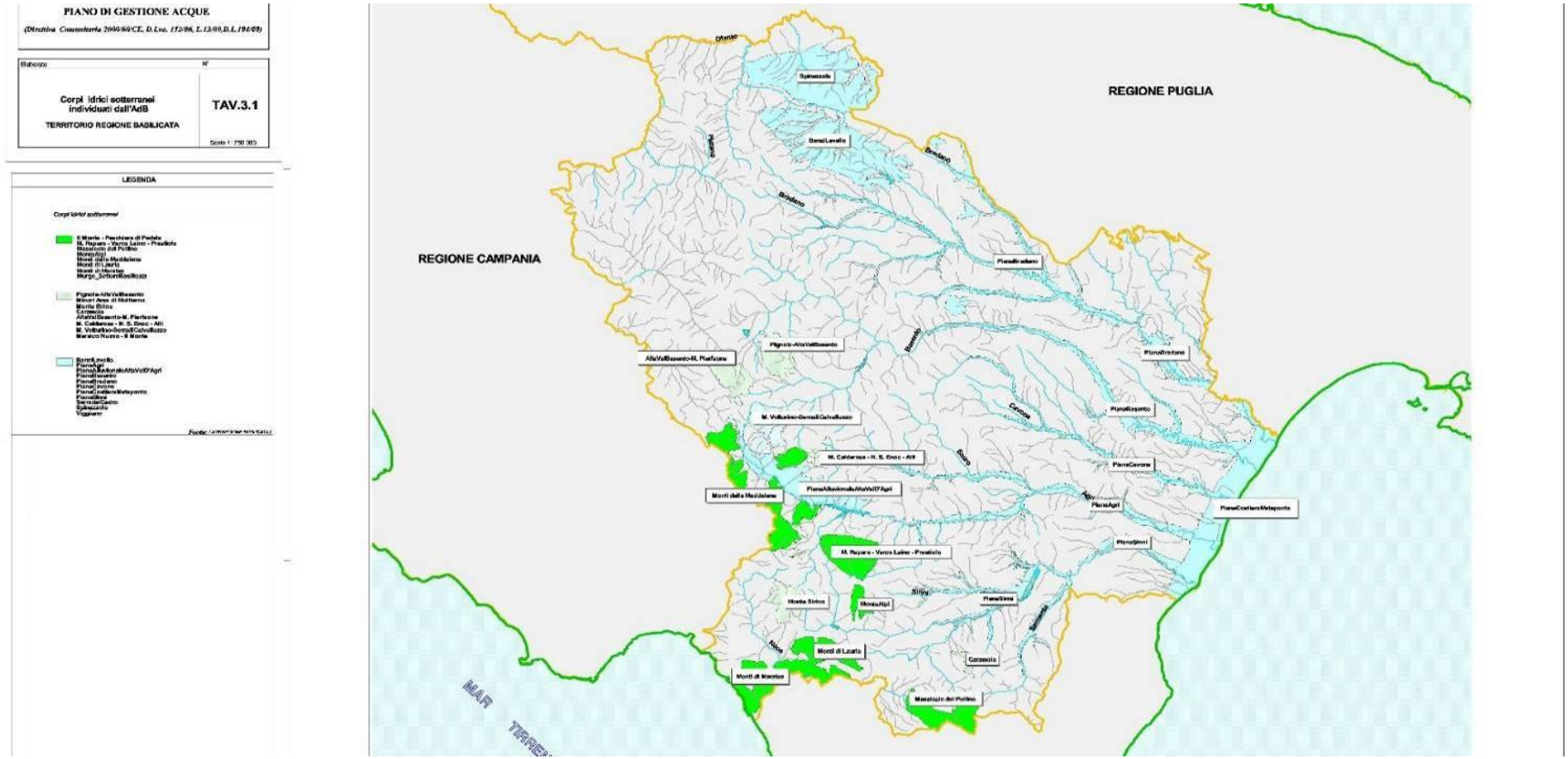


Fig. 154: Basilicata groundwater map (source: Distretto idrografico **dell'Appennino Meridionale)**

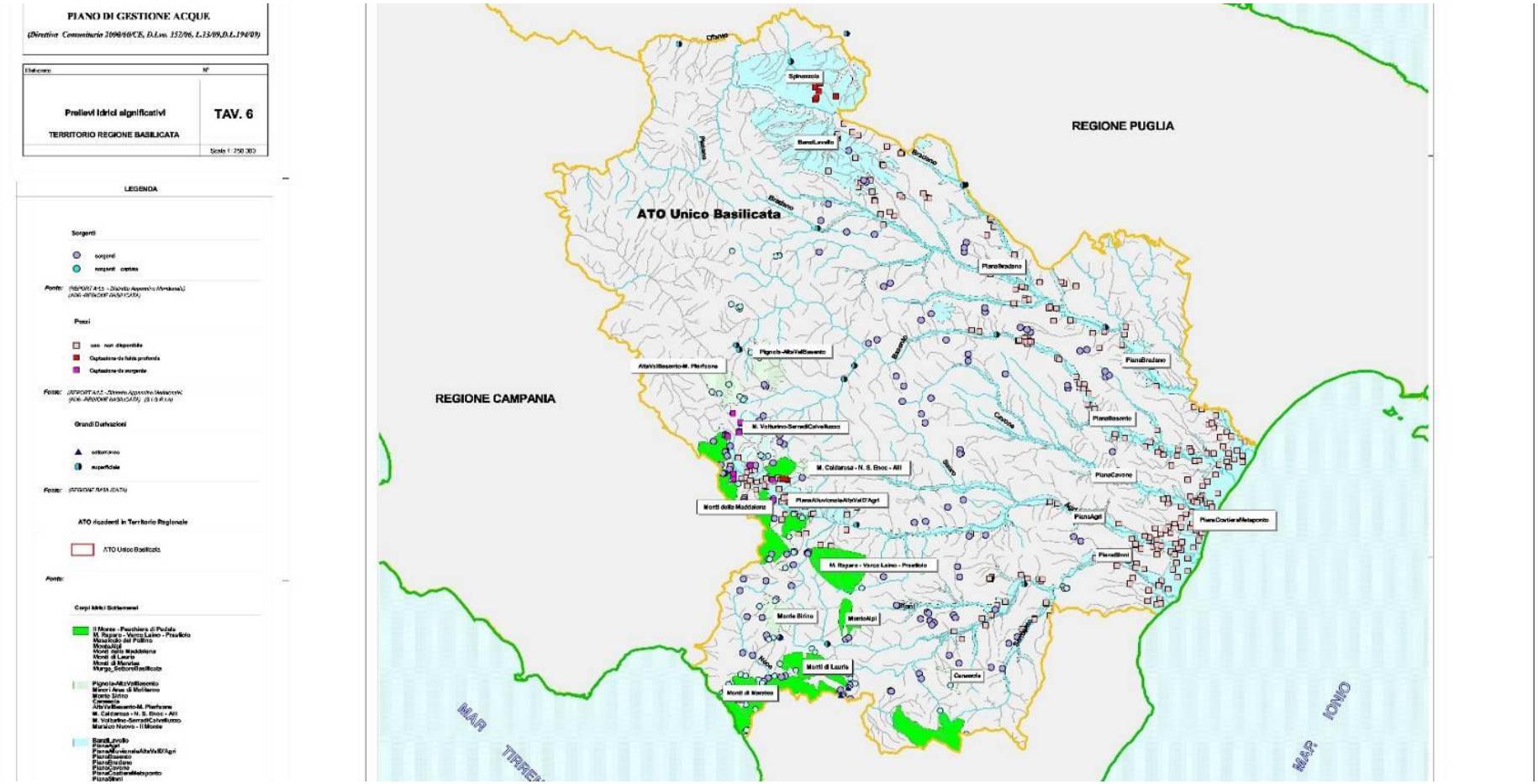


Fig. 155: Basilicata abstraction points: water springs and wells (source: **Distretto idrografico dell'Appennino Meridionale**

1.8.3 WATER STATUS

National legislation (Article. 80 of N. 152/2006 - Surface water for the production of drinking water) provides that fresh surface water that is to be used for drinking water, is classified in categories A1, A2 and A3, according to the physical, chemical and microbiological characteristics of water (third part, Table 1/A, Annex 2). Depending on the category, fresh surface water to be utilized as potable is subjected to the following treatments:

- Category A1: simple physical treatment and disinfection;
- Category A2: normal physical and chemical treatment and disinfection;
- Category A3: physical and chemical treatment pushed, refining and disinfection.

Surface waters of Basilicata for the production of drinking water fall into category A2 and are depicted in Fig. 156 (http://www.arpab.it/).

Fig. 156: Basilicata water resources for drinking use

1.9 RESPONSIBLE BODIES ON WATER SERVICES

The Basilicata water supply system conceived for water resources planning and management involves the following bodies:

- Basilicata Region (General Management and Water Cycle Office of Environment, Territory and Sustainability Policy Department);
- Interregional River Basin Authority of Basilicata (IRBA), which controls a great part of the territory of Basilicata Region and smaller parts of Apulia and Calabria regions, carrying out its planning and programming activities on the basins of

the main rivers of Basilicata region, besides the surface and ground water resources;

- Authority of Optimum Territorial Ambit of Basilicata (Basilicata AATO - Control Body of the Management Body for the Integrated Water Service-IWS) whose area of influence is given by the whole regional territory;
- Acquedotto lucano (the Management Body of the IWS) and Acqua S.p.A. (public company for raw water transfer);
- Interregional River Basin Authority of Apulia, whose area of programming activity covers the water resources located in Basilicata Region and belonging to the Ofanto river basin, and the Interregional Sele Basin Authority, which exerts its duties on the part of Basilicata region territory that belongs to the Marmo and Platano rivers, affluent of Sele river.

Summing up, the territory of Metapontino Area falls into the responsibility of four Interregional River Basin Authorities: the Interregional River Basin Authority of Basilicata (IRBA) that comprises most of Basilicata's territory, the Interregional River Basin Authority of Apulia, the Interregional Sele Basin Authority and the Interregional River Basin Authority of Calabria (that holds a small part of Basilicata Region).

1.9.1 ACQUEDOTTO LUCANO

Acquedotto Lucano, established by Basilicata AATO with Deliberation 19/2002, is an entirely public working capital Company (established by the Municipalities and the Government of Basilicata Region), and is in charge of the Integrated Water Service in Basilicata. Acquedotto Lucano is responsible for water uptake from the springs, water treatment, water transfer through the aqueducts and the hydraulic network, water distribution to the houses and the commercial utilizations.
The Body in charge of the management for the IWS in Basilicata is operating inside an area that comprises 131 Municipalities, with a population of about 610.000 inhabitants, with 250.000 users and more than 4.000 km of network.

1.9.2 ACQUE SPA

The Government of Basilicata Region, with the Law no. 21 of 3rd June 2002 ("Rules on the exertion of regional duties with respect to water supply") has created an entirely Limited Public Company under the name of "Acqua S.p.A. – Limited Public Company for water supply". This company, with an entirely public working capital (thus open to the participation of other Institutional and/or private bodies) primarily deals with the collection of water, its storage, transfer and distribution, but also with its treatment for the primary supply linked to the great water schemes, in order to satisfy civil uses, irrigation and industrial purposes in the territories served and, last but not least, with the proper management and maintenance of the technical structures.

1.10 WATER CONSUMPTION

The water consumption in Basilicata and its neighboring regions is presented on Table 106. In total, Basilicata Region manages 640 x 10^6 m^3 of water per year.

Table 106: Water supplies – Basilicata and neighboring Regions

Region	Water Consumption (10^6 m^3/year)	%
Basilicata	257	40
Puglia	373	58
Calabria	10	2
Sum	640	100

Water consumption by use is listed on Table 107.

Table 107: Basilicata water supply by use (Interregional River Basin Authority of Basilicata)

Water Use	Consumption (10^6 m^3/year)	%
Drinking	270	42.2
Irrigation	350	54.7
Industrial	20	3.1
Sum	640	100

Water resources of Metapontino Area are mainly used for drinking and irrigation purposes, and less for other uses, not only within the Basilicata region but also in other regions, like Apulia, where a significant quantity of water is transferred, and Calabria. Metapontino drinking water consumption data, on the municipality level are presented in Fig. 157.

Municipality	Drinking water introduced into the network (mc)	Drinking water supplied by the network (mc)	Percentage of water supplied to the total water fed into the network
Bernalda	1,945,256	1,587,480	81.6
Colobraro	178,585	111,096	62.2
Craco	135,696	69,023	50.9
Montalbano Jonico	1,058,985	829,699	78.3
Nova Siri	1,767,585	958,236	54.2
Pisticci	3,725,545	2,897,525	77.8
Policoro	2,025,684	1,784,126	88.1
Rotondella	741,445	399,858	53.9
San Giorgio Lucano	239,521	135,003	56.4
Stigliano	887,569	469,858	52.9
Tursi	520,102	439,951	84.6
Valsinni	298,510	123,652	41.4
Scanzano Jonico	1,510,589	957,471	63.4
Sum	**15,035,072**	**10,762,978**	

Fig. 157: Drinking water per municipalities (Metapontino area)

1.11 IRRIGATION NETWORKS AND METHODS

The irrigation network of Basilicata Region is quite complex, because of the necessity to face effectively the needs for water demand of different users, within Basilicata region, as well as other boundary regions. Moreover, it is important that water availability is ensured during periods of drought or in areas characterized by water scarcity. As a consequence, the technical features of the hydraulic irrigation structures, that are part of this network, are advanced, in order to enable the efficient transfer of large quantities

of water between boundary regions and different areas (Fig. 158). This is the main reason why important dams have been built so that the necessary quantities of water to satisfy the needs of different uses in Basilicata and Apulia regions be reserved. This system of hydraulic infrastructures (Fig. 159), the very heart of the primary hydraulic system of Southern Italy, is made of a very complex network of hydraulic schemes (a system of great hydraulic works such as dams, weirs, pipelines, by means of which it is possible to link water sources and final users); among which the most important are Jonico-Sinni and Basento-Bradano schemes. Other schemes, such as Alta Val d'Agri, Noce and Mercure, can be considered as minor ones, because of their less complexity (Interregional River Basin Authority of Basilicata).

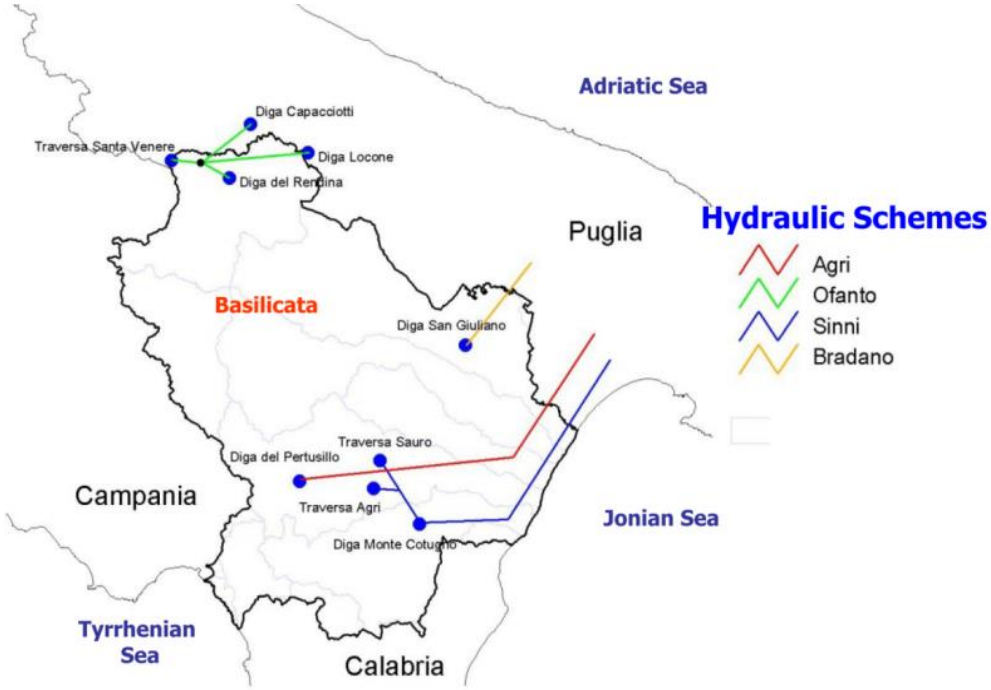


Fig. 158: Main Hydraulic Schemes for Water Supply from Basilicata to Puglia (source: Interregional River Basin Authority of Basilicata)

The Basilicata main hydraulic schemes supply 590 million cubic meters annually, in order to guarantee water supply in Basilicata and Puglia regions. Metapotino Area is supplied by the Agri scheme (170 x 10^6 m^3/year) and the Sinni scheme (300 x 10^6 m^3/year).

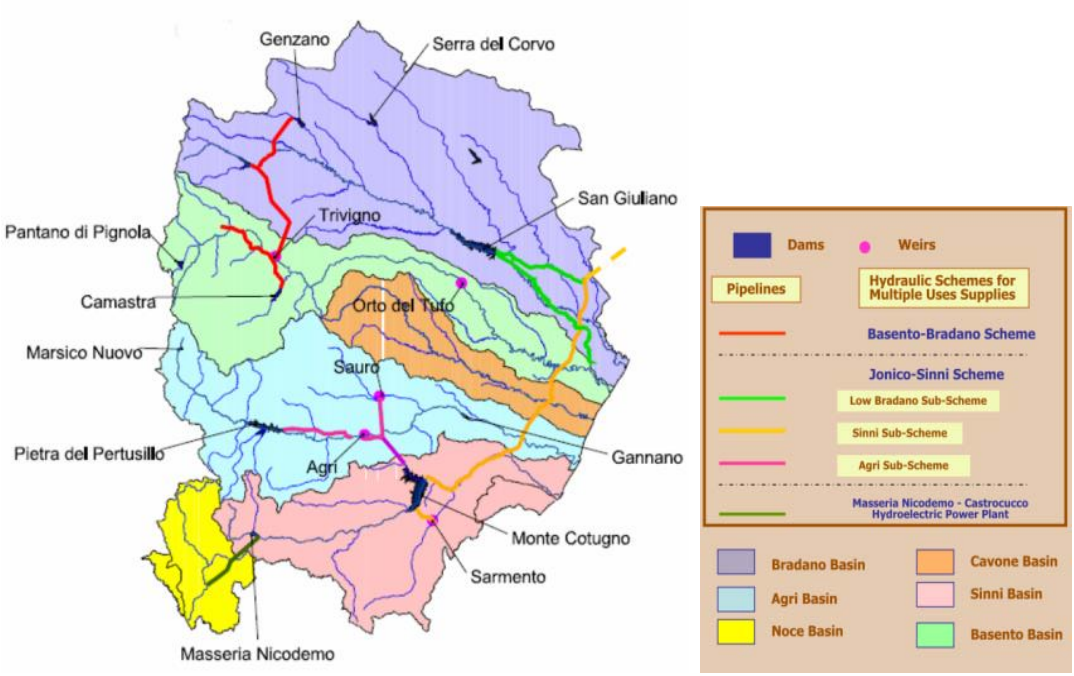


Fig. 159: Main Hydraulic Infrastructures in the Interregional River Basin Authority of Basilicata Territory (source: Interregional River Basin Authority of Basilicata)

	Completion year	Use	River	Cachemnt area (km^2)	Capacity (Mmc)	Regulation volume (Mmc)
		Bradano				
Acerenza Dam	1994	Irrigation	Bradano	142	47	38
Genzano Dam	1990	Irrigation	Fiumarella	37	57	52.95
Basentello Dam	1974	Irrigation	Basentello	267	41	28
San Giuliano Dam	**1955**	Irrigation	Bradano	1631	107	90.13
		Basento				
Pantano Dam	1981	Industrial	Tora		5.5	4.5
Trivigno Weir	1996	Irrigation	Basento			
Camastra Dam	**1968**	Multiple use	Camastra	350	32	23.6
		Agri				
Marsico Nuovo Dam	1996	Irrigation	Agri	26	7	5.31
Pertusillo Dam	1963	Multiple use	Agri	630	155	142
Agri Weir						
Gannano Weir	**1959**	Irrigation	Agri	1490		
		Sinni				
Monte Cotugno Dam	1983	Multiple use	Sinni	890	530	433
Sarmento Weir	1982	Multiple use	Sarmento	175.4		
Cogliandrino Dam	1975	Hydroelectric	Cogliandrino	120	12.4	10.1

Fig. 160: Basilicata Dams and Weirs Technical Data (source: Interregional River Basin Authority of Basilicata)

1.12 DESCRIPTION OF RESPONSIBILITIES OF PROJECT'S FARMERS ORGANIZATIONS (ASSOFRUIT)

The Asso Fruit Italia group (AFI) is one of the major companies operating in southern Italy and was founded in 2010 in Scanzano Jonico as the result of a strategic

collaboration of four major fruit and vegetable producers (AssoFruit Sca, Prometas Sca, Generalfruit Basilicata Sca and Fruit Italia Sca) and immediately it became the most important association in the fruit and vegetable sector in the south of Italy.
Asso Fruit Italia is made up of mainly companies from Lucania which come from the historical association of fruit and vegetable and citrus growers Assobasilicata, formed in 1984.
The Producers' Organization Asso Fruit Italia has the following characteristics:

- 13 cooperatives and 400 farms associated;
- a turnover of 56 million € in 2009;
- almost 98,400 tons of products marketed in 2010;
- 3,045 hectares of land dedicated to fruit and vegetables cultivation in five Italian regions (Basilicata, Apulia, Calabria, Campania, Lazio);
- 10 fruit processing plants, one of which certified for organic cultivation (http://www.assofruit.com/)

Asso Fruit Italia plays an important economic role in planning and collecting the associates' products to satisfy the demands of a globalised market. So Asso fruit Italia created the commercial company Frutthera srl, in order to put these products in the main international commercial centres. What's more, Frutthera buys also products from companies that are not associated to Asso Fruit Italia to guarantee the continuity of the productions on the national market and G.D.O.
Asso Fruit Italia organizes a lot of research projects (an example is the partnership with Unibas for the project IquaSoPo (a combined experimentation on new systems of precision farming, carbon foot printing, better management of soil and studies on nutritional factors). The most important are the operational programmes through which the companies take part in the promotion as well as in the control of all of the agricultural practices, which are at the base of an improvement in quality standards of the grower's fruit and vegetable produce Their technical support guarantees the correct application of the production guidelines through on-site assistance as well as a strict selection process in order to provide the consumer with a high quality, wholesome and controlled product which rigorously respects food standards. The work of Asso Fruit Italia is to continually train and review its associates, to supports investments and technological upgrades. It also makes the producers aware of the need to respect the land, the environment and the people around us and guarantees a dialogue between the farms and the clients, and between the producers and the consumers.

2. SELECTION OF LIFE AGROCLIMAWATER PILOT SUB-BASIN IN METAPONTINO AREA, ITALY

The selection criteria and methodology presented in section 2.1 were used for the selection of the pilot sub-basin in Metapontino Area. This section concerns the evaluation and the scores received for each sub-basin in the two evaluation stages for the selection of the pilot sub-basin.

2.1 1st STAGE EVALUATION

As already described in part 1 (description of the greater area), Metapontino Area is crossed by five rivers, each of which forms its proper river basin. Thus, 1st stage evaluation will be performed for each Metapontino river basins in order to select the most appropriate for the project's purposes. Concerning crops availability (criterion A.1), apricots, olives, citruses and peaches have been taken into account because these are the most representative ones in Metapontino.

2.1.1 RIVER BASIN EVALUATION WITHIN METAPONTINO AREA

2.1.1.1 1st Evaluation Stage

As mentioned above, Metapontino includes 5 river basins, coded as 1MA, 2MA, 3MA, 4MA and 5MA (Fig. 163). The procedure followed for the evaluation of these river basins is presented in detail in the following paragraphs.

Available pilot crops

The main tree crops in Metapontino are traditionally olive, apricot, peach and citrus trees. Metapontino Area key crops map presents areas of fruit tree cultivation that refers to both apricot and peach plantations. The land use map and the key crops map for the Metapontino Area are presented in Fig. 156 and Fig. 161.

It is clear that fruit trees (peaches and apricots) are the dominant tree crop cultivated in basins 1MA, 2 MA, 3 MA and 4 MA. The citrus cultivation zone is mainly located in areas 4 MA and 5 MA, while olive is the mainly located in area 1MA and 5MA. Based on the key crops data presented in Fig. 162, the status in the five basins is presented on Table 108.

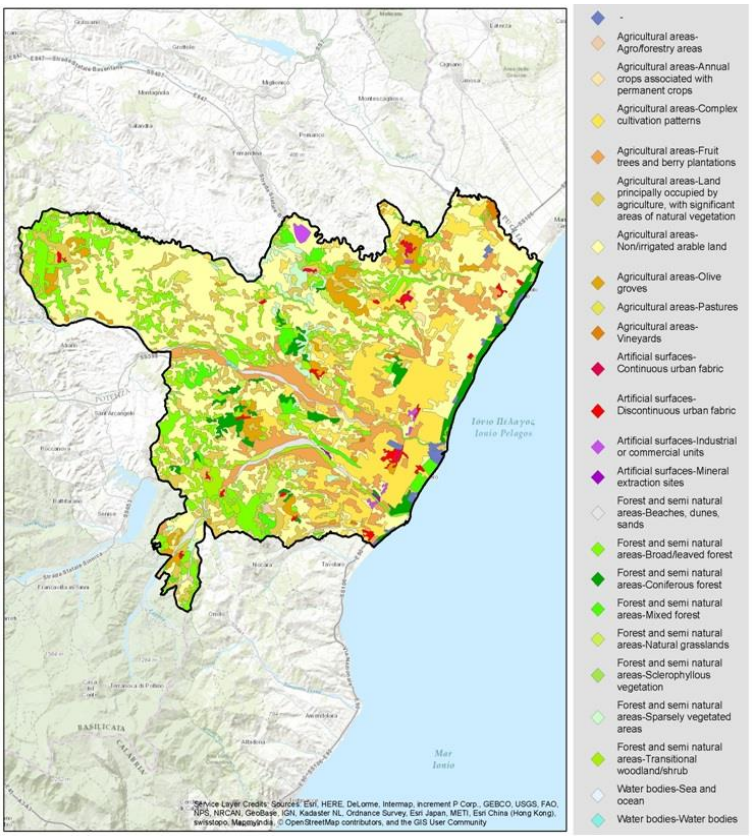


Fig. 161: Geodatabase Map extract depicting the land uses within the Metapontino Area.

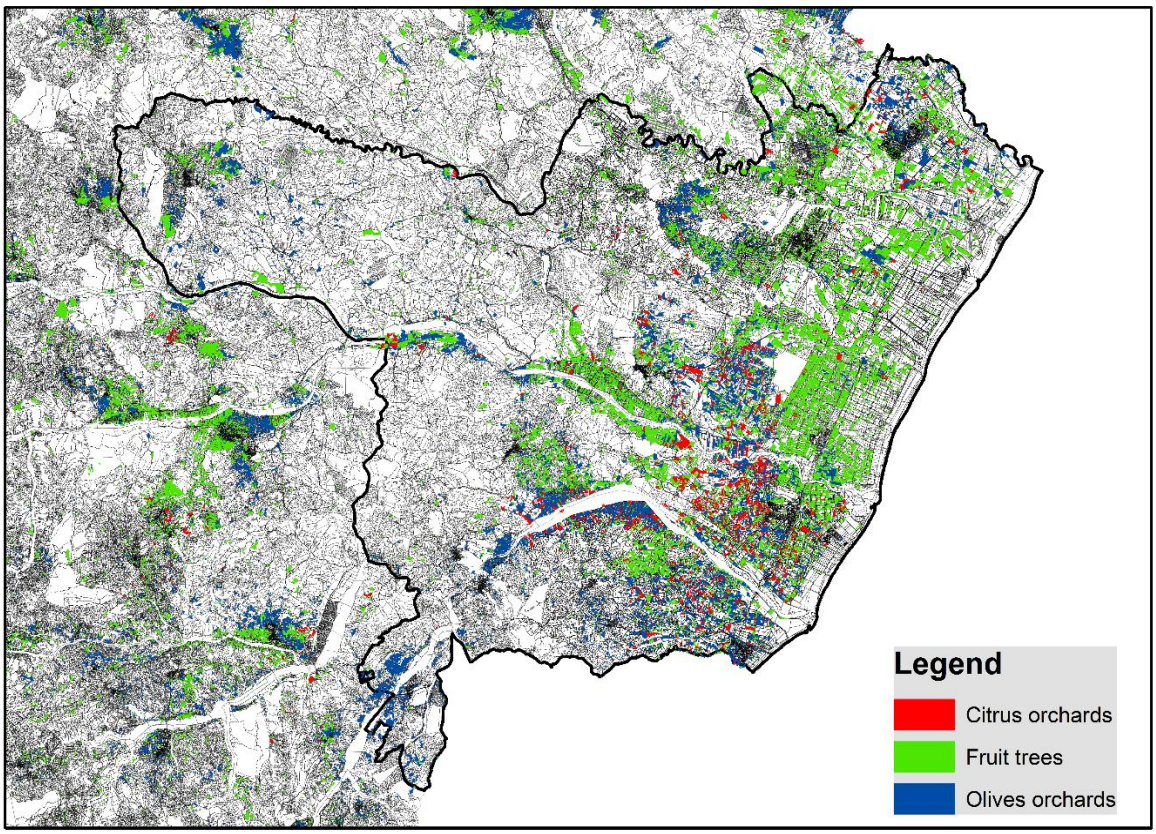


Fig. 162: Metapontino Area key crops map

Table 108: Data on olive, apricot, peach and citrus tree cultivation within the Metapontino Area

Basin	Parameter	Area (sq.km)	Percentage of total area (%)	Fruit /Citrus trees		Fruit trees/Olive	
				Ratio	Difference from typical	Ratio	Difference from typical
1MA	Total	16,29		8,57	4,736358	1,68	-0,76
	Olive orchards	5,66	34,74				
	Citrus orchards	1,11	6,82				
	Fruit trees	9,52	58,44				
2MA	Total	33,05		31,08	27,17169	4,23	1,79
	Olive orchards	6,16	18,64				
	Citrus orchards	0,84	2,54				
	Fruit trees	26,05	78,83				
3MA	Total	42,59	-	15,19	11,37057	3,26	0,82
	Olive orchards	9,51	22,34				
	Citrus orchards	2,04	4,80				
	Fruit trees	31,03	72,86				
4MA	Total	69,17	-	1,90	-1,94098	4,70	2,26
	Olive orchards	8,46	12,23				
	Citrus orchards	20,94	30,28				
	Fruit trees	39,77	57,49				
5MA	Total	50,07	-	2,51	-1,33083	0,66	-1,53
	Olive orchards	22,04	44,02				
	Citrus orchards	7,99	11,55				
	Fruit trees	20,05	28,98				
Total	Total	211,17	-	3,84	-	2,44	-
	Olive orchards	51,83	24,55				
	Citrus orchards	32,92	15,59				
	Fruit trees	126,42	59,86				

As shown above, all river basins include the cultivation of fruit trees, olive groves and citrus trees. However, the area cultivated with citrus trees in the first three basins is significantly low, resulting in very high fruit/ citrus trees ratios and differences from the typical status of Metapontino area. On the other hand, the differences in the fruit / olive

trees ratios estimated for the five basins examined are significantly lower. Thus, sub-basins 1MA-3MA receive a lower score than the latter two (4MA and 5MA), as shown on Table 109.

Table 109: Recorded score based on the criterion of pilot crop availability in Metapontino area

River Basin	1MA	2MA	3MA	4MA	5MA
Score	5	5	5	15	15

Acceptance of the project by the FOR farmers

The evaluation for the criterion of farmer acceptance was based on the following two factors: a. the group of farmers that signed the form of initial intention to participate in the project upon its submission, and b. the group of farmers that had already taken part to DiCEM programs for the implementation and application of agricultural practices in an environmentally friendly way. Most farmers that expressed an interest to be informed about the project were located in sub-basins 3MA and 4MA. Based on the above, the scoring for criterion A.2 is presented on Table 110.

Table 110: Recorded score based on the criterion of project acceptance by FOR farmers in Metapontino area

River Basin	1MA	2MA	3MA	4MA	5MA
Score	5	5	10	15	5

Agricultural management systems already implemented by farmers

In general, farmers in Metapontino Area are growing olives, citrus, peaches and apricots in a traditional and empirical way. In the past few years, AFI has participated in programs for the implementation of integrated management schemes that include the application of agricultural practices in an environment-friendly way. Therefore, there are several farmers that have medium knowledge/ experience in implementing agricultural management systems following certain rules, and these farmers are spread throughout the basin 4MA. Farmers located in basins 1MA, 2MA, 3MA and 5MA could be characterized as having low knowledge/experience in implementing agricultural management systems. Taking into account the above information, scoring for this criterion is presented on Table 111.

Table 111: Recorded score based on the criterion of agricultural management system implementation in Metapontino area

River Basin	1MA	2MA	3MA	4MA	5MA
Score	5	5	5	10	5

Availability of data for 2nd stage evaluation

Data availability, mostly concerning meteorological parameters, soil properties and water use, is very important for the successful implementation of the project. In general, and based upon the preliminary experience of collecting data for various Actions of the AgroClimaWater project, more data is available for river basins 3MA and 4MA. Therefore, the scoring for this criterion is as presented on Table 112.

Table 112: Recorded score based on the criterion of data availability in Metapontino area

River Basin	1MA	2MA	3MA	4MA	5MA
Score	5	5	10	10	5

Overall scoring at Evaluation Stage I and basin selection for Stage II

Based on the scoring for each criterion and the weighing factors that have been defined, the following overall scoring was calculated for each basin:

- Basin 1MA: 5*0.3 + 5*0.3 + 5*0.2 + 5*0.2 → Overall score = 5
- Basin 2MA: 5*0.3 + 5*0.3 + 5*0.2 + 5*0.2 → Overall score = 5
- Basin 3MA: 5*0.3 + 10*0.3 + 5*0.2 + 10*0.2 → Overall score = 7.5
- Basin 4MA: 15*0.3 + 15*0.3 + 10*0.2 + 10*0.2 → Overall score = 13
- Basin 5MA: 15*0.3 + 5*0.3 + 5*0.2 + 5*0.2 → Overall score = 8

Therefore, the sub-basin selected to be further evaluated during Stage II is the river basin 4MA, known as Agri river basin.

Fig. 163: River basins in Metapontino Area (above) with depiction of the sub-basins in the selected Agri river basin, 4MA (below)

2.2 2nd STAGE EVALUATION

Agri river basin is further divided in two sub basins: Sauro sub basin and Agri sub basin (according to Italian National legislation D.Lgs.152/99) www.sciamlab.com/opendatahub/es/dataset/arpa_bacini-idrografici-secondari-servizio.

Following the 2nd stage evaluation will be performed within the Agri Basin in order to select the most representative sub-basin for the implementation of AgroClimaWater.

Concerning the type of crops cultivated in the sub-basin in relation with the proposed crops (criterion B.1), apricot has also been taken into account along with olive, citrus and peach because these are the most typical regional crops.

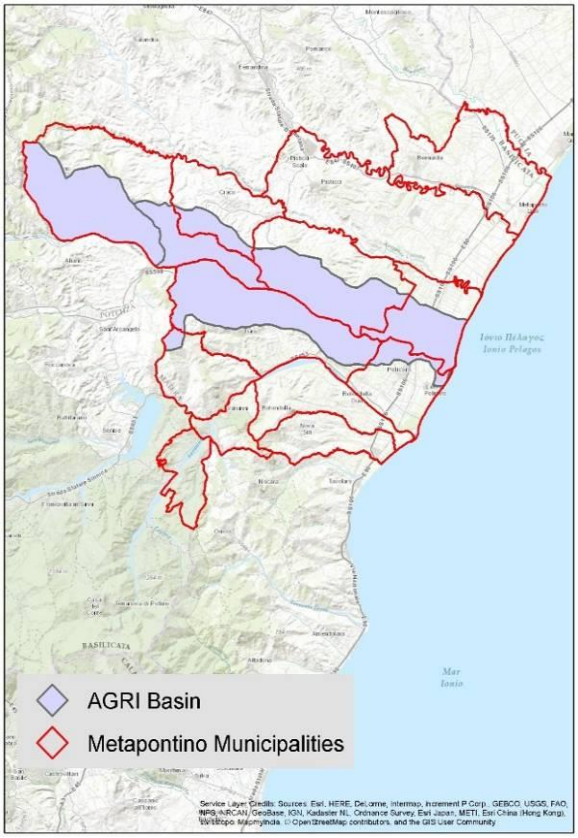


Fig. 164: Sub-basins within the Agri basin and Metapontino area municipalities

As mentioned before, the selected river basin 4MA corresponds to the Agri river basin. It is characterized by cultivation of apricot and peach trees in its Eastern coastal zone, with olive and citrus cultivation mostly located in its middle part. Basin 4MA is divided into two sub-basins, namely 4MAa to 4MAb, as shown in Fig. 163. The Stage II evaluation for the sub-basins of the selected river basin is presented in the following paragraphs.

Available pilot crops

Based on key crops data in Metaponto area presented in Fig. 165 the situation in Agri river basin is presented on Table 113.

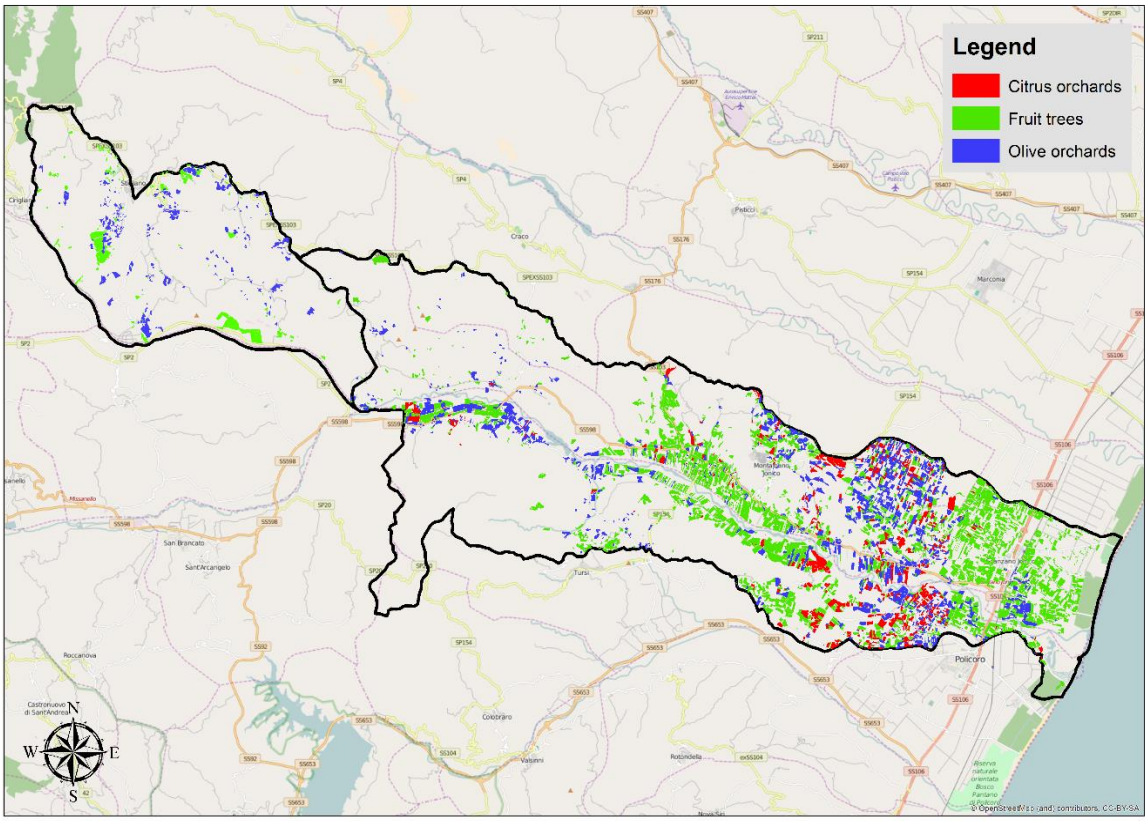


Fig. 165: Agri river basin key crops map

Table 113: Data on olive, citrus and fruit tree cultivation within the Agri river basins

Basin	Parameter	Area (sq.km)	Percentage of total area (%)	Fruit trees/Citrus ratio	Fruit trees/Olive ratio
4MAa	Total	63,27		4,38	2,08
	Olive orchards	17,79	28,12		
	Citrus orchards	8,46	13,37		
	Fruit trees	37,02	58,51		
4MAb	Total	5,89		--	0,88
	Olive orchards	3,13	53,14		
	Citrus orchards	0,00	0,00		
	Fruit trees	2,76	46,86		
Total	Total	69,16		4,70	1,90
	Olive orchards	20,92	30,25		
	Citrus orchards	8,46	12,23		
	Fruit trees	39,78	57,52		

According to the crop availability in each sub-basin, the scoring for this criterion is presented on Table 114. Citrus orchards are not available in sub-basin 4MAb and therefore this sub-basin is excluded from further evaluation.

Table 114: Recorded score based on the criterion of crop availability in Agri area sub-basins

Basin	4MAa	4MAb
Score	0	20

Overall scoring at Evaluation Stage II and sub-basin selection

The overall scoring was not calculated for each sub-basin due to lack of pilot crops in sub-basin 4MAb. Therefore, the study area will include sub-basin 4MA**a "**Agri sub-**basin"**.

3. DESCRIPTION OF LIFE AGROCLIMAWATER PILOT SUB-BASIN IN METAPONTINO

3.1 GENERAL DESCRIPTION OF THE PILOT BASIN AREA

The Agri sub-basin has a population of 4,802 inhabitants (within Metapontino area). The municipalities that fall within the territory of the Agri sub basin are (Fig. 166): Craco, Montalbano Jonico, Policoro, Scanzano Jonico, Colobraro, Stigliano and Tursi, the population of which is presented on Table 115.

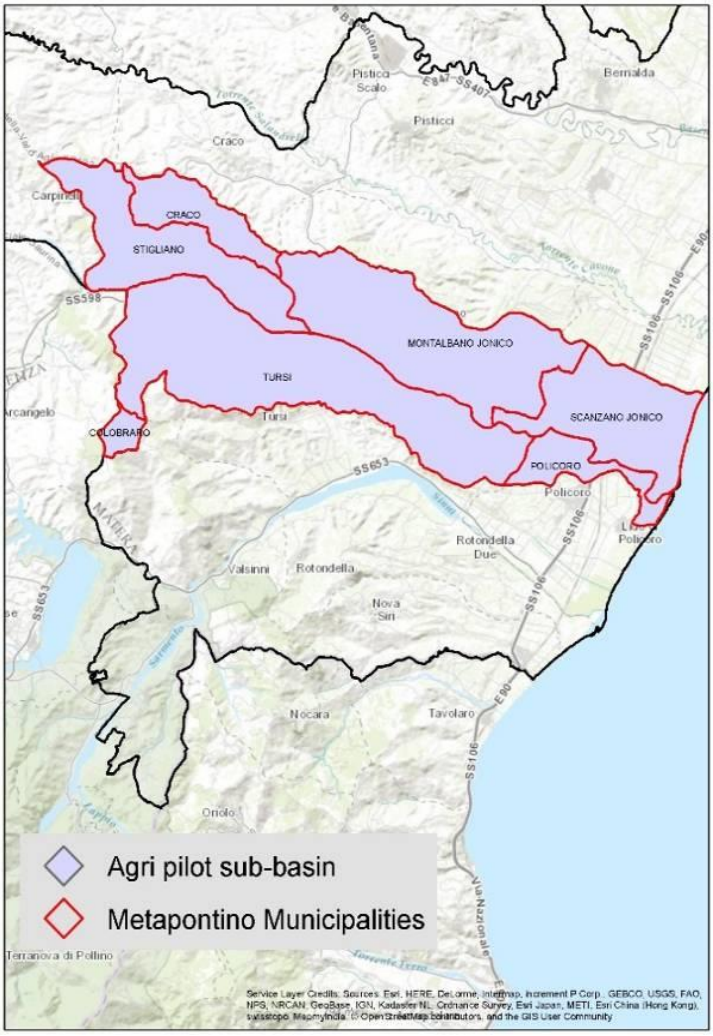


Fig. 166: Municipalities of the Agri pilot sub-basin

Table 115: Agri Sub-basin population

Municipality	Population		
	Male	Female	Sum
Colobraro	619	658	1,277
Craco	386	371	757
Montalbano Jonico	3,495	3,595	7,090
Policoro	7,656	8,014	15,670
Scanzano Jonico	3,792	3,598	7,390
Stigliano	2,033	2,304	4,337
Tursi	2,413	2,465	4,878
Sum	20394	21005	41399

Moreover, the type of farms located in Agri sub-basin per municipality is presented on Table 116.

Table 116: Type of farms per Municipality (Agri sub-basin)

Municipality	Province	Management	Farms
COLOBRARO	Matera	Other	1
COLOBRARO	Matera	with employees	5
COLOBRARO	Matera	without employees	245
CRACO	Matera	with employees	5
CRACO	Matera	without employees	201
MONTALBANO JONICO	Matera	with employees	39
MONTALBANO JONICO	Matera	without employees	894
POLICORO	Matera	with employees	23
POLICORO	Matera	without employees	906
SCANZANO JONICO	Matera	Other	1
SCANZANO JONICO	Matera	with employees	25
SCANZANO JONICO	Matera	without employees	841
STIGLIANO	Matera	Other	1
STIGLIANO	Matera	with employees	15
STIGLIANO	Matera	without employees	710
TURSI	Matera	with employees	33
TURSI	Matera	without employees	857
		Sum	4,802

Gross Domestic Product (GDP) per municipality in Agri sub-basin is presented on Table 117.

Table 117: GDP per Municipality (Agri sub-basin)

Municipality	**GDP 2012 (€)**
Colobraro	11,705
Craco	10,345
Montalbano Jonico	13,382
Policoro	14,460
Scanzano Jonico	10,564
Stigliano	13,765
Tursi	11,584
Mean	12,399

3.2 GEOLOGICAL – HYDROGEOLOGICAL DESCRIPTION – DATA

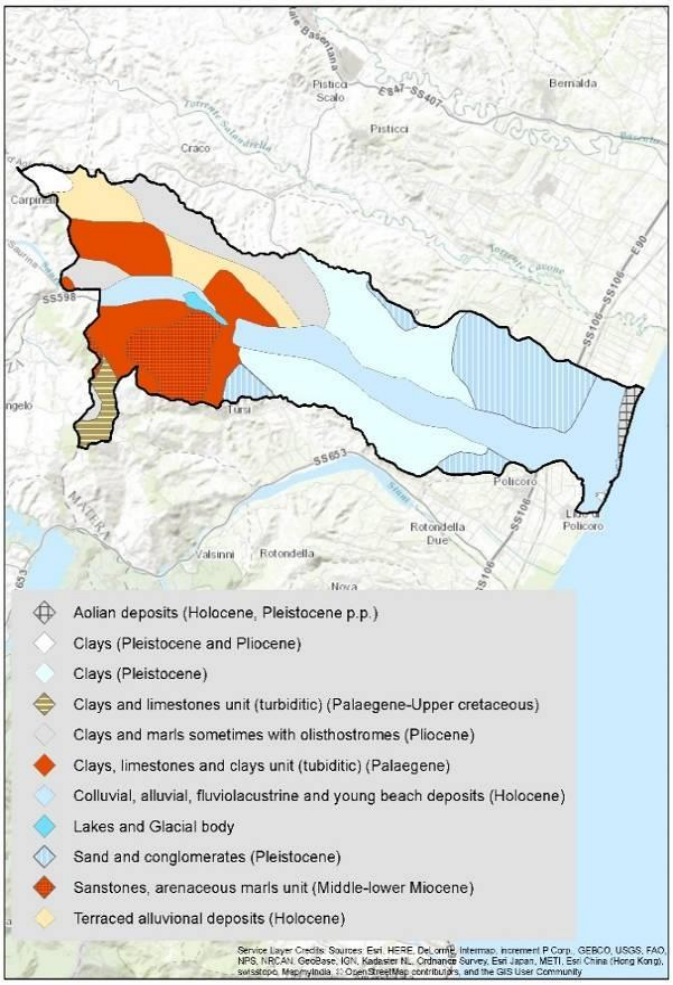


Fig. 167: Pilot sub-basin geological map

The hydrogeological systems of the pilot sub-basin are made of Silicatic sediment rock aquifers and unconsolidated aquifers (more than 60% of the territory, Fig. 168).

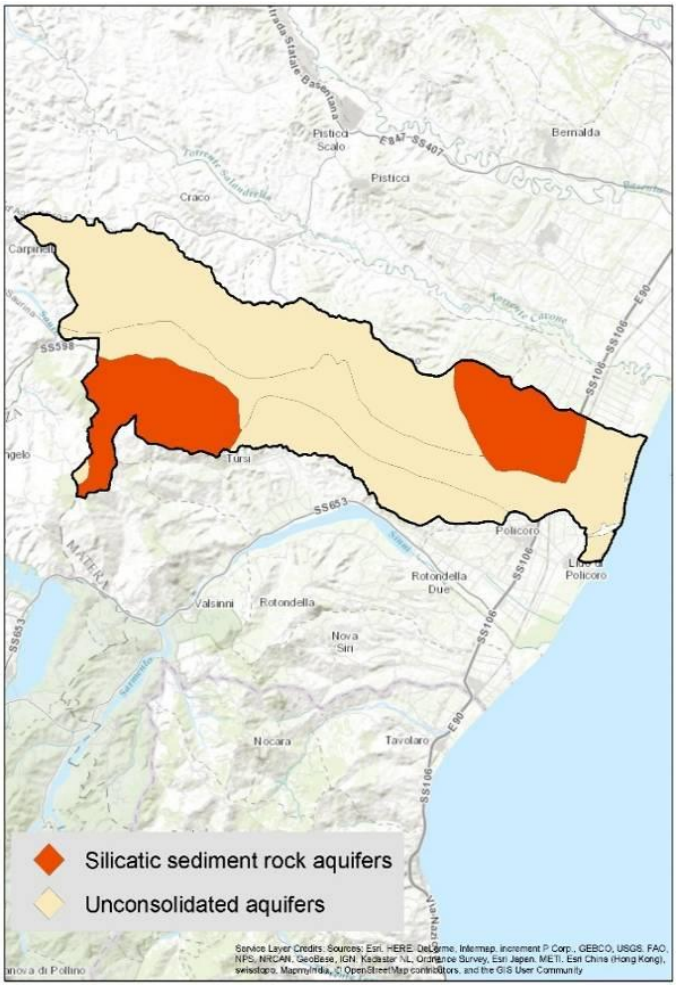


Fig. 168: Pilot sub-basin hydrogeological systems

3.3 SOIL CHARACTERISTICS

Sub-basin area, as shown in Fig. 169, has the following pedological areas:

- Geological Province 14: Soils of the plains, on alluvial deposits, lake with variable grain size, from clay to pebble
- Pedological area 61.1: Apennines and antiappenninici with tertiary sedimentary rocks (sandstone flysch marl and clay of central and southern).
- Pedological area 61.3: Surfaces of the pit with Bradanica pilocenici deposits (deposits marine, estuarine and river).
- Pedological area 62.1: Surfaces of the pit Bradanica and Ofanto basin with Pleistocene deposits (deposits, marine estuary and river).

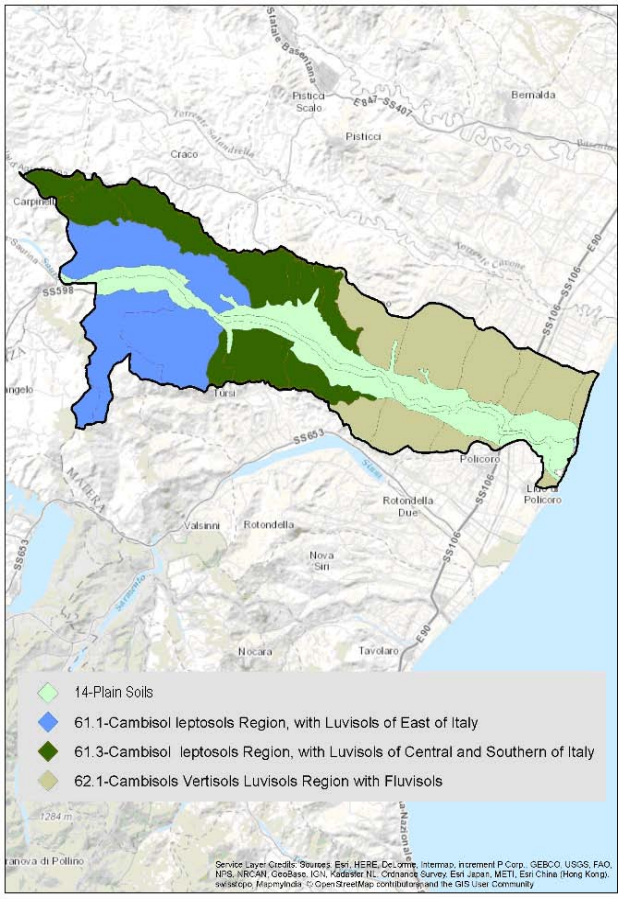


Fig. 169: Pilot sub-basin pedological areas

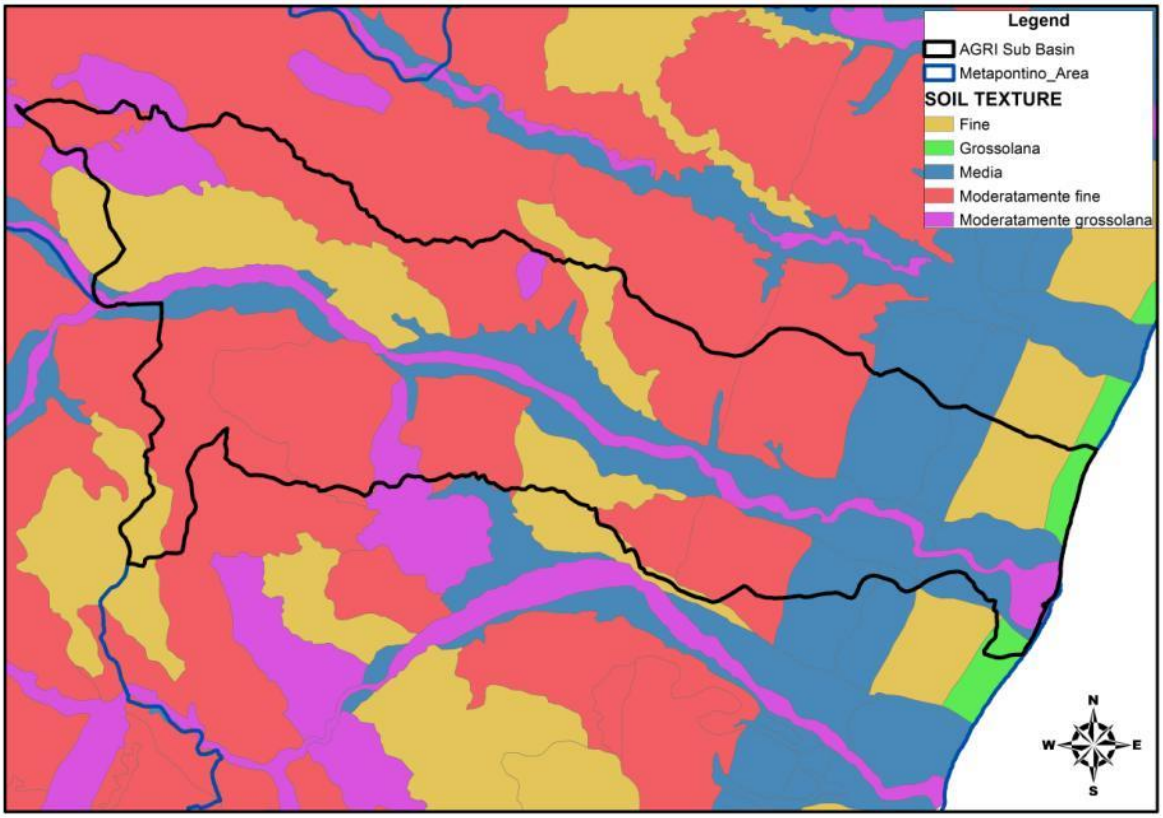


Fig. 170: Pilot sub-basin soil texture map

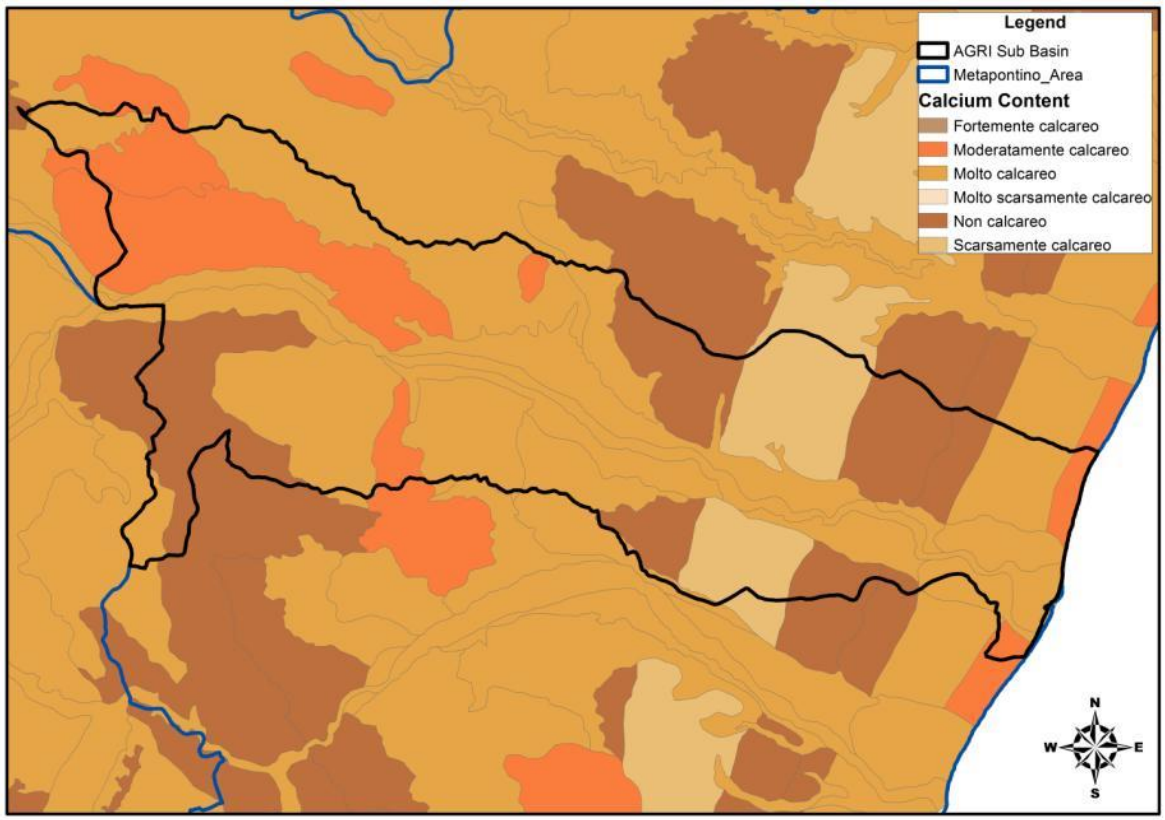


Fig. 171: Pilot sub-basin calcium content map

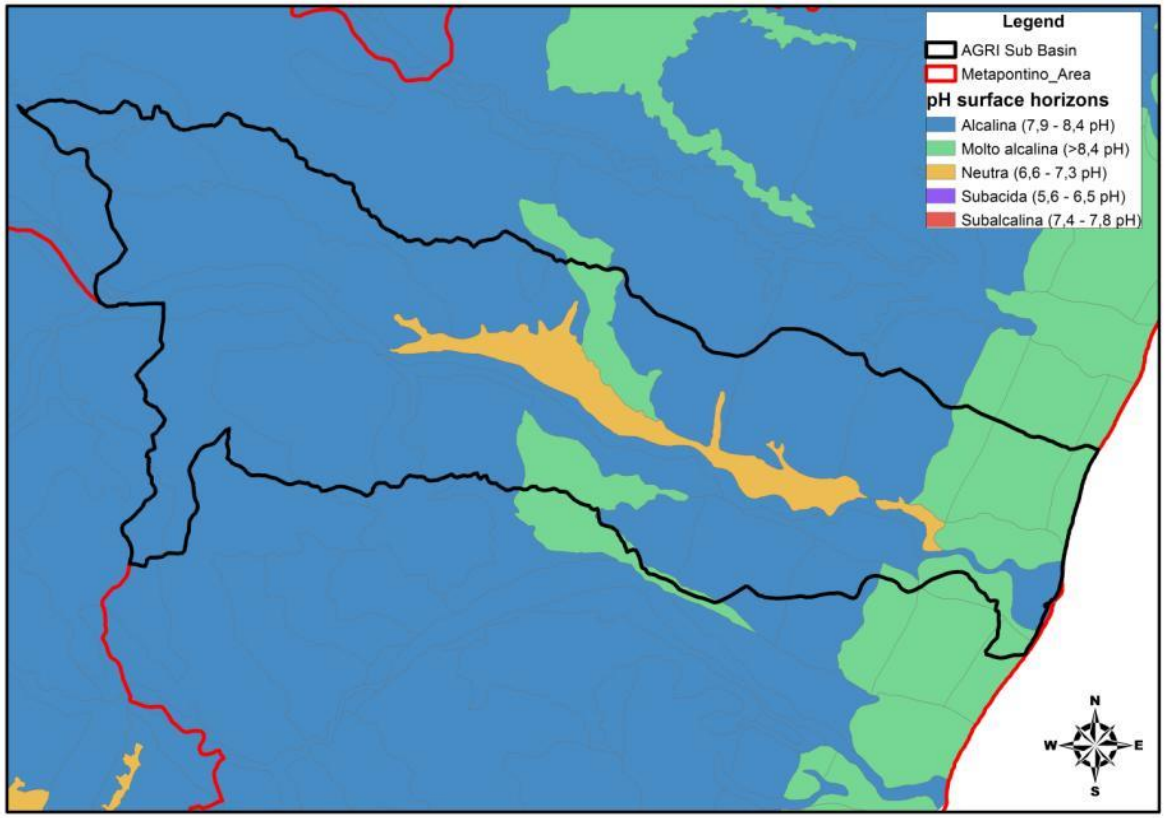


Fig. 172: Pilot sub-basin pH surface horizons

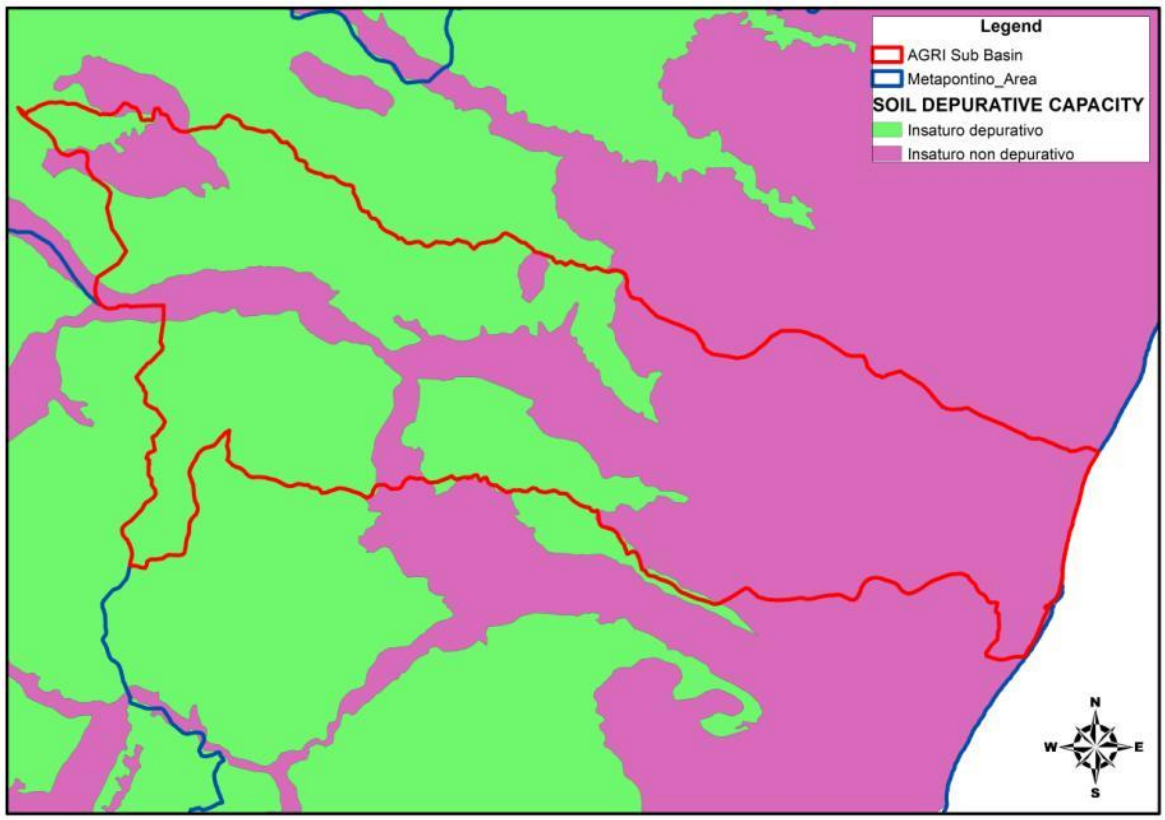


Fig. 173: Pilot sub-basin soil depurative capacity

3.4 MORPHOLOGY AND SLOPES

According to European standard classification Low land (0-200 m) and semi-mountainous areas (200-800 m) are included within the Agri sub-basin (Fig. 174).

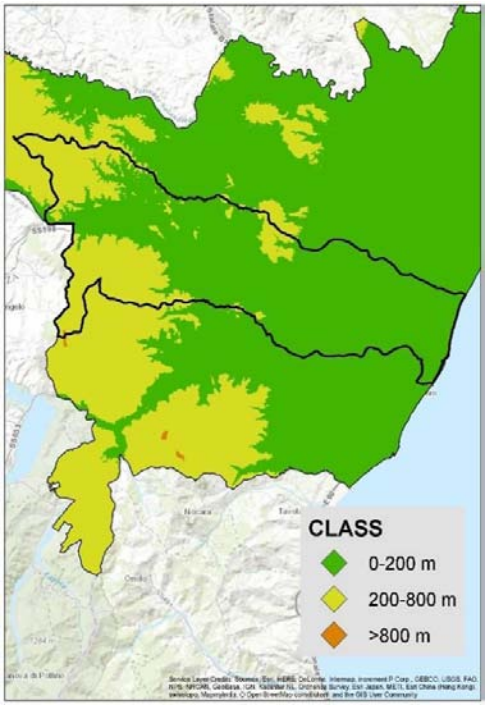


Fig. 174: Pilot sub-basin altimetry map

Agri sub-basin morphology is quite different with a range of slopes from 0 to over 40% (Fig. 175).

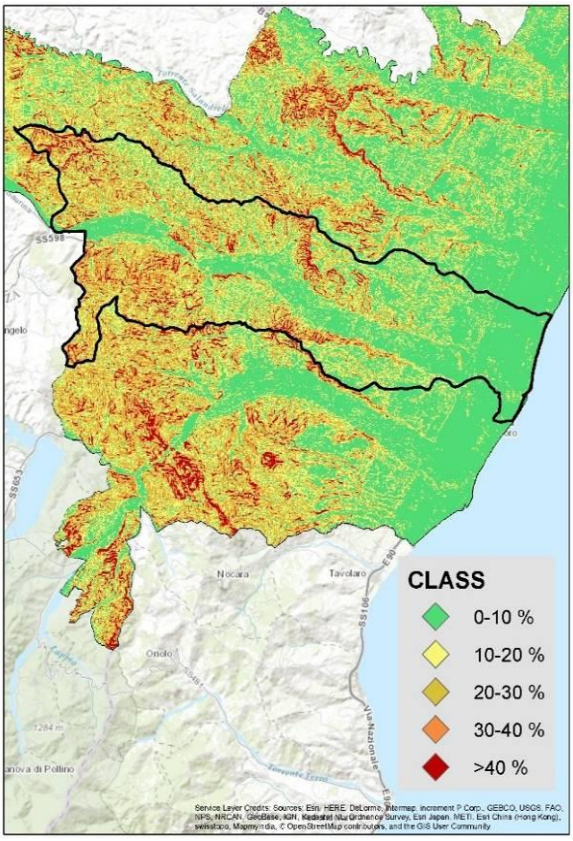


Fig. 175: Pilot sub-basin slopes map

3.5 LAND USES – CULTIVATED AREA AND TYPE OF CROPS CULTIVATED – AGRICULTURAL PRACTICES APPLIED IN RELATION TO WATER

The Agri sub-basin agricultural sector is specialised in fruit and vegetables cultivation, particularly citrus fruit, olive and other orchards (mainly peach and apricot) and vegetables with a total of area 6,326.21 Ha of cultivated land (Table 118).

Table 118: Agri sub-basin crops

Sub basin	Olive (Ha)	Orchards (Ha)	Citrus (Ha)	Sum
Agri Sub Basin	1,778.79	3,701.50	845.92	6,326.21

Apricot and peaches are available with a total of nearly 2,635 Ha; Apricot with 1,464 Ha and peaches with 1,171 Ha. (Radogna F. Et al. 2008).

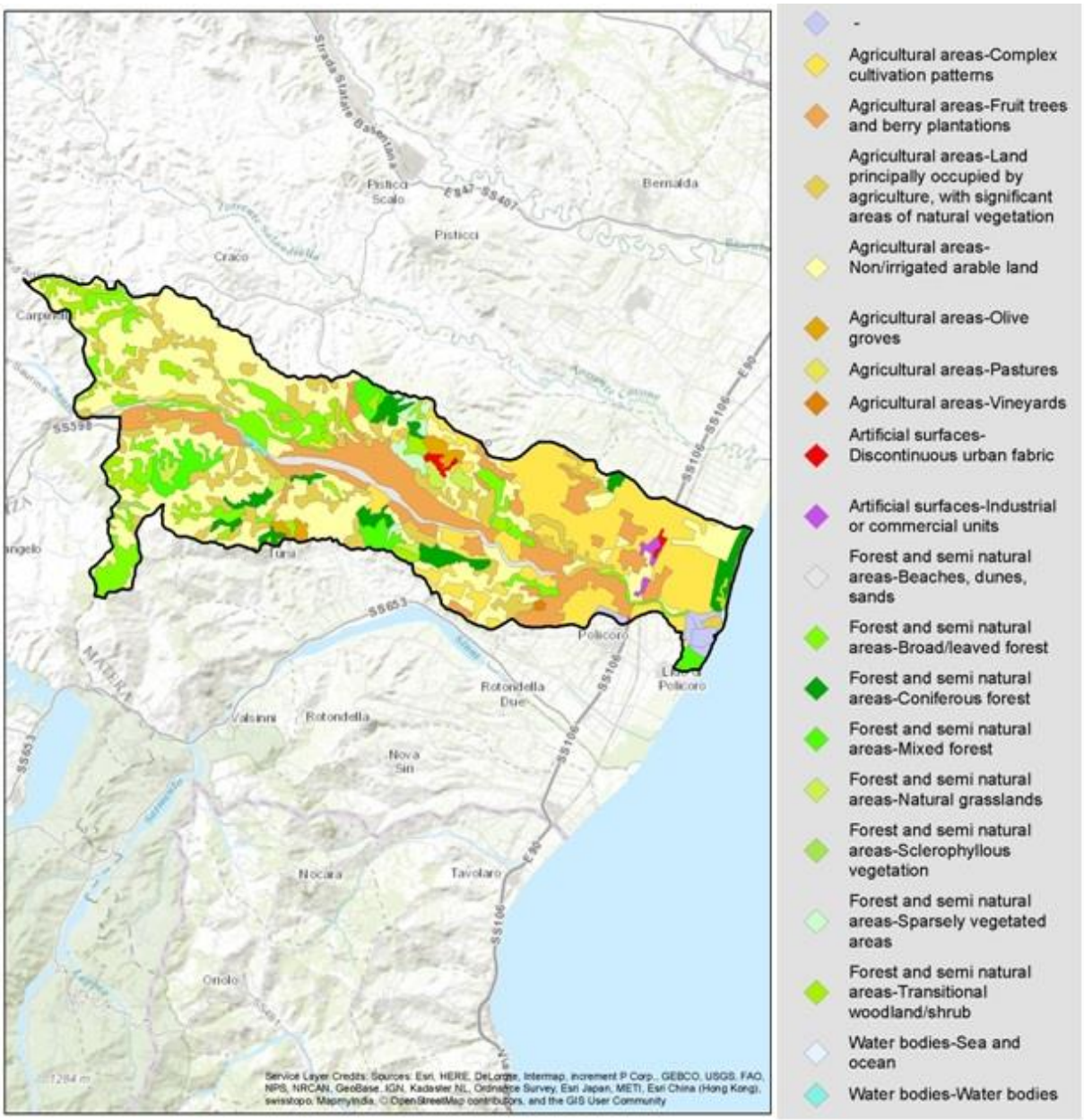


Fig. 176: Pilot sub-basin's land use map

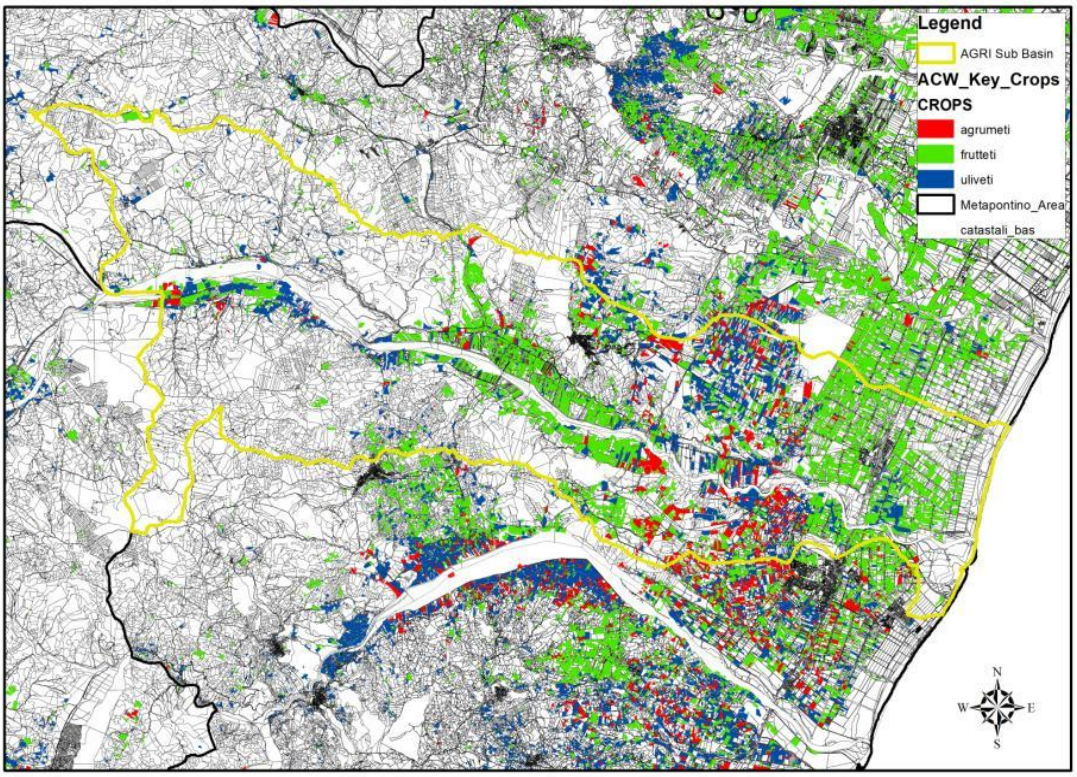


Fig. 177: Pilot sub-basin's key crops map

3.6 HIGH CONSERVATION VALUE AREAS

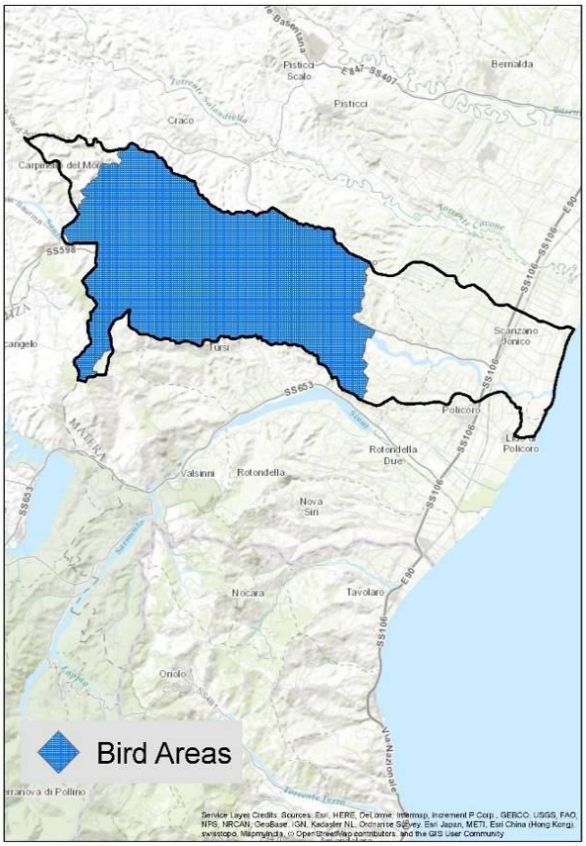


Fig. 178: Agri sub-basin Important Bird Areas (IBA 196)

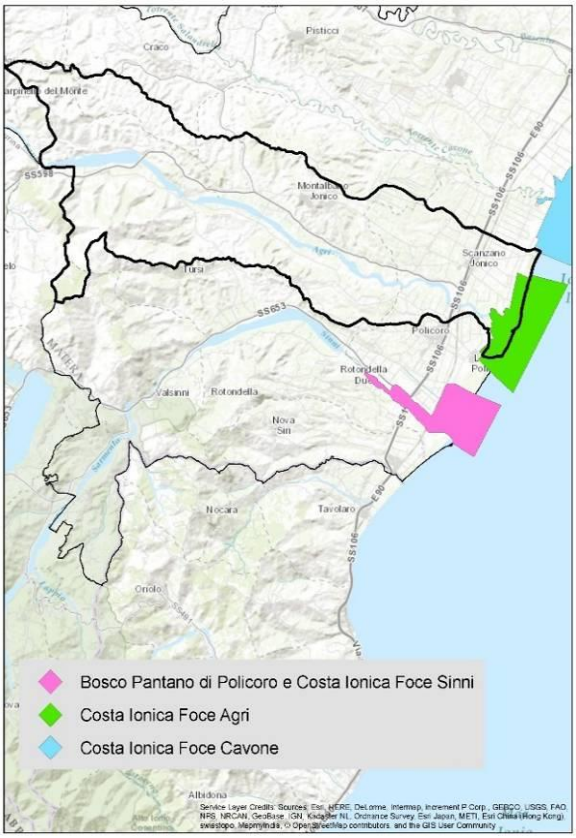


Fig. 179: Agri sub-basin Sites of Community Importance (SCI)

One Site Community Importance (SCI) is located in Agri sub-basin:

- SIC IT9220080 - Ionian coast mouth river Agri

The site, located in the province of Matera at the mouth of the River Agri on the Ionian coast of Basilicata (Gulf of Taranto), covers 845 hectares. The Agri River springs from the sources of Piano del Lago between Monte Maruggio and Monte Lama and flows into the Ionian Sea in municipality of Policoro. The percentage of public property (State Property, Esab) over the entire area of the SCI amounts to 63.42%, which drops to 58.3% because of the presence of land parcels in litigation between private and State Property. The territory of the SCI has an average height of 2 meters above sea level and the geographical coordinates are E 16°43'40" and N 40°12'52" (http://natura2000basilicata.it/).

NOME	Costa Ionica Foce Agri
CODICE	IT9220080
TIPO	B
ESTENSIONE	845 ha
COMUNI	
PROVINCE	
HABITAT	(All. 1 Dir. 92/43/CEE): 2230, 2260, 2250*, 2110, 2120 dettagli »
SPECIE	
NOTE	

Fig. 180:Ionian coast mouth river Agri - SIC IT9220080 (source: http://natura2000basilicata.it)

3.7 RIVER BASINS WITHIN SUB-BASIN AREA

The Agri basin covers 1,730 sq.km, covering 17% of the Basilicata Region, with a small part in the neighbouring Campania Region. The basin can be divided into the Upper, Middle and Lower Agri by both physical–environmental and socio-economic criteria.

The Upper region of the valley, above the Pertusillo reservoir, has an average elevation higher than 600 m, an area of just under 600 sq.km (28% of the catchment area) and is dominated by a valley-floor plain. This region has a population density of 54 inhabitants/sq.km.

The Middle Valley stretches from the Pertusillo reservoir to the confluence of the Sauro and Agri rivers, in municipality of Stigliano, and occupies 47% of the catchment area. This is an area of badlands, called 'calanchi', where the population averages 31 inhabitants/sq.km.

The Lower Agri Valley, stretching from the Sauro junction to the sea, occupies about 25% of the basin and has the highest population density with 72 inhabitants/sq.km. The region includes a fertile coastal zone of Metaponto soils (F. Basso et al., 2000).

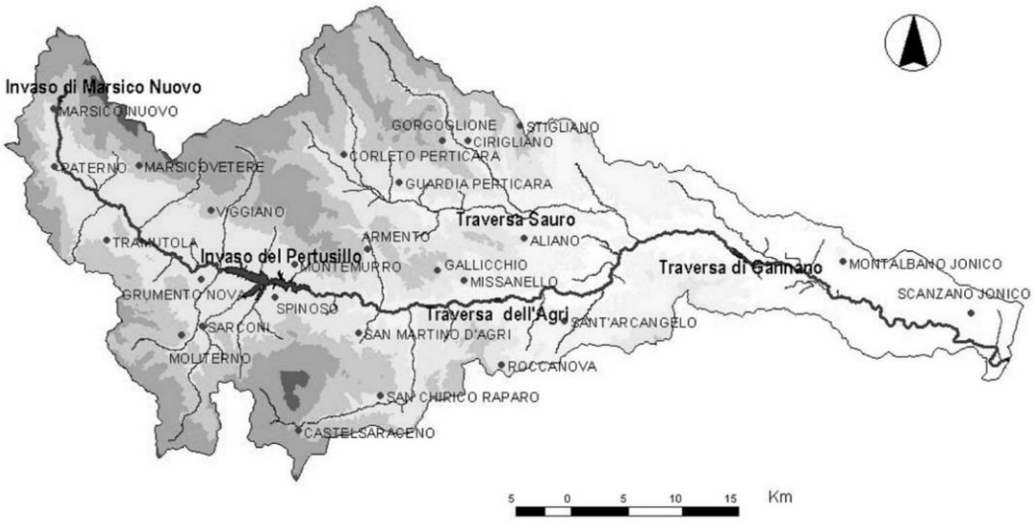


Fig. 181: Agri river Basin (source: Interregional River Basin Authority of Basilicata)

The Agri River springs from the sources of Piano del Lago between Monte Maruggio and Monte Lama, at 1300 m above sea level, and flows into the Ionian Sea, in the municipality of Policoro. It stretches for 132 km, and its basin covers an area of 1730 sq.km. The course of Agri can be divided into two sections: the mountainous section, which goes from the mountain foot to the village of Marsiconuovo, presents significant slopes, and runs through a narrow valley of clay soils. However, the valley, up to the limit of the reservoir from Marsiconuovo Pertusillo, presents lower slopes, which are further reduced below the dam of Pertusillo, where the area is called Val d'Agri. At the mountainous section of Agri river, located in the area of Lagonegro, the geological substratum is characterized by a succession of formations. More specifically, it is a land of Mesozoic clay component (Monte Facito), a prevailing component stone (Limestone with chert, siliceous schists) and siliceous marl. Close to the area of Marsico Nuovo, the valley opens out into a vast plain filled by fluvial - lacustrine deposits, bounded by major tectonic features. While on the left bank the land as described above outcrops, on the right the intense sequences of South Apennines calcareum-related dolomite platform are found. This land is intensely fractured and karstified with successions, where important aquifers are located.
The river flows through sandstone-clay soils from the Pertusillo dam to the confluence with the Raganello stream. In the section between the confluence of "Torrente Sauro" and "Stretta di Gannano", Agri river flows through clay-marl and sandstone soils. In the final section, Agri river flows through clays, sands and conglomerates. Finally, in the section next to the mouth of the river, where meanders have been formed, Agri river is developed in Quaternary deposits marine terraces (Interregional River Basin Authority of Basilicata).

3.8 DESCRIPTION OF RESPONSIBLE BODIES ON WATER SERVICES

The "Consorzio di Bonifica di Bradano e Metaponto" (CBBM) is the main responsible body on water services, concerning agricultural irrigation, within the sub-basin area (Fig. 182).
CBBM is a public legal entity established by Presidential Decree 12.01.1966, resulting from the merger of two existing and neighboring Consortia: Metaponto (1925) and Middle Valley of Bradano (1931). The area of authority of the Consortium coincides with that of the 31 municipalities of the province of Matera and is equal to 344,678 ha. Geographically, it covers the plain of Metaponto with its upstream municipalities, the basins of the rivers Bradano, Basento and Cavone on its West, up to the borders of the province of Matera. The area is characterized by lowland areas of the coastal strip up to the Metaponto terraces that rise to a height of 250-300 m above sea level and by the alluvial plains of the five rivers and hill areas of E-W orientation.
From an economic and agricultural significance point of view, the area is divided in two categories, the Metapontino area that has a potential for development at the national level and the inner land, tending to underdevelopment that includes the mountainous area of the line Ferrandina-Pomarico-Montescaglioso. About 90% of the total irrigated land of Matera is found in Metaponto and accounts for approximately 55% of its area (http://www.bradanometaponto.it/).

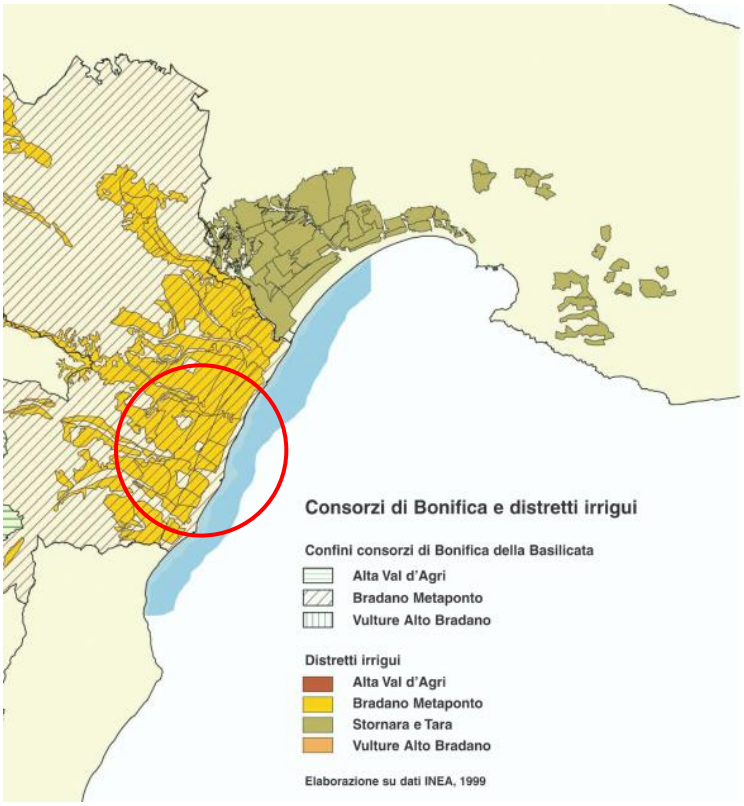


Fig. 182: The main responsible body on water services, CBBM, within the sub-basin area (source: Interregional River Basin Authority of Basilicata)

3.9 WATER CONSUMPTION DATA

Water consumption data is available, at a sub-basin level. The water consumption per water use as well as the volume of drinking water distributed and consumed per municipality is presented on Table 119 and Fig. 183, respectively.

Table 119: Sinni Agri-Scheme Water consumption (source: Interregional River Basin Authority of Basilicata)

Uses	Volumes supplied (Mm^3/y)	Availability [T=5y] (a/y)
Drinking	227.54	
Irrigation	246.5	
Industrial	12.6	
MVO	66.65	
	553.29	795

Municipality	Drinking water introduced into the network (mc)	Drinking water supplied by the network (mc)	Percentage of water supplied to the total water fed into the network
Colobraro	178,585	111,096	62.2
Craco	135,696	69,023	50.9
Montalbano Jonico	1,058,985	829,699	78.3
Policoro	2,025,684	1,784,126	88.1
Stigliano	887,569	469,858	52.9
Tursi	520,102	439,951	84.6
Scanzano Jonico	1,510,589	957,471	63.4
Sum	**6,317,210**	**4,661,224**	

Fig. 183: Drinking water per municipalities (Agri sub-basin)

3.10 IRRIGATION NETWORKS AND METHODS

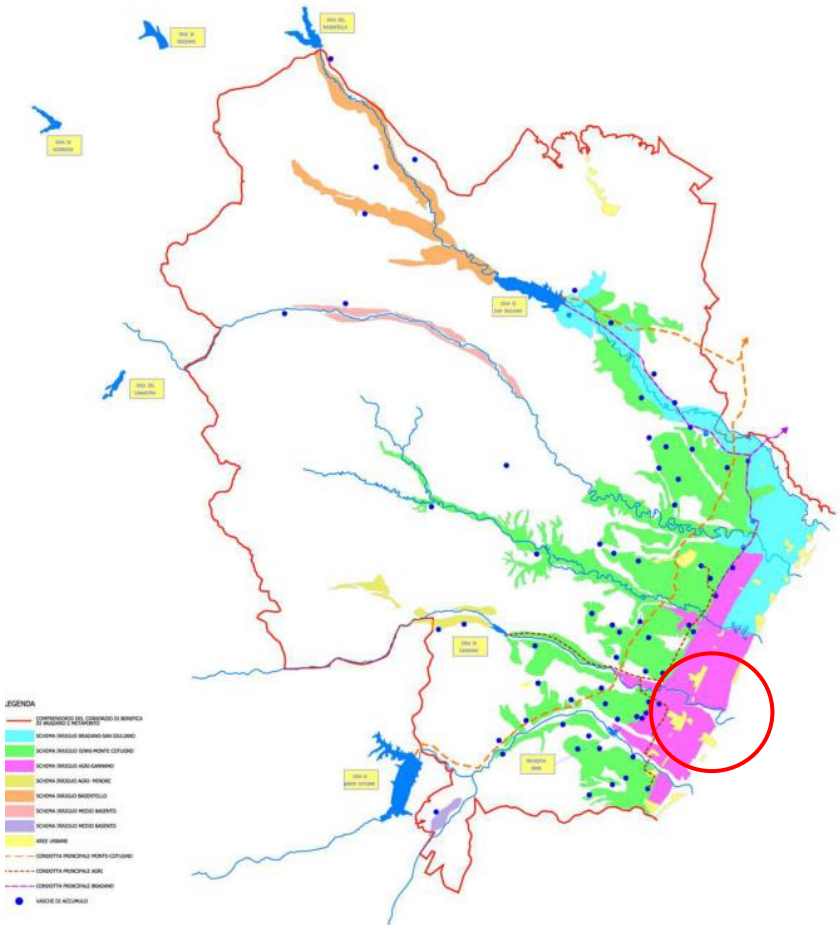


Fig. 184: Agri Sub-basin irrigation scheme (source: Interregional River Basin Authority of Basilicata)

The Ionian-Sinni Scheme has an interregional character and is made out of four main aqueduct systems, linked one to another. It is indeed the most complex and important scheme operating in Basilicata region, because it ensures water supply for multiple uses to a wide area comprising of Basilicata and Apulia Ionian area, Salento (Apulia) and the Ionian area belonging to Calabria region. These four aqueduct systems that constitute this scheme are usually referred to as Sinni, Sinni-Noce, Agri and Lower Bradano. The most important infrastructure existing in the Aqueduct system of Sinni is represented by the Monte Cotugno reservoir, located on Sinni River. This reservoir receives water

flows from its own basin and from the Agri, Sauro and Sarmento weirs, though this last one is not yet finished. The water supply towards areas of Metaponto and Southern Apulia is carried out through a pipeline, called "Canna del Sinni", that starts from M. Cotugno and ends in Nardò (Salento), with an overall development of about 189 Km. The Monte Cotugno dam and the first 133 Km of the main pipeline (up to the Hydraulic point of Monteparano) have been built in several phases, starting from the first half of the seventies. These infrastructures are managed by EIPLI. The Monte Cotugno dam, finished and functioning since 1983, was conceived as a strategic infrastructure to avoid and mitigate an eventual water deficit crisis, for multiple uses, in the coastal plains of Basilicata and Apulia. The water resources stored in this reservoir in Basilicata, Apulia and Calabria, is used for drinking, irrigation and industrial purposes through the Sinni pipeline. At the present state, Sinni pipeline is working up to the Monteparano hydraulic node (TA). For the completion of the scheme, a connection between the Sinni pipeline (Ginosa node) and San Giuliano dam has been made. This infrastructure, called Ginosa pipeline - S. Giuliano Dam, that has never worked because of the damages caused by the earthquake of 1980, was constructed with the aim to transfer water resources from the M. Cotugno reservoir to the S. Giuliano reservoir, often characterized by water deficits, but also in order to serve some irrigation districts (Irrigation and Land Reclamation Consortium of Bradano and Metaponto) located along the direction of the pipeline. The project aimed at restoring and reactivating of this structure, which was included in the Programme of intervention for water sector, referred to as the General State Agreement of 20.12.2002, signed by the Government of Basilicata Region according to the Water Resources Objective Law (Law n. 443 of December 21st 2001)[2]. The Agri Aqueduct system is supplied by Marsico Nuovo, Pietra del Pertusillo and Gannano reservoirs, which catch the Agri river flows. The main node of the scheme is the Pietra del Pertusillo dam. Water supply is allowed by means of a derivation tunnel that forces water to the Missanello power plant, where it is forced into power turbines for energy generation and subsequently partially released in the downstream river basin and partially led to the Missanello water treatment plant, essential for Apulia's drinking water supply. The river flows discharged in the river bed are captured by the Agri weir during winter, that channels them into the M. Cotugno reservoir; while in summer (March to September), these are kept and derived by the accumulation weir of Gannano, placed in the lower basin of Agri river.

3.11 ARGUMENTS ON THE SELECTION OF AGRI SUB- BASIN AS LIFE AGROCLIMAWATER PILOT AREA

The Agri sub-basin adequately satisfies the following selection criteria:

- Availability of data on water abstraction and consumption;
- Acceptance of the project by the F.ORs' farmers and other water users;
- Diversification of parcels and practices within the target area.

Moreover, many farmers located in the Agri sub-basin have already knowledge/ experience in agricultural management systems implementation and took part in other Regional funding projects implemented by UNIBAS and ASSOFRUIT.

Within the pilot area (Agri sub-basin) 10 pilot farms will be selected, where the Agricultural Practices proposed by AgroClimaWater will be demonstrated to enhance water efficiency and adaptability to climate change on the field.

[2] Interregional River Basin Authority of Basilicata

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