WP3

Deliverable 3.1.4

Upgrade of the DSS model (1)

Soil Maps of Land Reclamation Organizations

Interreg V- A
Greece-Italy
Programme
2014 2020

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IR2MA
Large Scale Irrigation Management Tools for Sustainable Water Management in Rural Areas and Protection of Receiving Aquatic Ecosystems

Subsidy Contract No: I1/2.3/27

Project co-funded by
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Partners

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PB2 REGION of EPIRUS (ROE) http://www.php.gov.gr/

PB2 ISTITUTO SCIENZE DELLE PRODUZIONI ALIMENTARI (ISPA/CNR) http://www.ispacnr.it/

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Notes

D3.1.4(a): Upgrade of the DSS model - Soil Maps of Land Reclamation Organizations

Involved partners:

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1 Introduction

This report presents soil information for the Land Reclamation Organizations (LROs) that are involved in the IR_2MA project (Table 1).

Table 1 Land Reclamation Organizations (LROs)

No	Name	Location
1	Acherontas	Preveza
2	Poros	Ioannina
3	Mpoida Mavri	Preveza
4	Kestrinis Ragiou	Thesprotia
5	Vrisellas	Thesprotia
6	Parapotamos	Thesprotia
7	Anatolis	Ioannina
8	Krias Lapsistas	Ioannina
9	Ano Kalama	Ioannina
10	Vasilikou	Ioannina
11	Klidonias	Ioannina
12	Kallithea	Ioannina
13	Konitsa	Ioannina

This information is about soil properties related to irrigation, such as texture, soil moisture at three characteristic levels i.e. Field Capacity, Permanent Wilting Point and Saturation.

The soil texture distribution is presented in Tables 2 to 14, including the area of each class in hectares (ha), along with its percentage compared to the total area. The soil moisture information, i.e. Field Capacity, Permanent Wilting Point and Saturation, are presented in $m^3\ m^{-3}$ for each LRO in Figures 3 to 41 and they are following the implementation of Twarakavi et al., 2009.

The following information is based on the results of the soil analyses performed in the context of the project: "New Land: An integrated information geographic framework for supporting the primary sector in Epirus, Soil analysis", in areas of Epirus, mainly irrigated, in the four prefectures (Arta, Thesprotia, Ioannina and Preveza) (TEI of Epirus, 2007; Misopolinos et al., 2008).

2 Soil water properties

The basic soil properties that are involved in irrigation scheduling are presented. The following properties can be estimated using the corresponding maps of the thirteen Land Reclamation Organizations.

2.1 Soil moisture content

The soil moisture content indicates the amount of water present in the soil. It is commonly expressed as the amount of water (in mm of water depth) present in a depth of one meter of soil. The soil moisture content can also be expressed in percent of volume or percent of weight i.e. volumetric or gravimetric soil moisture.

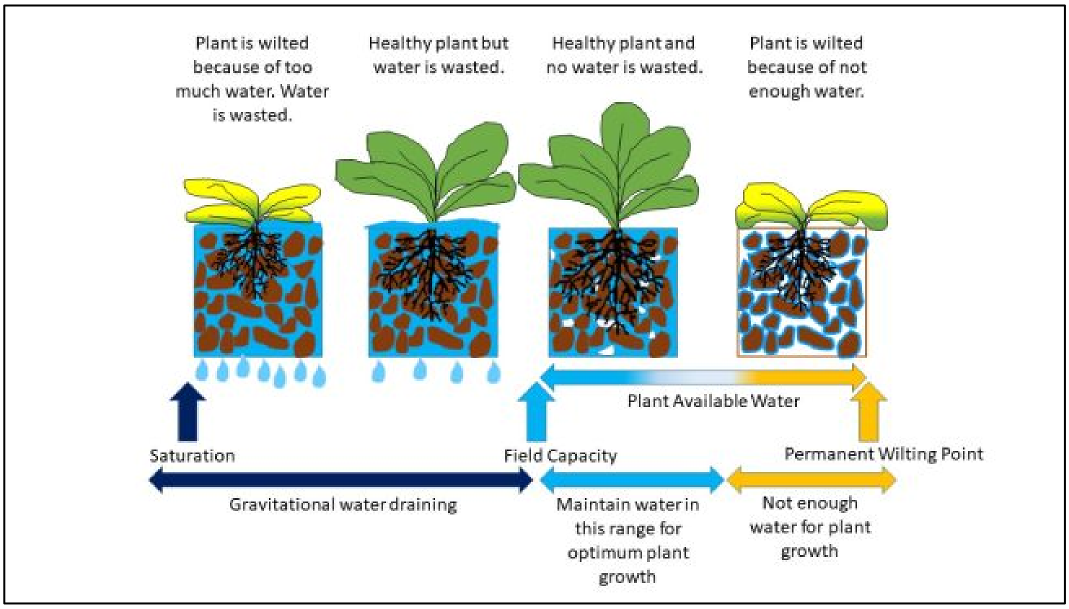

Fig. 1 Soil water and plant growth

2.2 Saturation and percolation

During a rain shower or irrigation application, the soil pores will fill with water. If all soil pores are filled with water the soil is said to be saturated. There is no air left in the soil. However, plants need air and water in the soil. At saturation, no air is present and the plant will suffer. Many crops cannot withstand saturated soil conditions for a period of more than 2-5 days. Rice is one of the exceptions to this rule. The period of saturation of the topsoil usually does not last long. After the rain or the irrigation has stopped, part of the water present in the larger pores will move downward. This process is called drainage or percolation.

The water drained from the pores is replaced by air. In coarse textured (sandy) soils, drainage is completed within a period of a few hours. In fine textured (clayey) soils, drainage may take some (2-3) days.

2.3 Field capacity

After the drainage has stopped, the large soil pores are filled with both air and water while the smaller pores are still full of water. At this stage, the soil is said to be at field capacity. At field capacity, the water and air contents of the soil are considered ideal for crop growth.

2.4 Permanent wilting point

As the water stored in the soil is taken up by the plant roots or evaporated from the topsoil into the atmosphere. If no additional water is supplied to the soil, it gradually dries out.

The dryer the soil becomes, the more tightly the remaining water is retained and the more difficult it is for the plant roots to extract it. At a certain stage, the uptake of water is not sufficient to meet the plant's needs. The plant looses freshness and wilts; the leaves change colour from green to yellow and finally the plant dies.

The soil water content at the stage where the plant dies, is called permanent wilting point. The soil still contains some water, but it is too difficult for the roots to remove it from the soil.

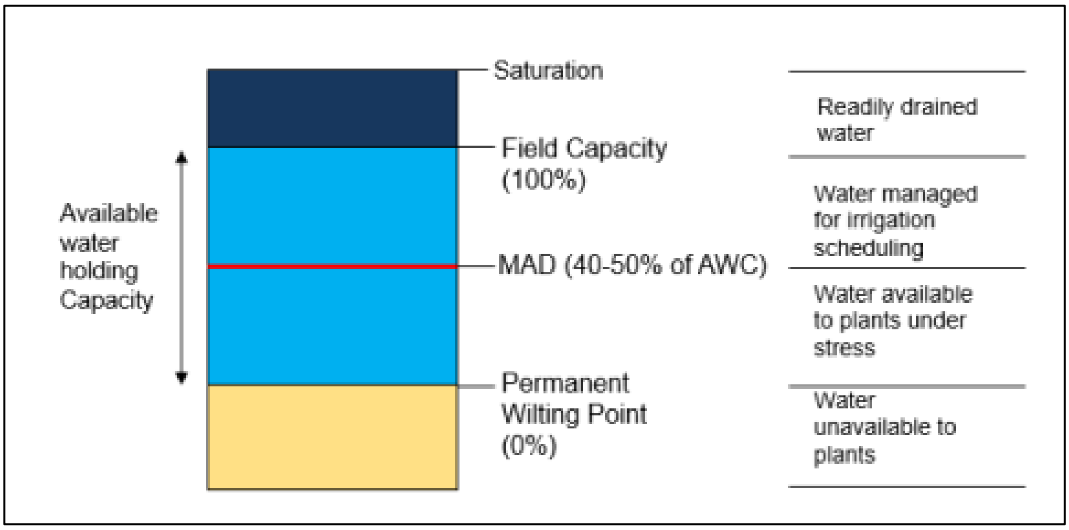

Fig. 2 Soil water reservoir components

2.5 Available water content

The soil can be compared to a water reservoir for the plants. When the soil is saturated, the reservoir is full. However, some water drains rapidly below the rootzone before the plant can use it. When this water has drained away, the soil is at field capacity. The plant roots draw water from what remains in the reservoir. When the soil reaches permanent wilting point, the remaining water is no longer available to the plant.

The amount of water actually available to the plant is the amount of water stored in the soil at field capacity minus the water that will remain in the soil at permanent wilting point.

2.6 Maximum allowable depletion or deficit (MAD)

Management allowable depletion specifies the maximum amount of soil water the irrigation manager chooses to allow the crop to extract from the active rooting zone between irrigations. Only a portion of the available water holding capacity is easily used by the crop before crop water stress develops. So, soil's MAD is less than its total available water content.

2.7 Soil water deficit

This is the amount of water removed by the crop from the active rooting depth. Likewise, it is the amount of water required to refill the root zone to bring the current soil moisture conditions to field capacity. Soil water decreases as the crop uses water (evapotranspiration) and increases as precipitation (rainfall or irrigation) is added. Expressed in soil water deficit, evapotranspiration increases the deficit and precipitation decreases it. It is usually expressed in millimeters of water and can be estimated or measured by several methods.

For irrigation scheduling, whenever the soil water deficit is equal to or higher than MAD, irrigation should be triggered. Irrigation amounts should be refilling the rooting zone to field capacity while also leaving some room for possible precipitation.

3 Land Reclamation Organization of Acherontas

3.1 Soil texture distribution

Table 2 Soil texture distribution - Acherontas

Texture	Area (ha)	Percentage of the total
Clay	2502.6	40.9%
Silty Clay	2244.5	36.7%
Clay Loam	542.1	8.9%
Silty Clay Loam	461.5	7.5%
Sandy Loam	361.2	5.9%
Loam	11.5	0.2%
Total	**6123.4**	**100.0%**

3.2 Maps of soil hydraulic properties (1:50000)

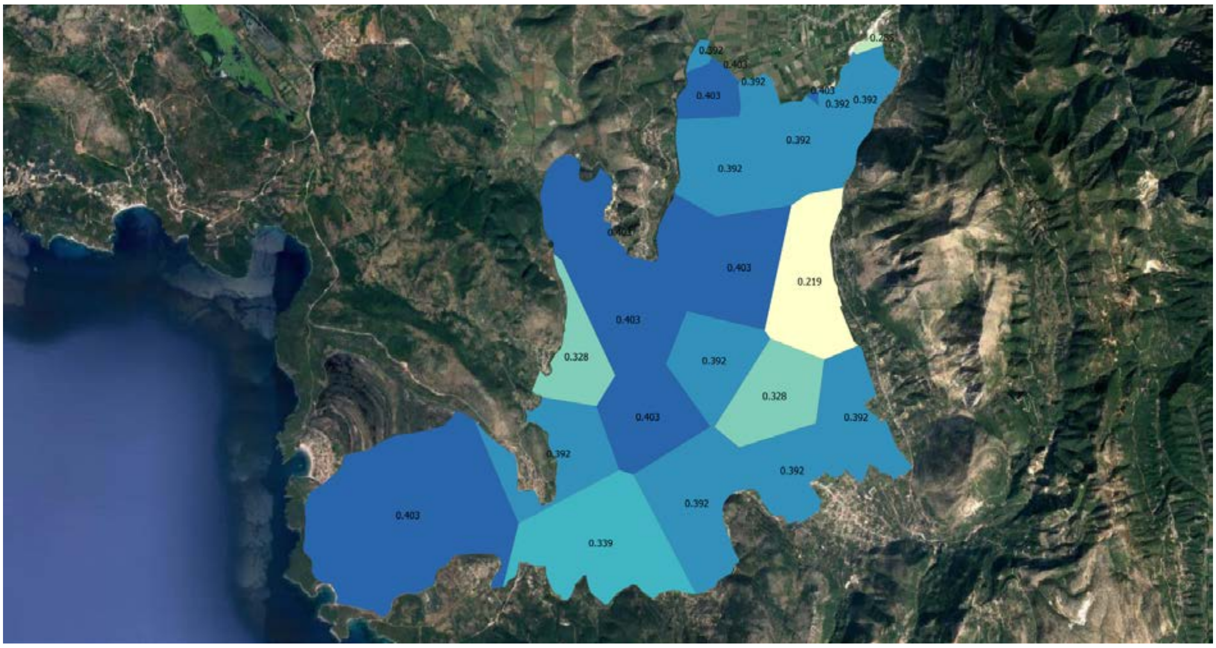

Fig. 3 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Acherontas

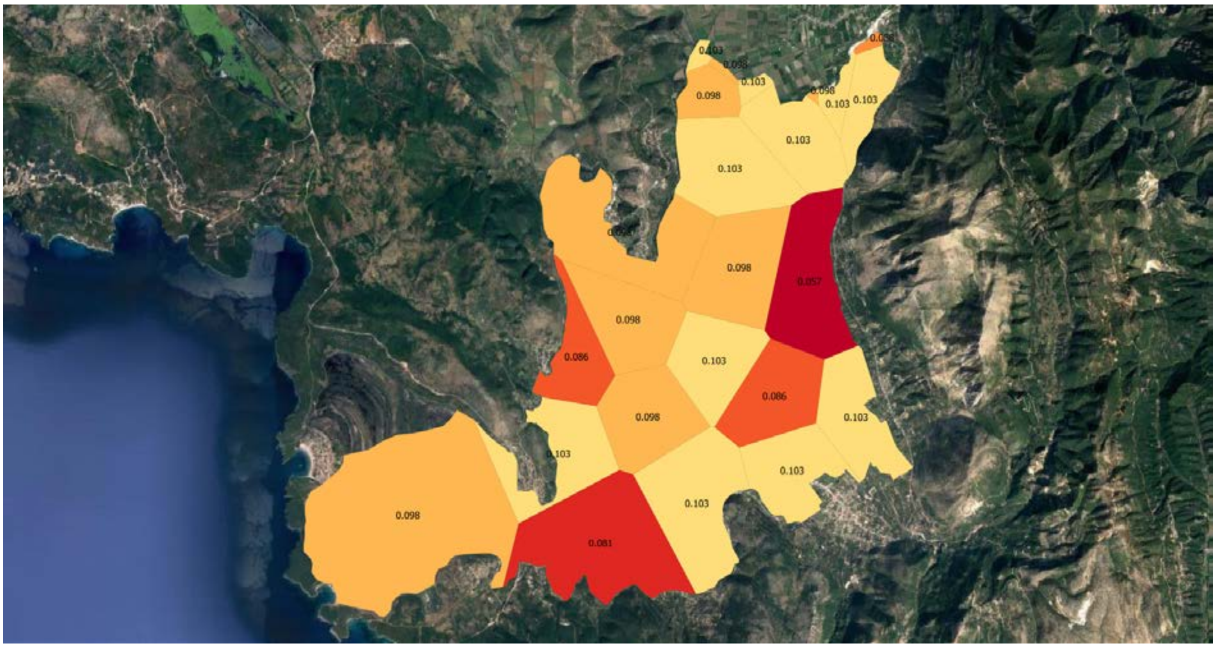

Fig. 4 Soil moisture at Permanent Wilting Point ($m^3\ m^{-3}$) - Acherontas

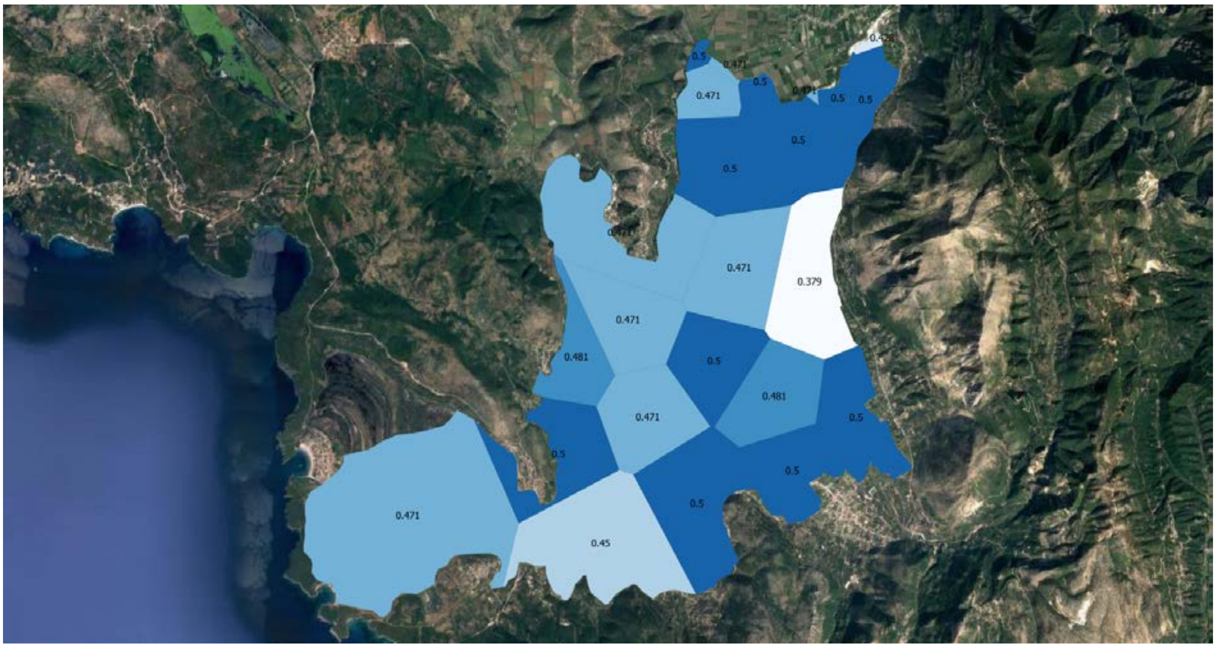

Fig. 5 Soil moisture at Saturation ($m^3\ m^{-3}$) - Acherontas

4 Land Reclamation Organization of Poros

4.1 Soil texture distribution

Table 3 Soil texture distribution - Poros

Texture	Area (ha)	Percentage of the total
Loam	1036.1	54.4%
Clay Loam	546	28.7%
Clay	153.5	8.1%
Silty Clay	94.6	5.0%
Silt Loam - Loam	74.2	3.9%
Total	**1904.4**	**100.0%**

4.2 Maps of soil hydraulic properties (1:50000)

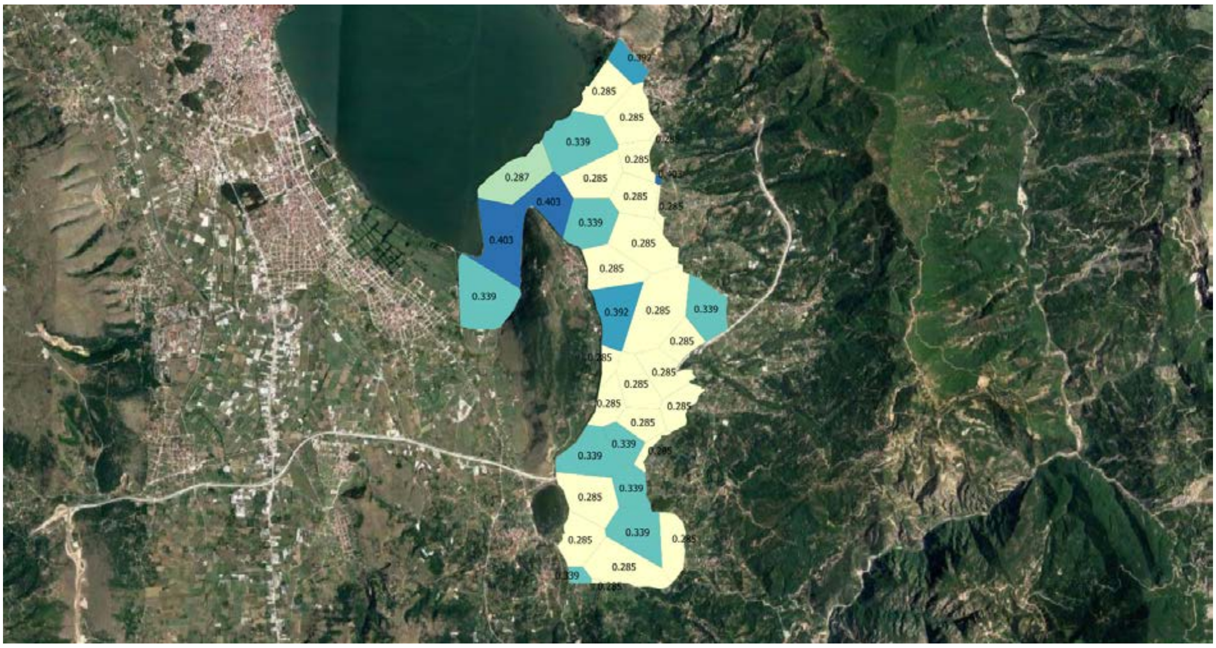

Fig. 6 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Poros

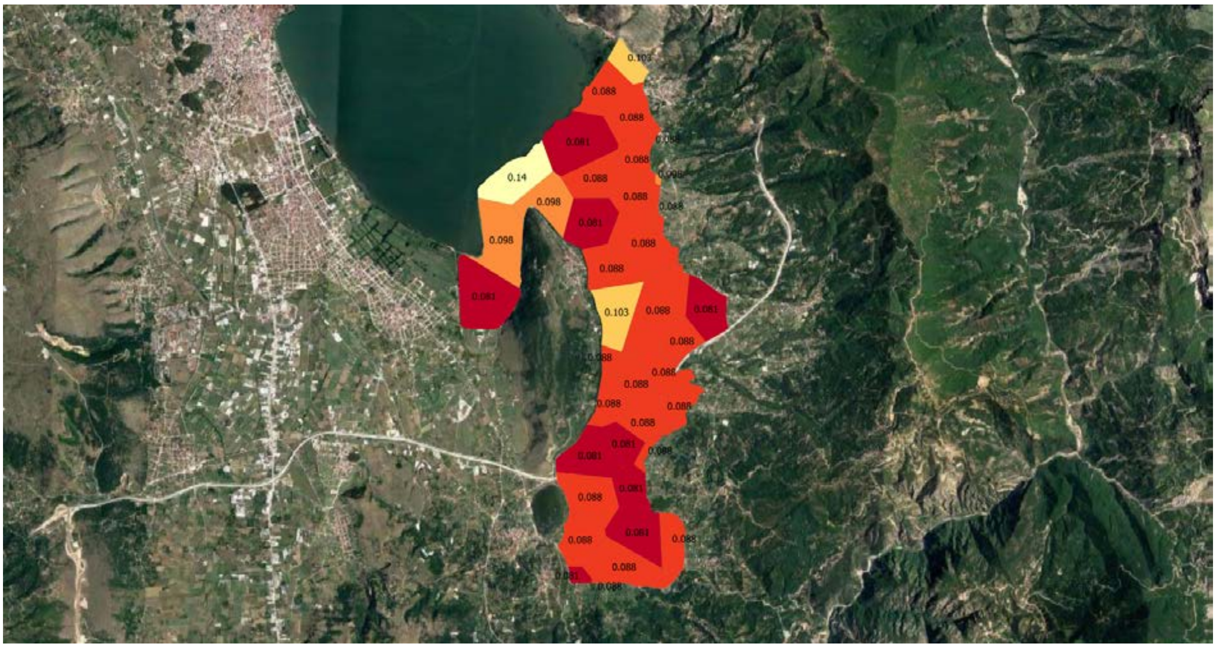

Fig. 7 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Poros

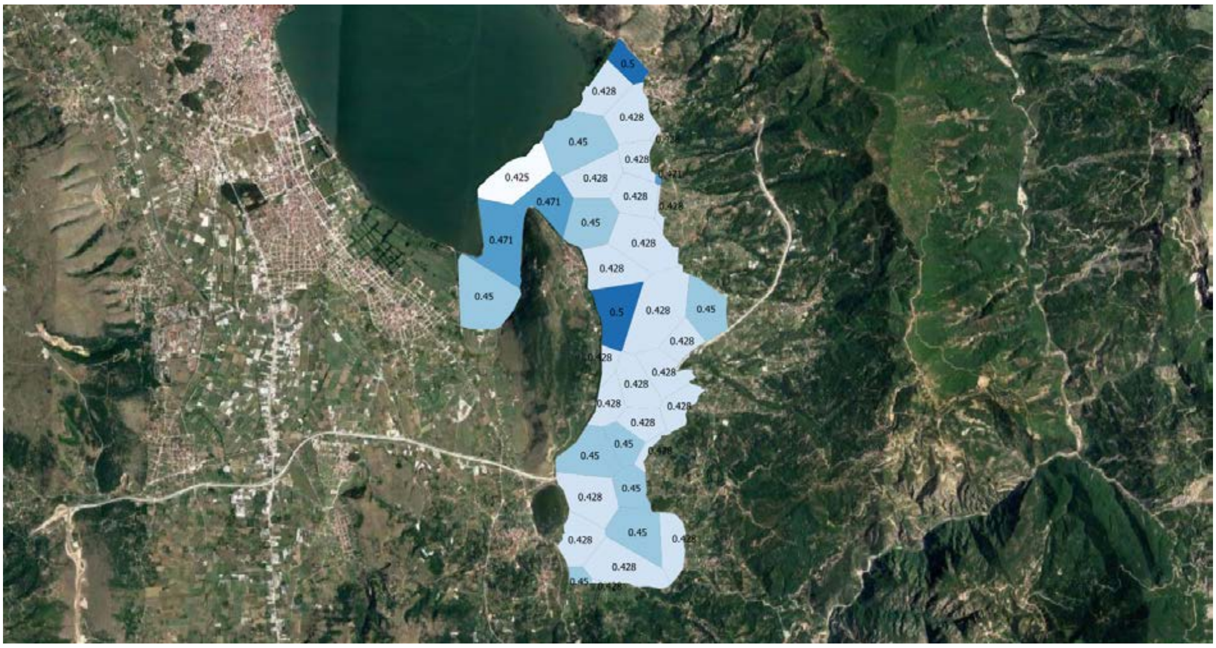

Fig. 8 Soil moisture at Saturation (m^3 m^{-3}) - Poros

5 Land Reclamation Organization of Mpoida Mavri

5.1 Soil texture distribution

Table 4 Soil texture distribution - Mpoida Mavri

Texture	Area (ha)	Percentage of the total
Loam	1036.1	54.4%
Clay Loam	546	28.7%
Clay	153.5	8.1%
Silty Clay	94.6	5.0%
Silt Loam - Loam	74.2	3.9%
Total	**1904.4**	**100.0%**

5.2 Maps of soil hydraulic properties (1:50000)

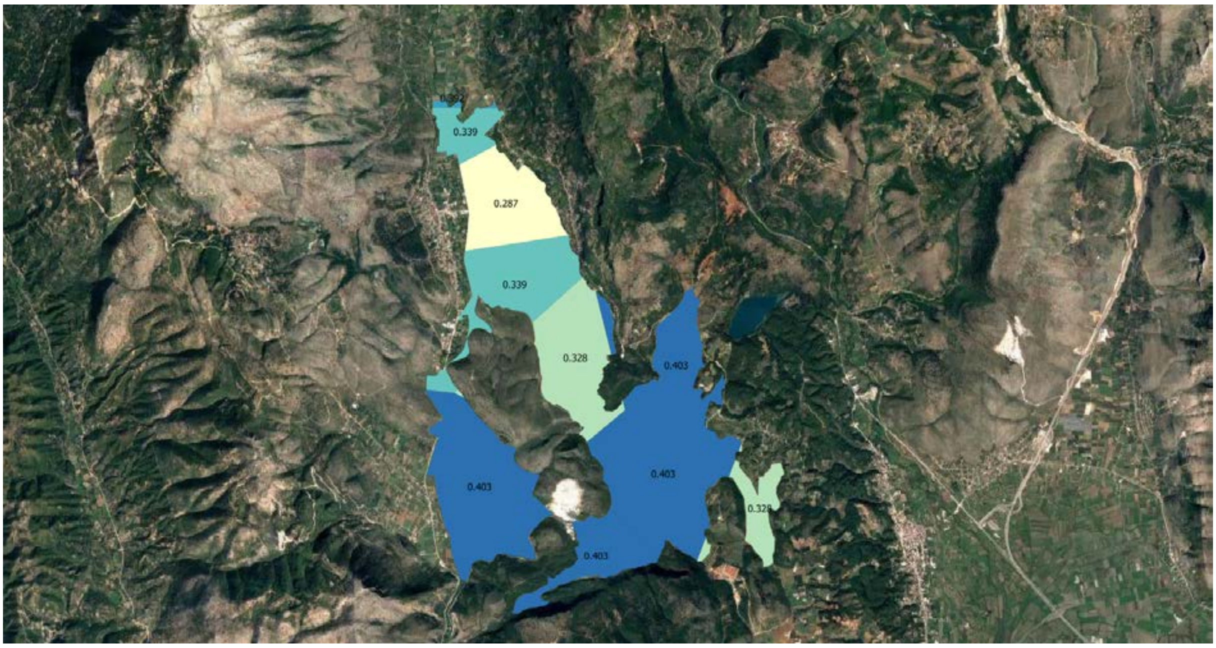

Fig. 9 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Mpoida Mavri

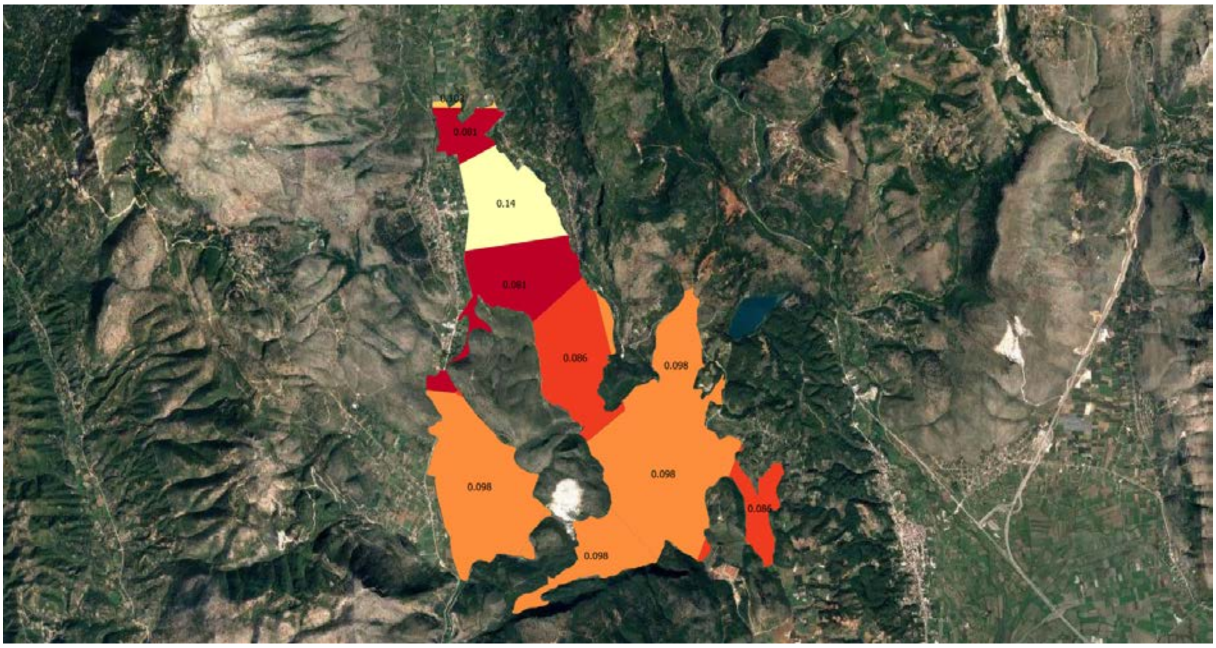

Fig. 10 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Mpoida Mavri

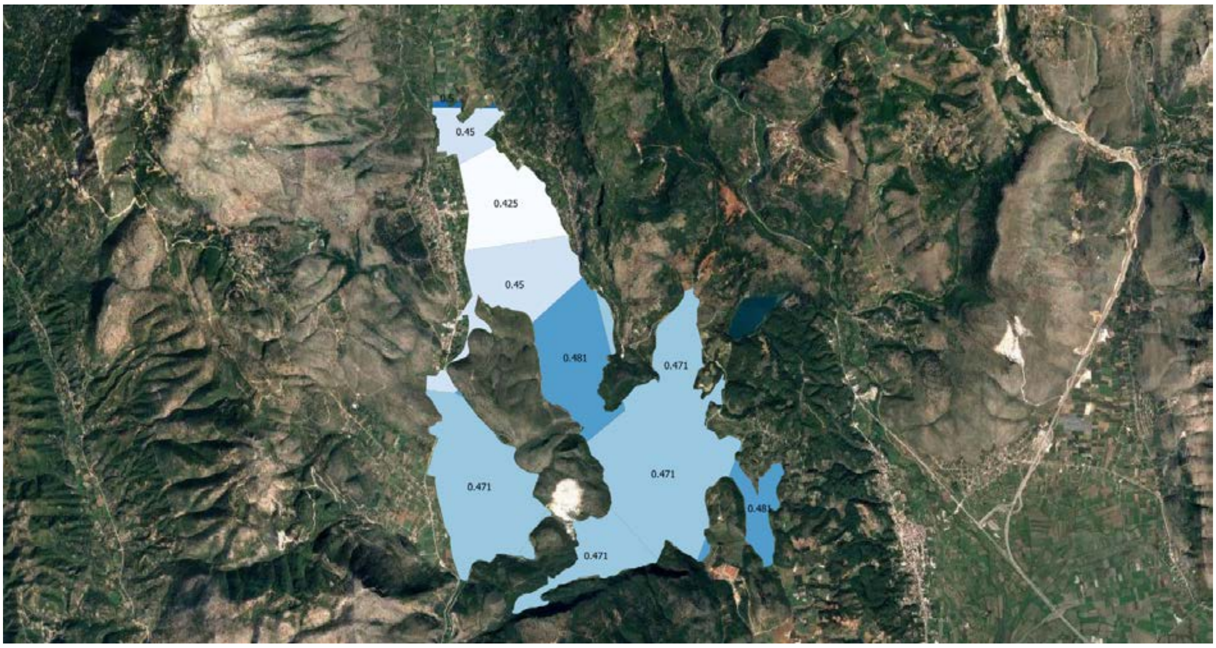

Fig. 11 Soil moisture at Saturation (m^3 m^{-3}) - Mpoida Mavri

6 Land Reclamation Organization of Kestrinis Ragiou

6.1 Soil texture distribution

Table 5 Soil texture distribution - Kestrinis Ragiou

Texture	Area (ha)	Percentage of the total
Silty Clay Loam	996.9	40.1%
Silt Loam	527.8	21.3%
Clay	357.9	14.4%
Silty Clay	343.7	13.8%
Loam	257.2	10.4%
Total	**2483.5**	**100.0%**

6.2 Maps of soil hydraulic properties (1:50000)

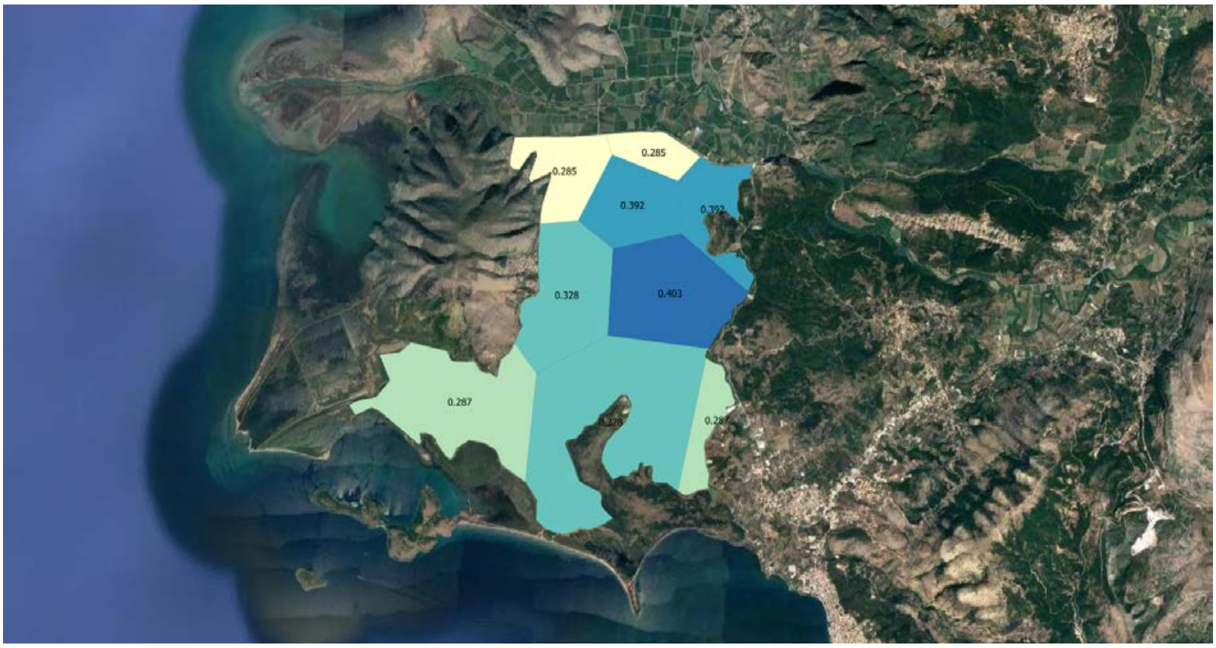

Fig. 12 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Kestrinis Ragiou

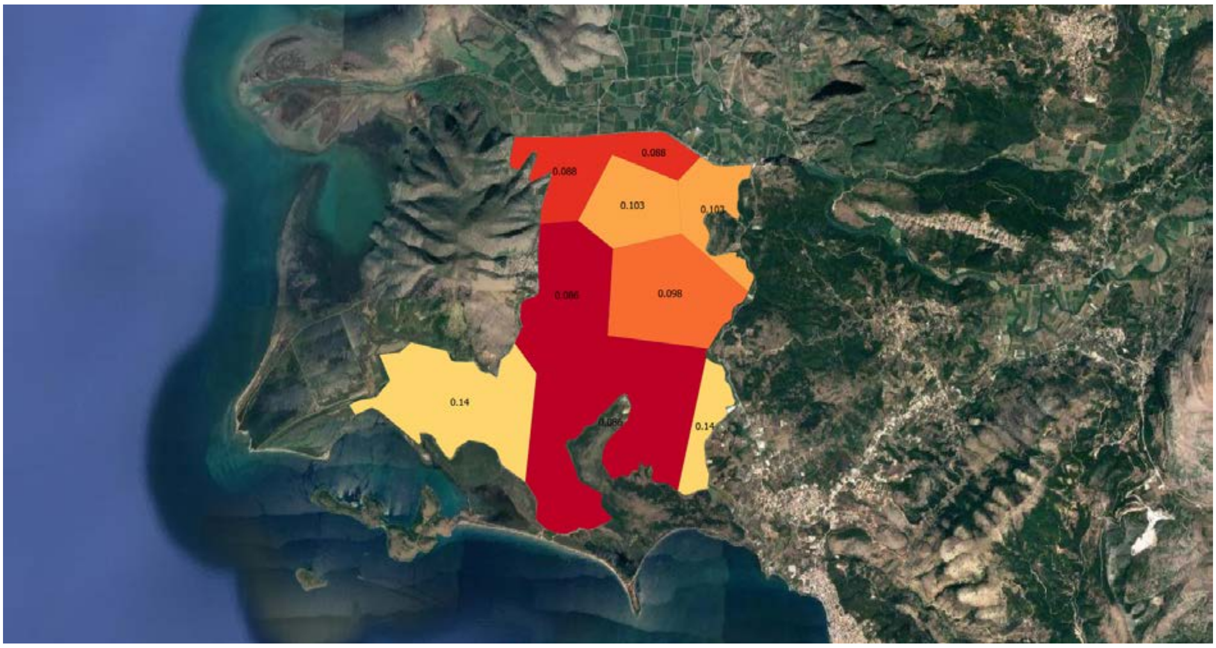

Fig. 13 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Kestrinis Ragiou

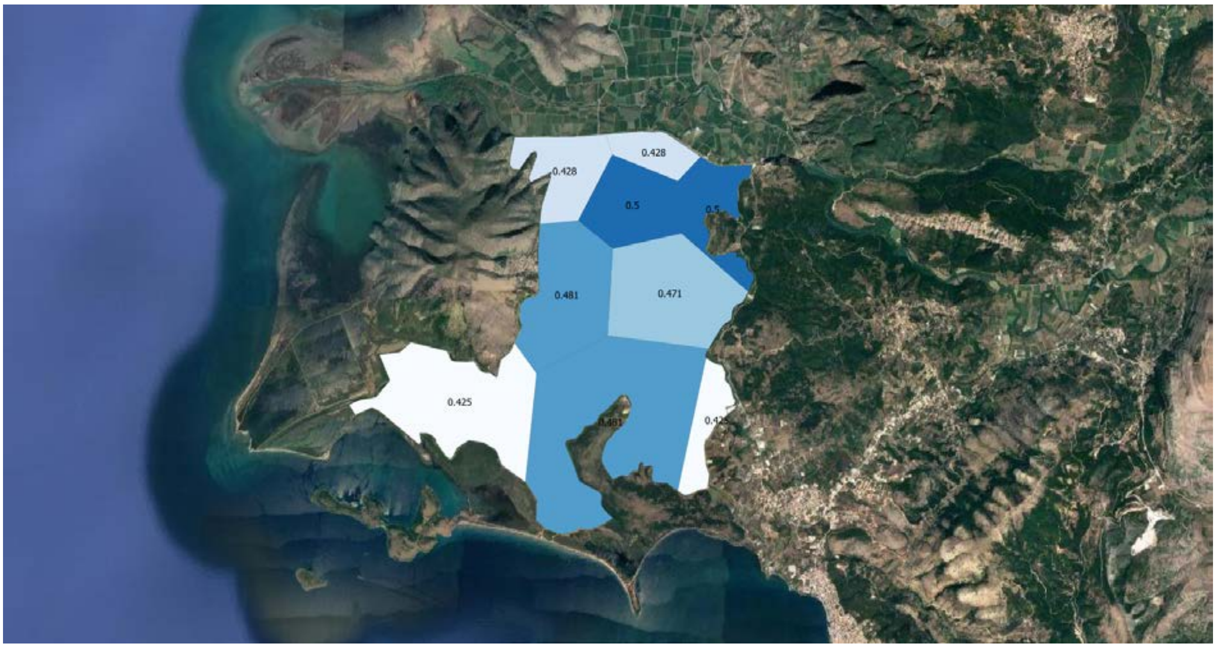

Fig. 14 Soil moisture at Saturation (m^3 m^{-3}) - Kestrinis Ragiou

7 Land Reclamation Organization of Vrisellas

7.1 Soil texture distribution

Table 6 Soil texture distribution - Vrisellas

Texture	Area (ha)	Percentage of the total
Sandy Clay Loam	111.5	100.0%
Total	**111.5**	**100.0%**

7.2 Maps of soil hydraulic properties (1:25000)

Fig. 15 Soil moisture at Field Capacity (m^3 m^{-3}) - Vrisellas

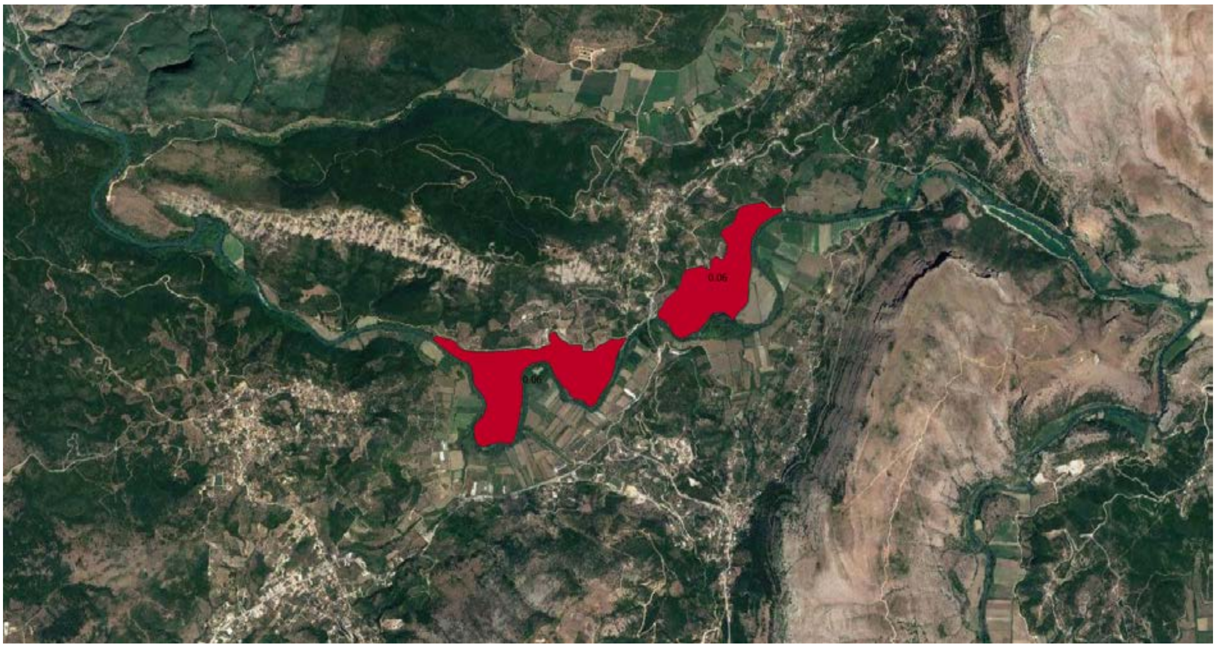

Fig. 16 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Vrisellas

Fig. 17 Soil moisture at Saturation (m^3 m^{-3}) - Vrisellas

8 Land Reclamation Organization of Parapotamos

8.1 Soil texture distribution

Table 7 Soil texture distribution - Parapotamos

Texture	Area (ha)	Percentage of the total
Sandy Clay Loam	168.7	79.2%
Clay Loam	44.4	20.8%
Total	**213.1**	**100.0%**

8.2 Maps of soil hydraulic properties (1:25000)

Fig. 18 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Parapotamos

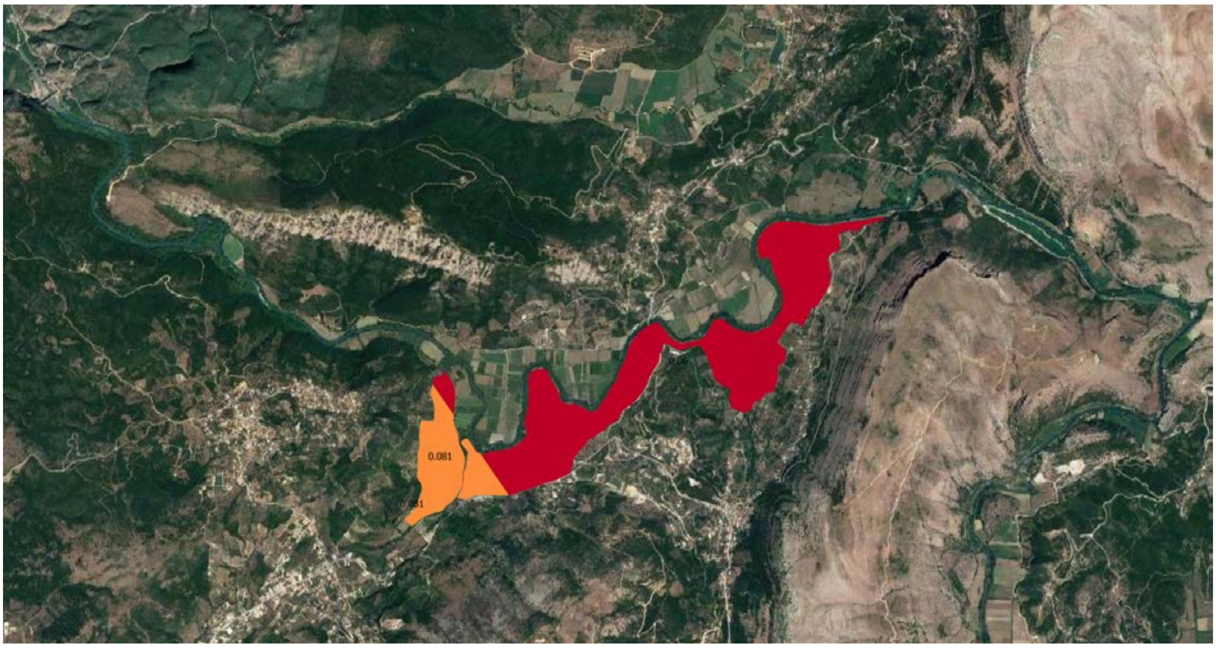

Fig. 19 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Parapotamos

Fig. 20 Soil moisture at Saturation (m^3 m^{-3}) - Parapotamos

9 Land Reclamation Organization of Anatolis

9.1 Soil texture distribution

Table 8 Soil texture distribution - Anatolis

Texture	Area (ha)	Percentage of the total
Clay	459.2	55.9%
Loam	229.6	27.9%
Sandy Clay Loam	69	8.4%
Clay Loam	64.1	7.8%
Total	**821.9**	**100.0%**

9.2 Maps of soil hydraulic properties (1:50000)

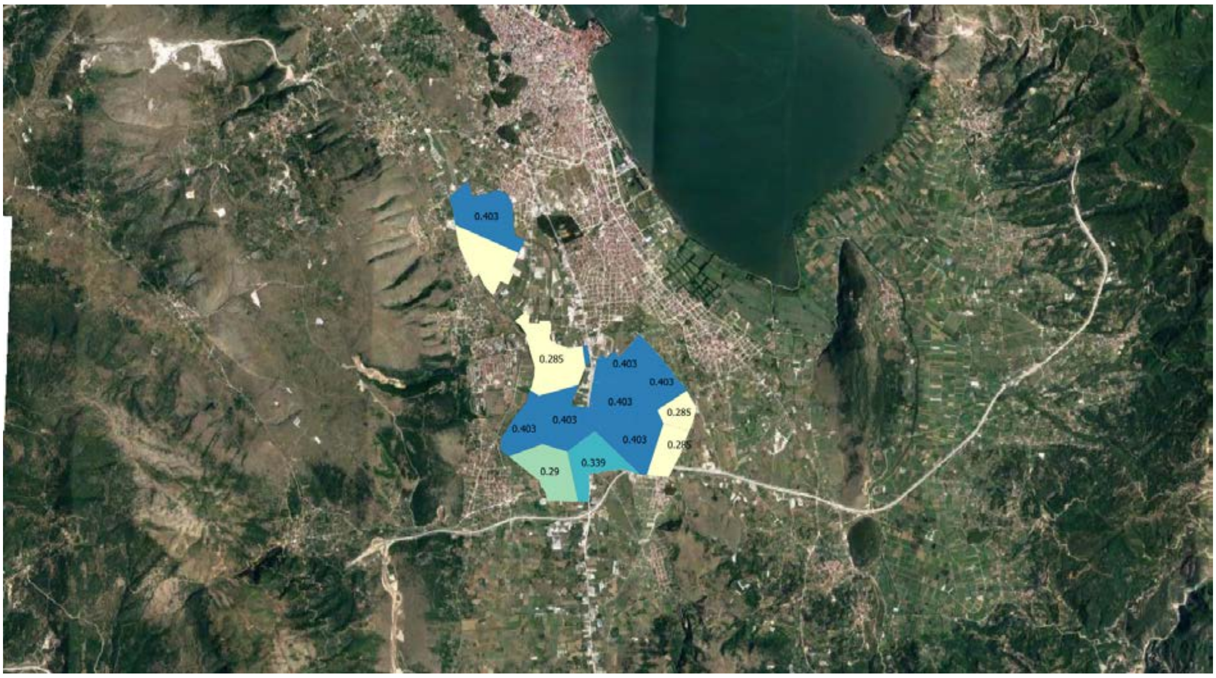

Fig. 21 Soil moisture at Field Capacity (m^3 m^{-3}) - Anatolis

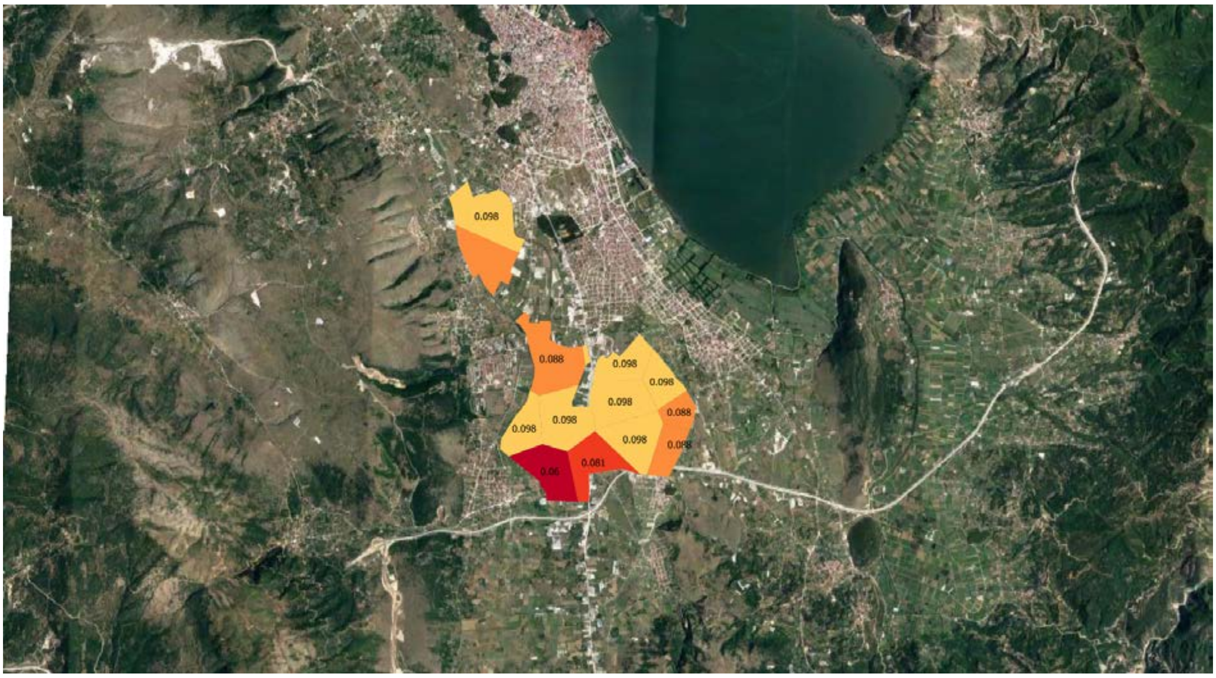

Fig. 22 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Anatolis

Fig. 23 Soil moisture at Saturation (m^3 m^{-3}) - Anatolis

10 Land Reclamation Organization of Krias Lapsistas

10.1Soil texture distribution

Table 9 Soil texture distribution - Krias Lapsistas

Texture	Area (ha)	Percentage of the total
Clay	1674.8	47.2%
Clay Loam	937.0	26.4%
Silty Clay	693.8	19.6%
Sandy Loam	82.3	2.3%
Sandy Clay Loam	81.7	2.3%
Sandy Clay	77.7	2.2%
Total	**3547.3**	**100.0%**

10.2Maps of soil hydraulic properties (1:50000)

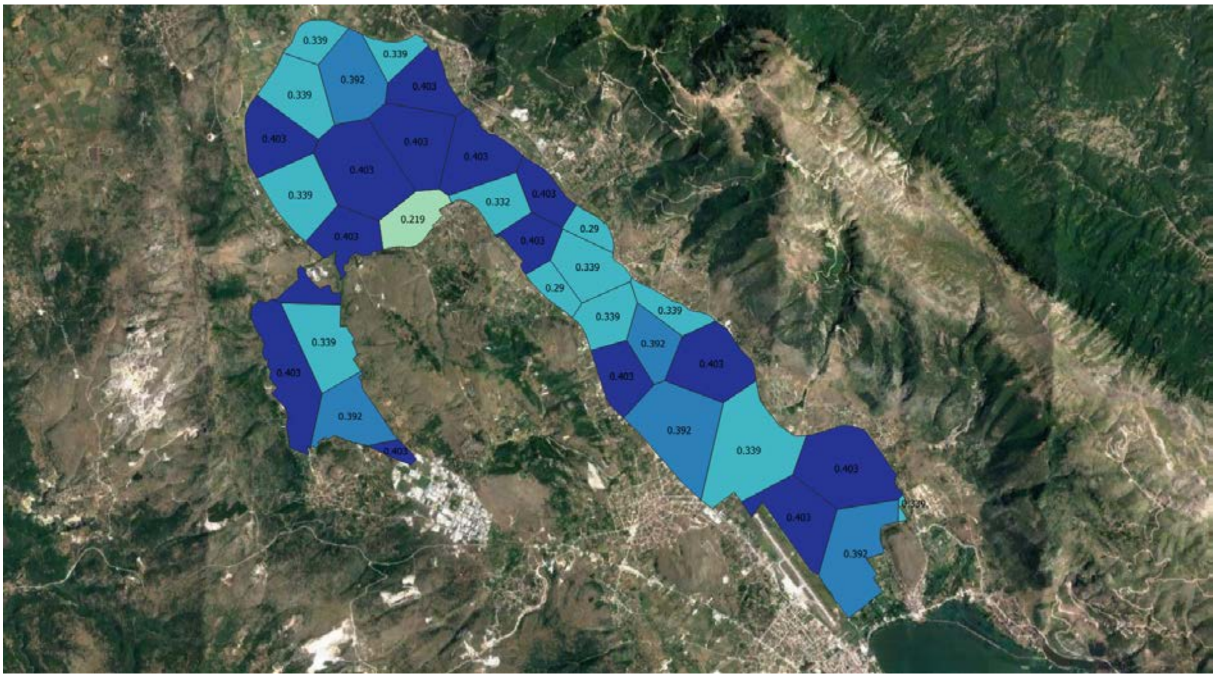

Fig. 24 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Krias Lapsistas

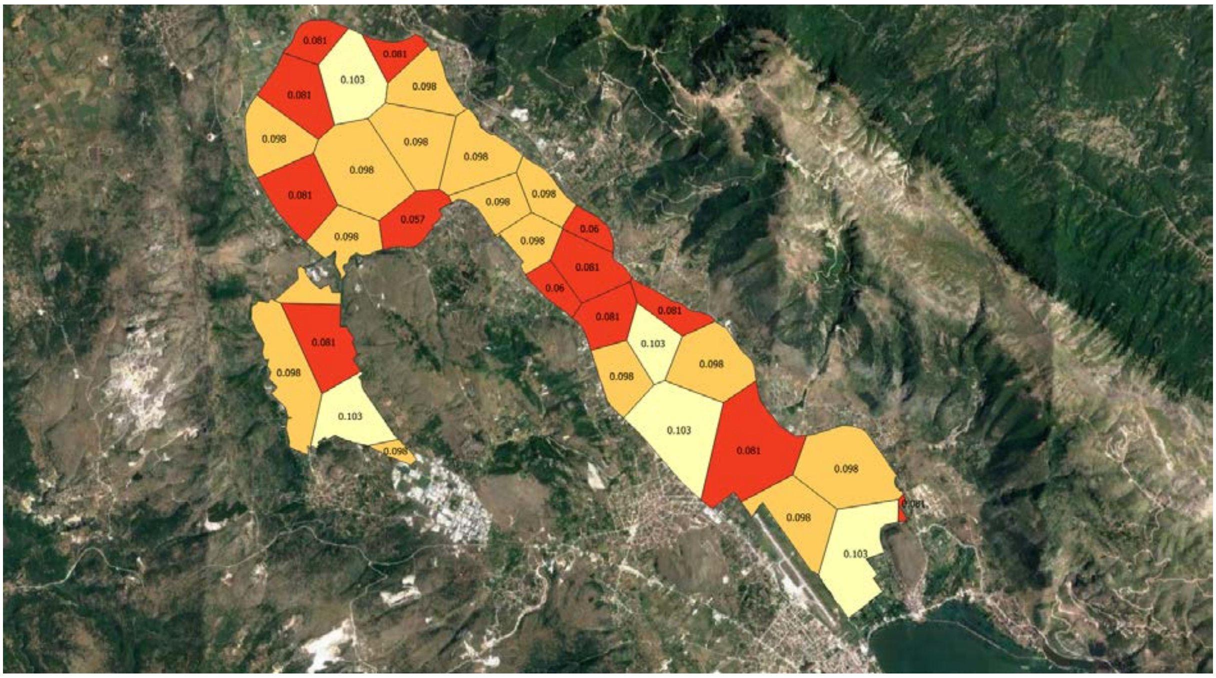

Fig. 25 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Krias Lapsistas

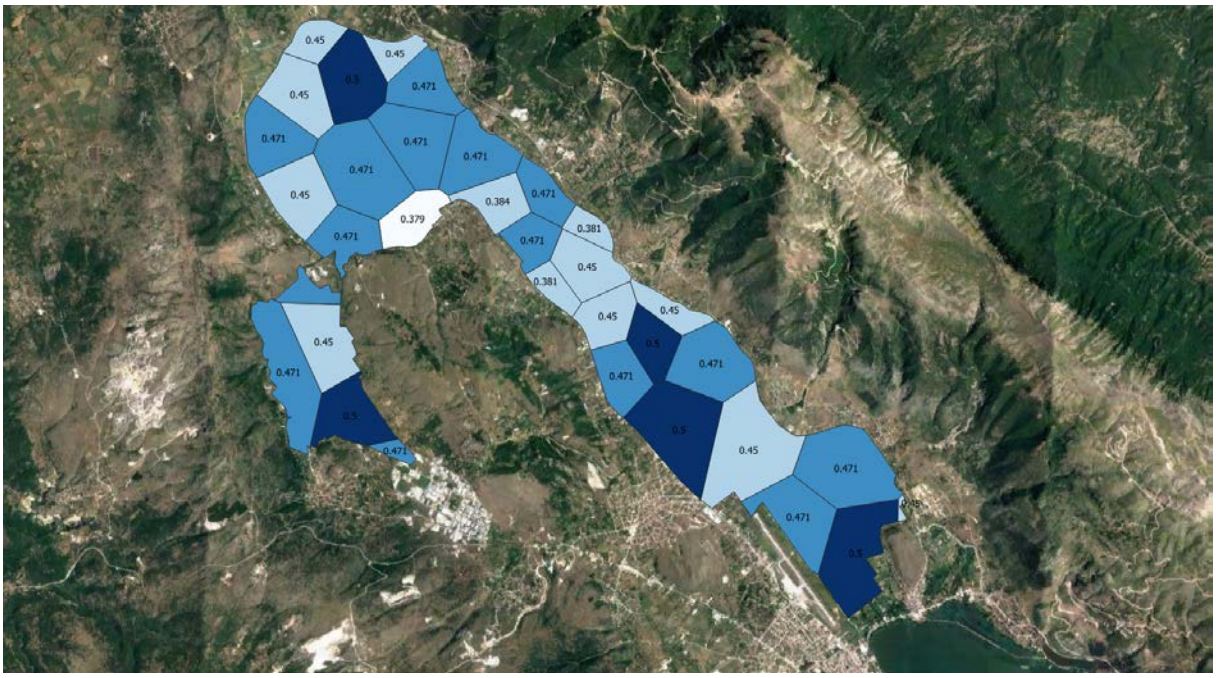

Fig. 26 Soil moisture at Saturation (m^3 m^{-3}) - Krias Lapsistas

11 Land Reclamation Organization of Ano Kalama

11.1Soil texture distribution

Table 10 Soil texture distribution - Ano Kalama

Texture	Area (ha)	Percentage of the total
Clay	636.8	46.1%
Silty Clay	282.5	20.4%
Loam	160.2	11.6%
Silt Loam	117	8.5%
Clay Loam	93.7	6.8%
Sandy Clay Loam	50.4	3.6%
Silt Loam - Loam	41.3	3.0%
Total	**1381.9**	**100.0%**

11.2Maps of soil hydraulic properties (1:50000)

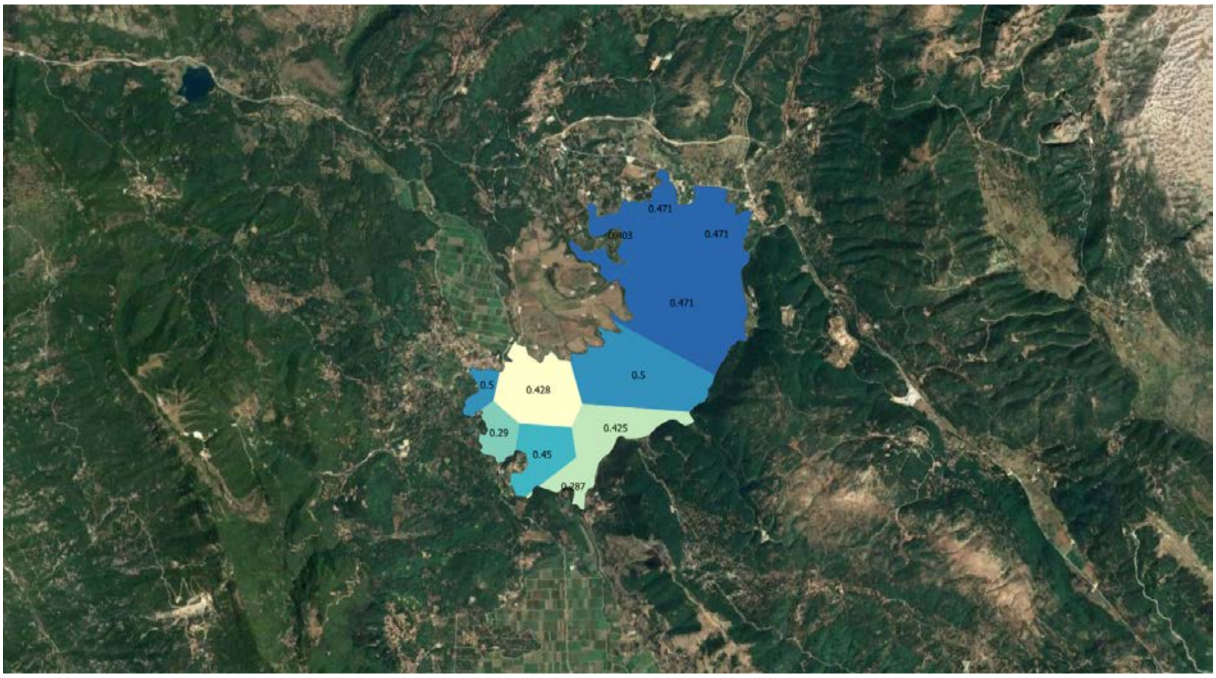

Fig. 27 Soil moisture at Field Capacity (m^3 m^{-3}) - Ano Kalama

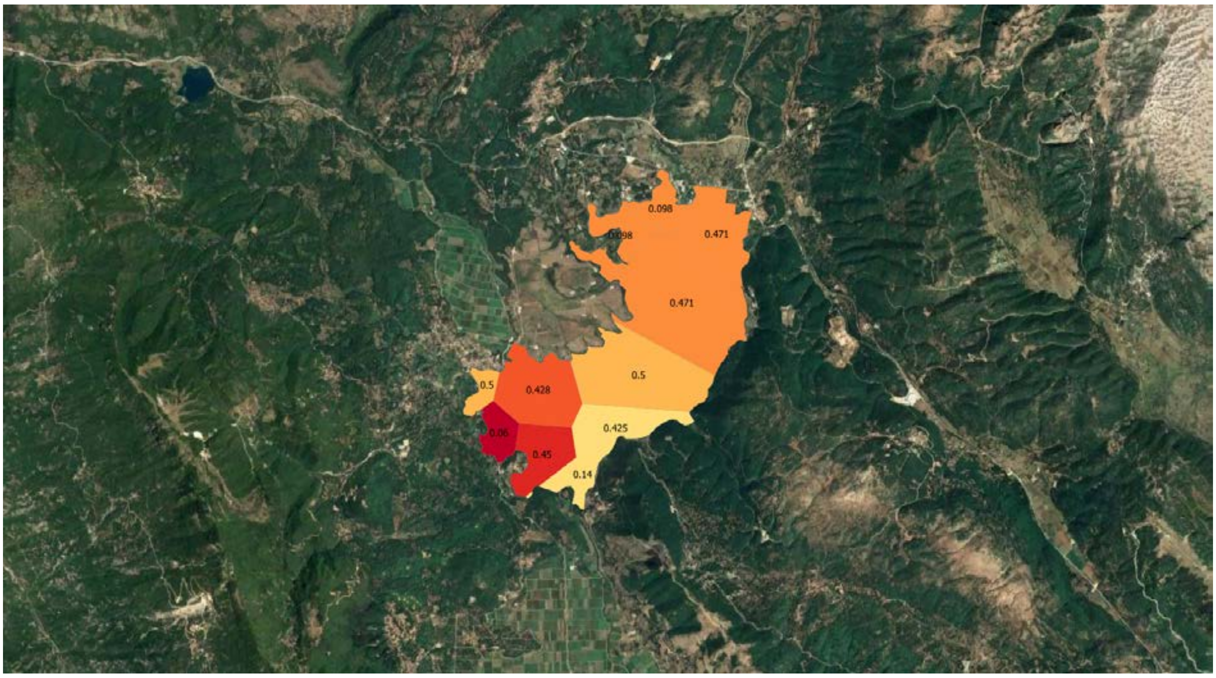

Fig. 28 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Ano Kalama

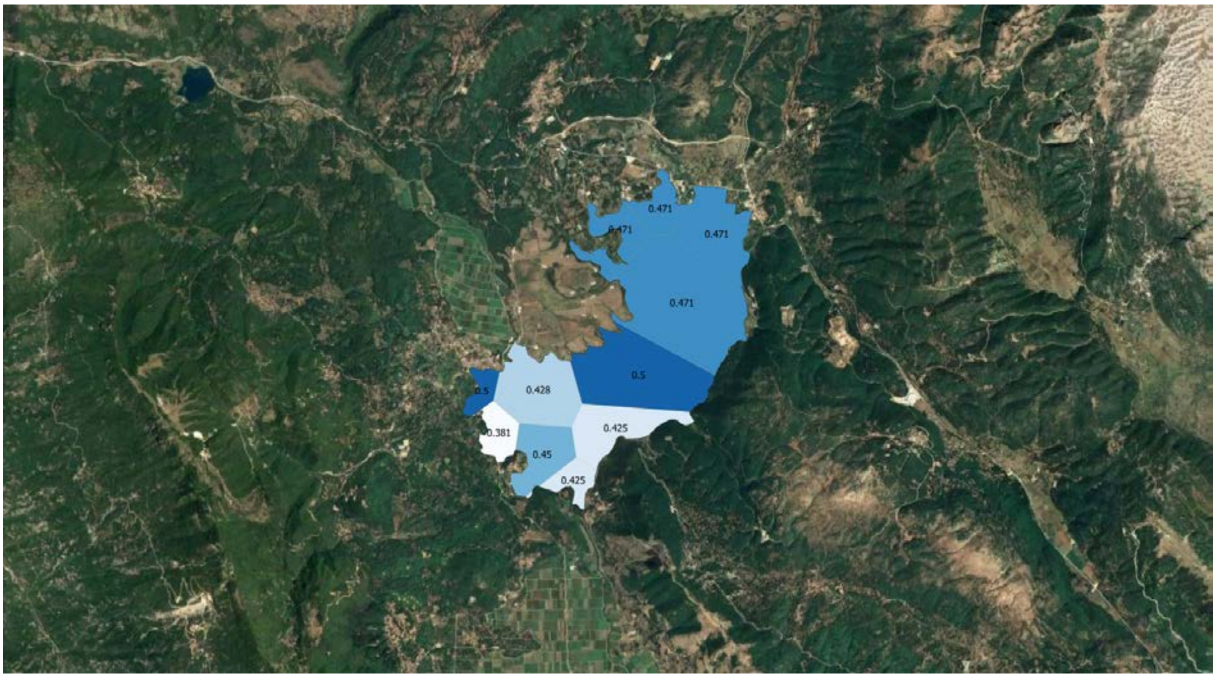

Fig. 29 Soil moisture at Saturation (m^3 m^{-3}) - Ano Kalama

12 Land Reclamation Organization of Vasilikou

12.1Soil texture distribution

Table 11 Soil texture distribution - Vasilikou

Texture	Area (ha)	Percentage of the total
Silty Clay Loam	220.5	90.2%
Loam	24	9.8%
Total	**244.5**	**100.0%**

12.2 Maps of soil hydraulic properties (1:25000)

Fig. 30 Soil moisture at Field Capacity (m^3 m^{-3}) - Vasilikou

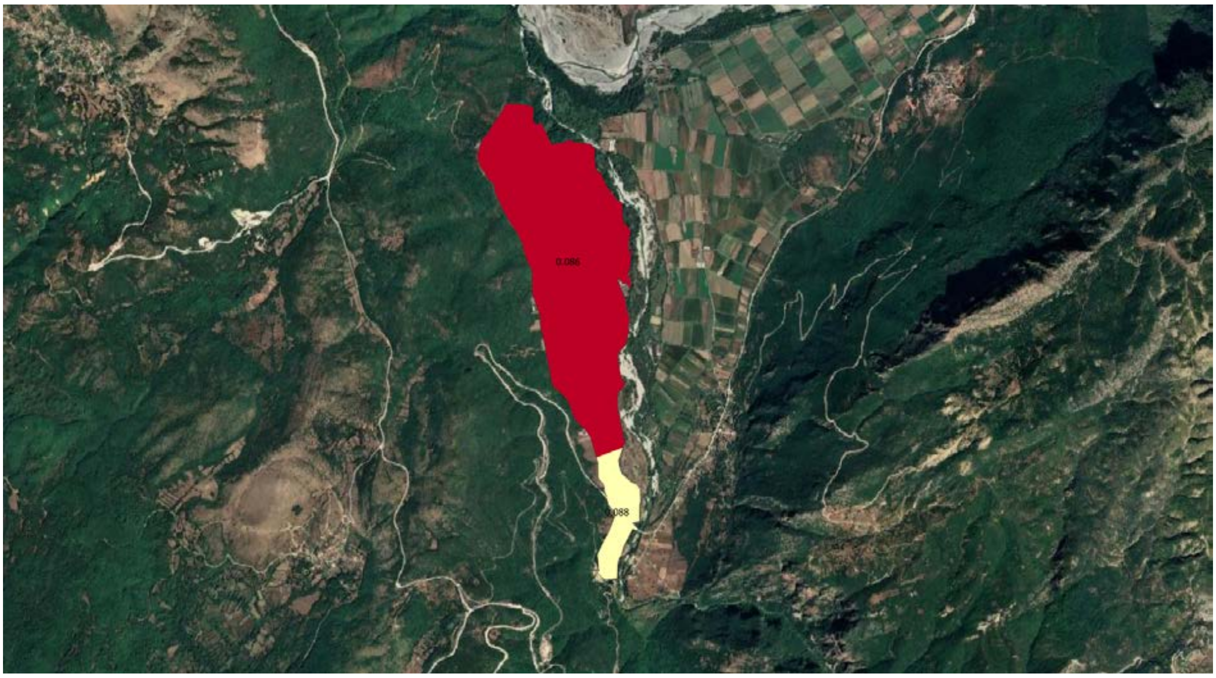

Fig. 31 Soil moisture at Permanent Wilting Point ($m^3\ m^{-3}$) - Vasilikou

Fig. 32 Soil moisture at Saturation ($m^3\ m^{-3}$) - Vasilikou

13 Land Reclamation Organization of Klidonias

13.1Soil texture distribution

Table 12 Soil texture distribution - Klidonias

Texture	Area (ha)	Percentage of the total
Clay	248.6	92.8%
Silty Clay Loam	14.1	5.3%
Loam	5.1	1.9%
Total	**267.8**	**100.0%**

13.2Maps of soil hydraulic properties (1:25000)

Fig. 33 Soil moisture at Field Capacity ($m^3\ m^{-3}$) - Klidonias

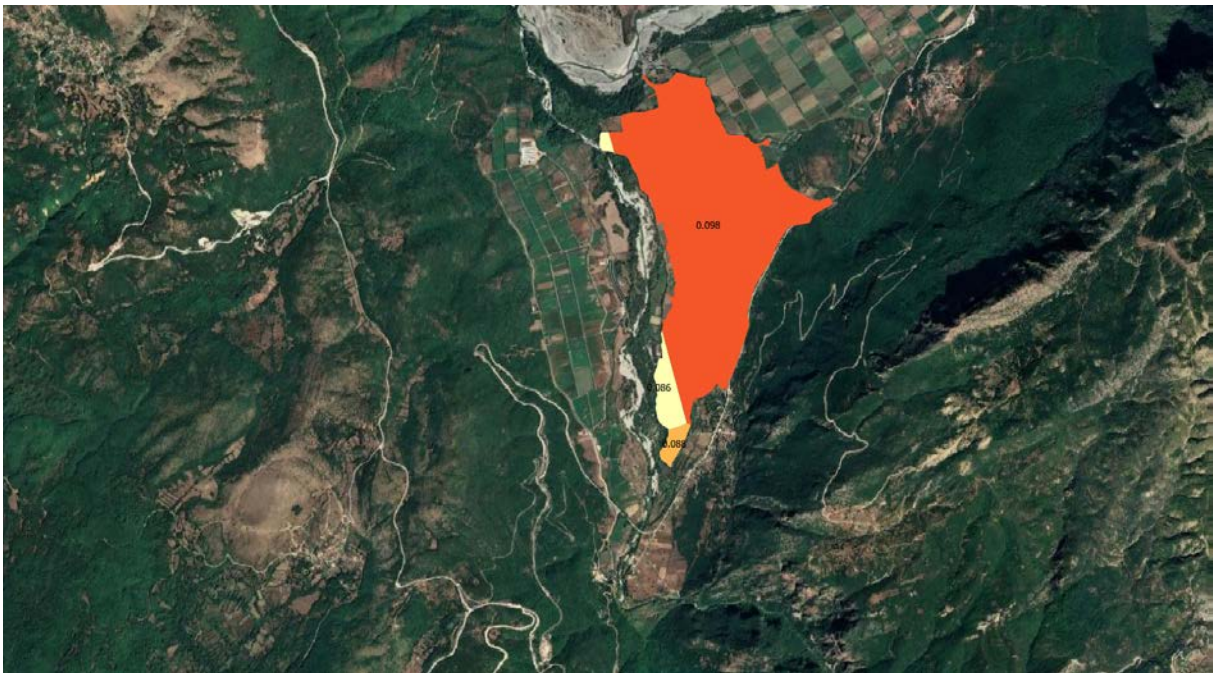

Fig. 34 Soil moisture at Permanent Wilting Point ($m^3\ m^{-3}$) - Klidonias

Fig. 35 Soil moisture at Saturation ($m^3\ m^{-3}$) - Klidonias

14 Land Reclamation Organization of Kallithea

14.1Soil texture distribution

Table 13 Soil texture distribution - Kallithea

Texture	Area (ha)	Percentage of the total
Silty Clay Loam	238.8	100.0%
Total	**238.8**	**100.0%**

14.2Maps of soil hydraulic properties (1:25000)

Fig. 36 Soil moisture at Field Capacity (m^3 m^{-3}) - Kallithea

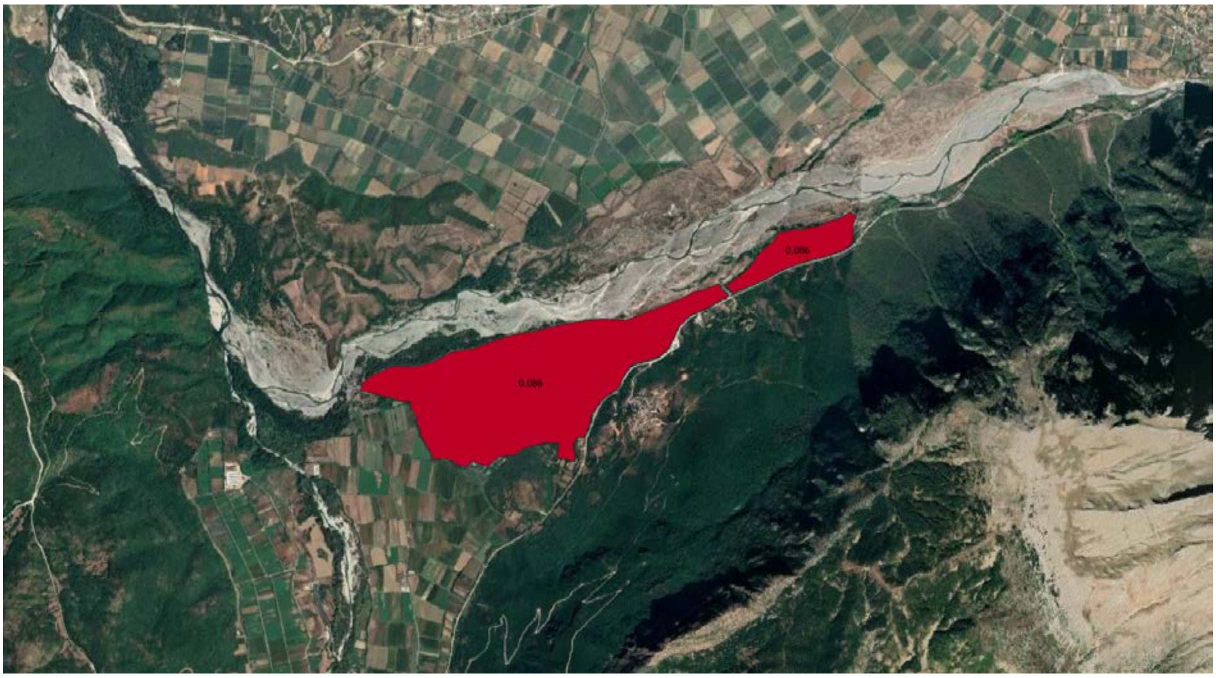

Fig. 37 Soil moisture at Permanent Wilting Point ($m^3\ m^{-3}$) - Kallithea

Fig. 38 Soil moisture at Saturation ($m^3\ m^{-3}$) - Kallithea

15 Land Reclamation Organization of Konitsa

15.1Soil texture distribution

Table 14 Soil texture distribution - Konitsa

Texture	Area (ha)	Percentage of the total
Silty Clay	301.1	22.1%
Loam	293.4	21.6%
Clay Loam	252.3	18.5%
Clay	177.1	13.0%
Silty Clay Loam	176.3	13.0%
Silt Loam	160.3	11.8%
Total	1360.5	100.0%

15.2Maps of soil hydraulic properties (1:50000)

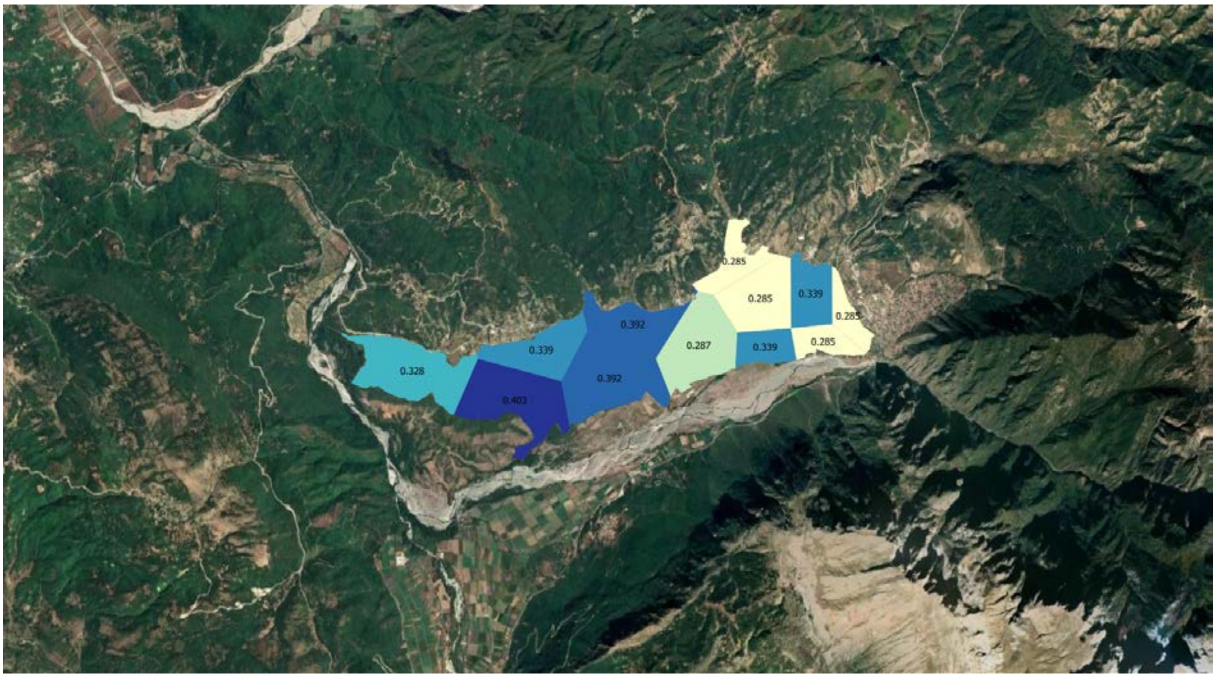

Fig. 39 Soil moisture at Field Capacity (m^3 m^{-3}) - Konitsa

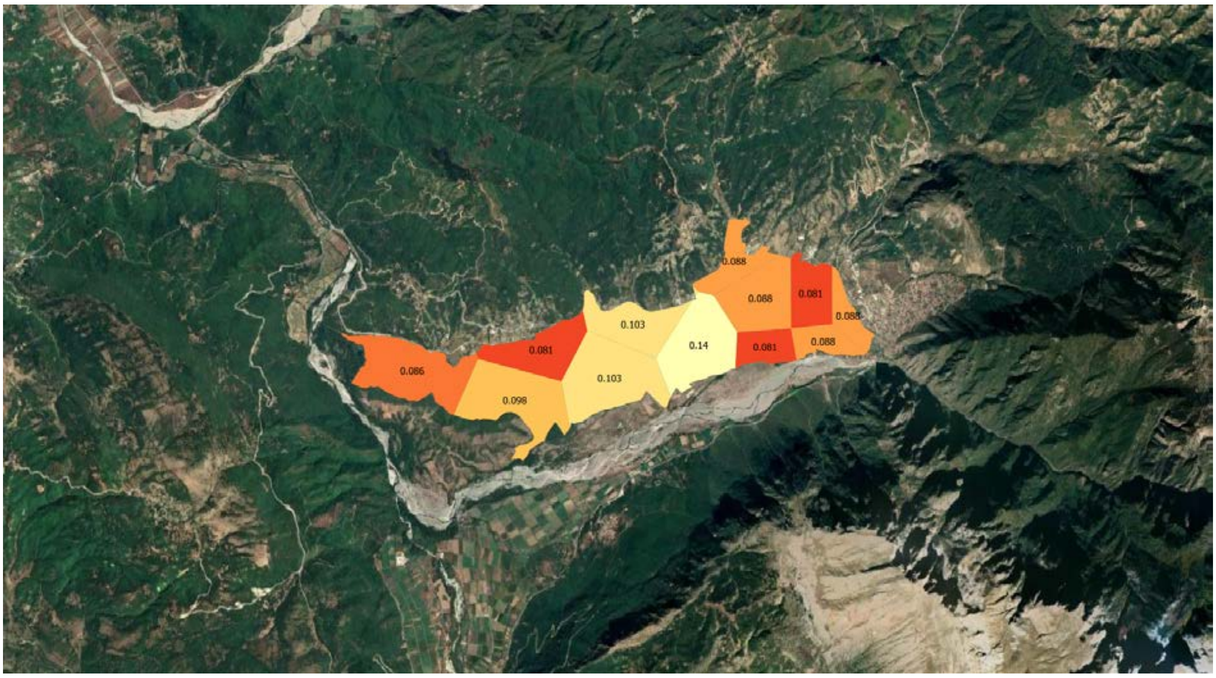

Fig. 40 Soil moisture at Permanent Wilting Point (m^3 m^{-3}) - Konitsa

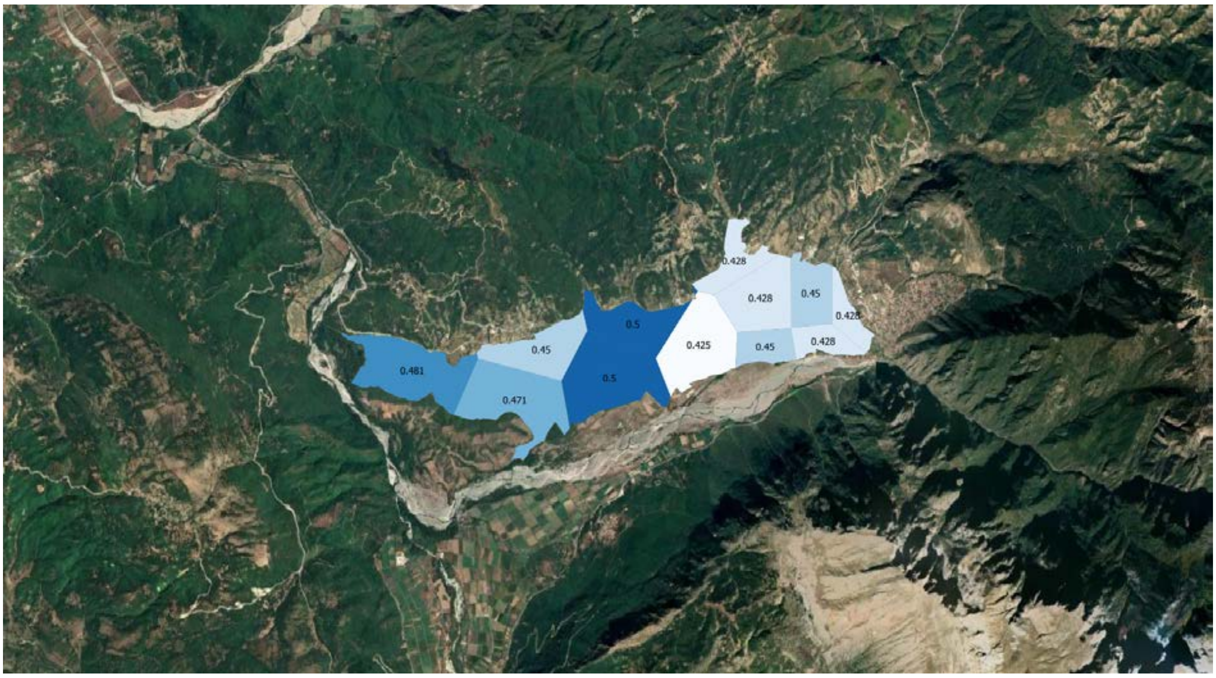

Fig. 41 Soil moisture at Saturation (m^3 m^{-3}) - Konitsa

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17 Σύνοψη στην ελληνική γλώσσα

Στην παρούσα αναφορά παρουσιάζονται οι απαραίτητες πληροφορίες σχετικά με τα επίπεδα εδαφικής υγρασίας που λαμβάνονται υπόψη κατά το σχεδιασμό προγραμμάτων της άρδευσης στους δεκατρείς Οργανισμούς Εγγείων Βελτιώσεων (ΟΕΒ) της Ηπείρου που εμπλέκονται στο έργο IR_2MA (Πίνακας 1).

Πίνακας 1 Οργανισμοί Εγγείων Βελτιώσεων (ΟΕΒ)

Α/Α	**Ονομασία**	**Περιοχή**
1	Αχέροντας	Πρέβεζα
2	Πόρος	Ιωάννινα
3	Μόιδα Μαυρή	Πρέβεζα
4	Κεστρίνης Ραγιού	Θεσπρωτία
5	Βρυσέλλας	Θεσπρωτία
6	Παραπόταμος	Θεσπρωτία
7	Ανατολής	Ιωάννινα
8	Κρύας Λαψίστας	Ιωάννινα
9	Άνω Καλαμά	Ιωάννινα
10	Βασιλικού	Ιωάννινα
11	Κλειδωνιάς	Ιωάννινα
12	Καλλιθέα	Ιωάννινα
13	Κόνιτσα	Ιωάννινα

Αρχικά γίνεται μια σύντομη αναφορά στις υγρασιακές ιδιότητες του εδάφους, ενώ στη συνέχεια για κάθε ένα από τους Οργανισμούς Εγγείων Βελτιώσεων παρουσιάζεται η κατανομή του εδάφους στις 13 κλάσεις εδαφικής υφής σε έκταση και ποσοστό επί του συνόλου της έκτασης του κάθε ΟΕΒ. Επίσης, για κάθε ΟΕΒ παρουσιάζονται χάρτες της κατ' όγκο υγρασίας στον κορεσμό, της κατ' όγκο υγρασίας στην υδατοϊκανότητα και της κατ' όγκο υγρασίας στο σημείο μόνιμης μάρανσης.

Συνολικά η αναφορά περιλαμβάνει 13 πίνακες κατάταξης εδαφών σε κλάσεις κοκκομετρίας και 39 χάρτες υγρασιακών παραμέτρων.

Οι ανωτέρω πληροφορίες προέκυψαν με βάση τα αποτελέσματα των εδαφικών αναλύσεων που πραγματοποιήθηκαν στο πλαίσιο του έργου «ΝΕΑ ΓΗ: Ολοκληρωμένο Γεωγραφικό Πληροφορικό Σύστημα στήριξης του Πρωτογενούς Τομέα της Ηπείρου, Εδαφολογικές αναλύσεις», ΤΕΙ Ηπείρου, 2007 και τις τιμές των παραμέτρων που παρουσιάζονται στην εργασία των Twarakavi et al., 2009.

18 Sinossi in lingua italiana

Al presente rapporto si presentano le informazioni necessarie sui differenti livelli di umidita del terreno che vengono presi in considerazione da tredici Consorzi di Bonifica di Epirus che sono coinvolti nel progetto IR2MA, per la progetazzione dei programmi di irrigazione.

In primo luogo si fa un breve riferimento alle proprieta di umidita del suolo ed in seguito, per ciascuno dei Consorzi di Bonifica, si presenta la distribuzione dei suoli nelle 13 classi di tessitura del suolo, in area e percentuale della superficie totale di ogni Consorzio di Bonifica.

Inoltre, si presentano carte del contenuto d' acqua volumetrico corrispondente al terreno saturo, del contenuto d' acqua volumetrico corrispondente alla capacita di campo ed il contenuto d' acqua volumetrico corrispondente al punto di appassimento per ciascuno dei Consorzi di Bonifica.

In totale, il rapporto contiene 13 tabelle di classificazione del suolo in classi di granulometria e 39 carte dei parametri di umidità.

Le informazioni fornite sono state ottenute sulla base dei risultati delle analisi del suolo che sono condotte nell' ambito del progetto "TERRA NUOVA: Sistema Integrato Informativo Geografico per il sostegno del settore primario in Epirus, Analisi del suolo" (TEI Epirus, 2007) ed i valori dei parametri che si presentano nel paper Twarakavi et al., 2019.

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